10 YEARS OF UNIVERSITY RECOGNITION

20 YEARS OF ACADEMIC EXCELLENCE

REVA UNIVERSITY

Bengaluru, India

HANDBOOK OF

B. Tech. Computer Science and Engineering

ACADEMIC YEAR 2023-24

RUKMINI EDUCATIONAL

Charitable Trust

www.reva.edu.in

Chancellor's Message

"Education is the most powerful weapon which you can use tochange the world."

- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, botheducational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA Universityto join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju
The Founder and Hon'ble Chancellor, REVA University

Pro-Chancellor's Message

REVA University is most sought-after destination for higher education in the major streams of engineering, science, commerce, management, architecture, law, arts and humanities. University practices modern tools and ICT basedtechnologies that focus on digital learning, project-basedlearning, personalized learning, etc. Educational reforms are adopted in terms of STEM education, teacher professional development with good mix of diversity and inclusivity.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. CBCS courses also provide knowledge on local, regional, national and global level issues along with enabling them to be employable and also aid to inculcate entrepreneurial skills across all the programs. Ample of opportunities are given for students to enhance their skill-sets through value added courses.

The current trends in engineering education Engineering profession in the next two decades will undergo dramatic changes, driven by not only technological developments but also societal transformation. Besides increased globalization, more acute concern for environment for sustainable development will characterize changes and challenges for future engineers in their roles.

REVA University is fully prepared to all such challenges and ready for creating talented engineers andleaders. Such growth has been witnessed in terms of design and delivery of curriculum, student centric methods in teaching-learning, hands-on based practices through state-of-the-art laboratories and research centres and effective outreach activities with premiere industries and academic institutions.

I thank all our students, parents, faculty, staff and well-wishers for their effort and contribution to take this university as one of next generation globally recognized education hub.

P. Umesh Raju
Pro-Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built over 50 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching- learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Benchmarked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is aculmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Mostof the faculty members of the University are involved in research by attracting funded projects from various research level organizations like STI HUB, ISRO, DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT),in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trustis Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU toPost Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 16,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27thFebruary, 2013. The University isempowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 50 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts,and Research Studies. REVA offers 41 Undergraduate Programmes, 31 Full-time and 2 Part-time Postgraduate Programmes, 18 PhD Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

The curriculum of each programme is designed with a keen eye for detail by giving emphasis on hands- on training, industry relevance, social significance, and practical applications. The University offers world-class facilities and education that meets global standards.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. TheChoice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of educationhas been introduced in all programs to facilitate students to opt for subjects of their choice in addition

to the core subjects of the study and prepare them with needed skills. CBCS courses also provide knowledge on local, regional, national and global level issues along with enabling them to be employable and also aid to inculcate entrepreneurial skills across all the programs. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. Ample of opportunities are given for students to enhance their skill-sets through value added courses. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Sensor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department

with world class infrastructure, headed by a dynamic team and supported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Dean facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd,Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partlyin REVA University and partly in foreign university.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N RNarayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of DefenseDr. Sathish Reddy, Scientific Advisor, Ministry of Defense, New Delhi and many others have acceptedour invitation and blessed our students and faculty members by their inspiring addresses and interaction.

REVA organizes various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden

talents and motivate them to contribute innovative ideas for the progress of the society. One of suchcultural events is REVOTSAVA conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this megaevent students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga class's everyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Vision

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standard.

Mission

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation anddevelopment
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence indifferent disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position
- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner

REVA UNIVERSITY
Bengaluru, India

ACADEMIC REGULATIONS

B. Tech., (4 years) Degree Programs (Applicable for the programs offered from 2023-24)

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of theREVA University Act, 2012)

THESE ACADEMIC REGULATIONS ARE UNDER CHOICE BASED CREDIT SYSTEM ANDCONTINUOUS ASSESSMENT GRADING PATTERN (CBCS-CAGP)

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – B. Tech., Degree Program for academic year 2023-24 subject to amendments from time to time bythe Academic Council on recommendation of respective Board of Studies and approval ofBoard of Management"**

1.2 These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:

These regulations cover the following B. Tech., Degree programs of REVA University offered during 2023-24 under respective schools.

SL No.	Name of the School	Name of the Program
1	School of Civil Engineering	B Tech in Civil Engineering B Tech in Agriculture Engineering
2	School of Computing and Information Technology	B Tech Computer Science and Engineering (AI and ML)
		B Tech Computer Science and Information Technology
		B Tech in Information Science and Engineering
		B Tech in Computer Science and Systems Engineering
3	School of Computer Science and Engineering	B Tech in Computer Science and Engineering
		B Tech in Computer Science and Engineering (AI and DS)
		B Tech in Computer Science and Engineering (IoT, Cybersecurity and Blockchain)
4	School of Electrical and Electronics Engineering	B Tech in Electrical and Electronics Engineering
5	School of Electronics and Communication Engineering	B Tech in Electronics and Communication Engineer
		B Tech in Electronics and Computer Engineering
		B Tech in Robotics and Automation
6		B Tech in Mechanical Engineering

	School of Mechanical Engineering	B Tech in Mechatronics Engineering
		B.Tech in Aerospace Engineering

3. Duration and Medium of Instructions:

3.1 Duration: The duration of the B Tech degree program shall be **FOUR** years comprising of **EIGHT**Semesters. A candidate can avail a maximum of 16 semesters - 8 years as per double duration norm, in one stretch to complete B. Tech degree, including blank semesters, if any. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

3.2 The medium of instruction shall be English.

4. Definitions:

4.1 Course: "Course" means a subject, either theory or practical or both and project, listed under a program; Example: "Fluid Mechanics" in B. Tech Civil Engineering program, "Engineering Thermodynamics" in B. Tech., Mechanical program are examples of courses to be studied under respective programs.

Every course offered will have three components associated with the teaching-learning process of the course, namely: L, T and P, where,

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion/self-study/desk work/brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the lecture classes.

P stands for **Practice** session and it consists of hands-on experience such as laboratory experiments, field studies, case studies, project based learning or course end projects and self- study courses that equip students to acquire the required skill component.

4.2 Classification of Courses

Courses offered are classified as: Foundation courses, hard core courses, Softcore courses, Open Electives, Mandatory courses, Project work/Dissertation, Skill Development Courses,etc.

4.2.1 Foundation Course: The foundation Course is basic course which should be completed successfully as a part of graduate degree program irrespective of the program of study.

4.2.2 Hard Core Course (HC)(also Professional Core Course): The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates have to complete compulsorily.

4.2.3 **Soft Core Course (SC) (also known as Professional Elective Course):** A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/relatedbranch of study which supports the main branch of study.

4.2.4 **Open Elective Course (OE):** An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an **Open Elective Course.**

4.2.5 **Mandatory Non Credit Course (MC):** These courses are mandatory for students joining B.Tech. Program and students have to successfully complete these courses before the completion of degree.

4.2.6 **Project Work / Dissertation:** Project work / Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problems to solve a multivariable or complex engineering problems. The project will be conducted in two phases, phase-I, consists of literature survey, problem identification, formulation and methodology. In Phase-II , student should complete the project work by designing or creating an innovative process or development of product as an outcome. A project work is carried out as minor project in 3rd year and major project in 4th year with appropriate credits allocated.

4.2.7 **Skill Development Course:** It is a practice based course introduced in first year, second year and third year that lead to a certificate, diploma and advanced diploma,respectively.

4.3 "Program" means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma Degree or such other degrees instituted and introduced in REVA University.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to B Tech Program of 4 years (8 Semesters) is given below:

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Technology (B. Tech)	4 Years (8 Semesters)	Passed 10+2 examination with Physics and Mathematics as compulsory subjects, along with any one of the following subjects, namely, Chemistry, Bio-Technology, Computer Science, Biology, Electronics and Technical Vocational subjectObtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together.

Sl. No.	Program	Duration	Eligibility
2	Bachelor of Technology (B Tech)	3 Years (6 Semesters)	A. Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marksin case of candidates belonging to reserved category) in ANY branch of Engineering and Technology. B. Passed B.Sc Degree from a recognized University as defined by UGC, with at least 45% marks (40% in case of candidates belonging to SC/ST category) and passed XII standard with mathematics as a subject. C. Provided that in case of students belonging to B.Sc. Stream, shall clear the subjects of Engineering Graphics / Engineering Drawing and Engineering Mechanics of thefirst year Engineering program along with the second year subjects. D. Provided further that, the students belonging to B. Sc. Stream shall be considered only after filling the seats in this category with students belonging to the Diploma stream. E. Provided further that student, who have passed Diploma in Engineering & Technology from an AICTE approved Institution or B. Sc., Degree from a recognized Universityas defined by UGC, shall also be eligible for admission to the first year Engineering Degree courses subject to vacancies in the first year class in case the vacancies at lateral entry are exhausted. However the admissions shall be based strictly on the eligibility criteria as mentioned in A, B, D, and E above. F. Passed D.Voc. Stream in the same or allied sector. (The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the program)
3	Bachelor of Technology (B Tech)		Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective semester inthe concerned branch of study, provided he/she fulfils the University requirements.

5.2 Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, such as AICTE, UGC from time to time.

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

6.2 Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for IA and Semester End Examination, evaluation and announcement of results.

6.3 The credit hours defined as below:
In terms of credits, every one hour session of L amounts to 1 credit per Semester and a minimum of two hour session of T or P amounts to 1 credit per Semester or a three hour session of T / P amounts to 2 credits over a period of one Semester of 16 weeks for teaching- learning process.

The total duration of a semester is 20 weeks inclusive of semester-end examination.
The following table describes credit pattern

Table -2: Credit Pattern

Lectures (L)	Tutorials (T)	Practice (P)	Credits (L:T:P)	Total Credits	Total Contact Hours
4	2	0	4:1:0	5	6
3	2	0	3:1:0	4	5
3	0	2	3:0:1	4	5
2	2	2	2:1:1	4	6
0	0	6	0:0:3	3	6
4	0	0	4:0:0	4	4
2	0	0	2:0:0	2	2

a. The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course.

7. Different Courses of Study:

Different **Courses of Study** are labeled as follows:

a. Core Course (CC)
b. Foundation Course (FC)
c. Hard Core Course (HC)
d. Soft Core Course (SC)
e. Open Elective Course (OE)
f. Skill Development Course (SDC)
g. Mandatory Non Credit Course (MC)

h. Project Work / Dissertation: A project work is carried out as minor project in 3rd yearand major project in 4th year with appropriate credits allocated. These are defined under Section 4.2.6 of this regulation.

8. Credits and Credit Distribution

8.1 A candidate has to earn 168 credits for successful completion of B Tech degree with the distribution of credits for different courses with the credit distribution given in the scheme of study.

8.2 The concerned BOS based on the credits distribution shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective, as **Foundation Course (FC), Hard Core (HC)or Soft Core (SC), Open Elective (OE) Skill Development Course (SDC).**

8.3 Every course including project work, practical work, field work, self-study elective should be entitled as **Foundation Course (FC), Hard Core (HC) or Soft Core (SC) or Open Elective(OE)** or Mandatory Course (MC) by the BoS concerned. However, as per AICTE, the credit distribution for various category of courses given below.

Sl. No.	Course Category	Abbreviation (AICTE)	Abbreviation (REVA)	Suggested breakup of credits (AICTE)	Credit breakup (REVA)
1	Humanities and Social Sciences including Management courses (HSMC)	HSMC	FC	12	9
2	Basic Science Courses	BSC	FC	25	20
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	ESC	FC	24	29
4	Professional core courses	PCC	HC	48	58
5	Professional Elective courses relevant to chosen specialization/branch	PEC	SC	18	15
6	Open subjects – Electives from other technical and /or emerging subjects	OE	OE	18	12
7	Project work, seminar and internship in industry or elsewhere	PROJ	HC	15	19
8	Mandatory Courses [Environmental Sciences, Induction training, Indian	MC	MC	-	-

	Constitution, Essence of Indian Knowledge Tradition]				
9	Skill Development Courses (SDC)	-	SDC		06
TOTAL CREDITS				**160**	**168**

8.4 The concerned BOS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program. A candidate can enroll for a maximum of 26 credits and a minimum of 16 credits per Semester. However, he / she may not successfully earna maximum of 26 credits per semester. This maximum of 26 credits does not include the credits of courses carried forward by a candidate.

8.5 **Only such full-time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully 168 credits in 8 successive semesters shall be considered for declaration of Ranks, Medals, Prizes** and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students.

8.6 Add- on Proficiency Certification:

To acquire Add on Proficiency Certification a candidate can opt to complete a minimumof 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 168credits for the B Tech Degree program**.**

8.6.1 Add on Proficiency Diploma / Minor degree/ Honor Degree:

To acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree: a candidate can opt to complete a minimum of 18 extra credits either in the same discipline /subject or in different discipline / subject in excess to 168 credits forthe B Tech Degree program.
The Add on Proficiency Certification / Diploma/ Minor degree/ Honor Degree: so issued to the candidate contains the courses studied and grades earned.

9 Assessment and Evaluation

9.1 The Scheme of Assessment will have two parts, namely;

i. Continuous Internal Assessment (CIA); and
ii. Semester End Examination (SEE)

9.2 Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of UG Engineering programs shall carry 50:50 marks respectively (i.e., 50 marks internal assessment; 50 marks semester end examination).

9.3 The 50 marks of CIA shall comprise of:

Internal Assessment Test	40 marks
Assignments / Seminars / Model Making / Integrated Lab / Project Based Learning / Quizzes, etc.	10 marks

9.4 There shall be **two Internal Assessment Tests** are conducted as per the schedule announced below. **The Students' shall attend both the Tests compulsorily.**

- 1st test is conducted for 20 marks during **8th week** of the Semester;
- 2nd test is conducted for 20 marks during **15th week** of the of the Semester;

9.5 The coverage of syllabus for the said tests shall be as under:

- Question paper of the **1st test should be based on first 50% of the total syllabus(Unit 1 & 2)**;
- Question paper of the **2nd test should be based on remaining 50 % of the totalsyllabus (Unit 3 & 4)**;
- An assignment must be designed to cover the entire syllabus

9.6 There shall be two Assignment / Project Based Learning / Field Visit / Quiz test carrying 10 marks covering the entire syllabus.

9.7 SEE for 50 marks practical exam shall be held in the 16th and 17th week of the semester.

9.8 SEE for 50 marks theory exam shall be held in the 18th 19th and 20th week of the semesterand it should cover entire syllabus.

9.9 Internal test paper is set for a maximum of 40 marks to be answered in 1.5 hours duration (for 1 credit course, exam is conducted for 25 marks with a duration of 1 hour). A test paper can have 5 main questions. Each main question is set for 10 marks. The main question can have 2-3 sub questions all totaling 10 marks. Students are required to answer any 4 main questions. Each question is set using Bloom's verbs. The questions must be set to assess the course outcomes described in the course document even withthe choice is given in questions.

9.10 The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by the Question Paper Scrutiny Committee (internal BoE members) to bring the quality and uniformity in the question paper.

9.11 The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

9.12 Assignment/seminar/Project based learning/simulation based problem solving/field work should be set in such a way, students be able to apply the concepts learnt to a real

life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarize the answer from web or any other resources. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and also self- study.

9.13 Internal assessment marks must be decided well before the commencement of SEE.

9.14 SEE theory question paper is set for a maximum of 100 marks to be answered in 3 hoursduration. Each main question be set for a maximum of 25 marks, main questions can havea 3 to 4 sub-questions. A total of 8 questions are set so that students will have a choice. Each question is set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document (question papers have to be set to test the course outcomes).

9.15 There shall be minimum three sets of question papers for the semester end examinationof which one set along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the question paper sets shall be scrutinized by the Board of Examiners (BoE). It shall be responsibility of the BOE particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of the course.

9.16 There shall be single evaluation by the examiners for each paper. However, there shall be moderation by one of the senior examiners, either internal or external.

9.17 Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers.

9.18 There shall also be an **Program Assessment Committee (PAC)** comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. The Examination Review Committee shall also review the question papers of both Internal Tests as well Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.

9.19 The report provided by the Examination Review Committee shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program

9.20 During unforeseen situation like the Covid-19, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC

9.21 University may decide to use available modern technologies for writing the tests and SEEby the students instead of traditional pen and paper.

9.22 Any deviations required to the above guidelines can be made with the written consent ofthe Vice Chancellor.

9.23 Online courses may be offered as per UGC norms.
For online course assessment guidelines would be as follows:

a. If the assessment is done by the course provider, then the School can accept the marks awarded by the course provider and assign the grade as per REVA Universitynorms.

b. If the assessment is not done by the course provider then the assessment is organized by the concerned school and the procedure explained in the regulation will apply

c. In case a student fails in an online course, s/he may be allowed to repeat the courseand earn the required credits

IAs for online courses could be avoided and will remain at the discretion of theSchool.

9.24 The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

9.25 Utilization of one or two credit online courses would be:4 week

online course – 1 credit

8 week online course / MOOC – 2 credits 12

week online course / MOOC – 3 credits

9.26 **Summary of Internal Assessment, Semester End Examination and Evaluation** Schedule is provided in the table given below (for theory courses having Credits >=2).

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	When	Syllabus Covered	Max Marks	Scaled down to	Date by which the process must be completed
1	Test-1	During 8th week	First 50%	40	20	9th week
2	Test -2	During 15th Week	Remaining 50%	40	20	16th Week
3	Assignment / Quiz - 1	Every week till Test-1	First 50%	10	05	9th Week

4	Assignment / Quiz - 2	Every week during Test-1 and Test-2	Remaining 50%	10	05	16th Week
5	SEE	18th to 20th Week	100%	100	50	20th Week

9.27 Summary of Internal Assessment, Semester End Examination and Evaluation Scheduleis provided in the table given below (for theory courses having Credit 1).

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	When	Syllabus Covered	Max Marks	Reduced to	Date by which the process must be completed
1	Test-1	During 8th week	First 50%	25	12.5	8th week
2	Test -2	During 15th Week	Remaining 50%	25	12.5	15th Week
5	SEE	18th to 20th Week	100%	50	25	20th Week

10 Assessment of Students Performance in Practical Courses

Lab courses are of two types: integrated labs and separate labs.

The performance in the practice tasks / experiments shall be assessed on the basis of:

a. Knowledge of relevant processes;
b. Skills and operations involved;
c. Results / products including calculation and reporting

10.1 Assessment of lab courses

10.1.1 Assessment of Separate lab course

The 50 marks meant for Internal Assessment (IA) of the performance incarrying out practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of internal lab test to be conducted after completion of all the experiments before lastworking day of the semester	20 marks
	Total	**50 marks**

10.1.2 Assessment of integrated lab course

The 10 marks meant for Internal Assessment (IA) of the performance incarrying out Integrated lab course shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the	05 marks

	Semester	
ii	Maintenance of lab records and performance of internal lab test tobe conducted after completion of all the experiments before last working day of the semester	05 marks
	Total	**10 marks**

10.2 The 50 marks meant for Semester End Examination (SEE) in case of separate labcourse shall be allocated as under:

i	Conduction of practical (experiment)	30 marks
ii	Write up about the experiment/tabulation/results/inference	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

Note: No Separate SEE for integrated lab course

10.3 The duration for semester-end practical examination shall be decided by the concernedSchool Board.

10.4 For MOOC and Online Courses assessment shall be decided by the BOS of the School.

For >= 2 credit courses

i	IA-I	25 marks
ii	IA-2	25 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc.)	50 marks
	Total	**100 marks**

For 1 credit courses

i	IA (Performance of internal test to be conducted after completion of entire syllabus)	25 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc.)	25 marks
	Total	**50 marks**

11. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to theregular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (50%)

12. Evaluation of mandatory courses: Students should maintain minimum of 75% attendance toappear for SEE of Mandatory course. The SEE should be conducted in MCQ pattern and students should get minimum pass grade to obtain the degree. There is no internal assessment

13. Evaluation of **Skill Development Courses:** The concerned BoS shall recommend to conduct test/demo/viva-voce/MCQ to test the student knowledge.

14. **Requirements to Pass a Course:**

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 , SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 30% (15 marks) in Semester End Examination (SEE) which is compulsory.

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate inthe subject will be as given below:

Marks, P	Grade, G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[IA + SEE]) secured by a candidate in a course whichis **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

a. Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA).
The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e : **SGPA (Si) = ∑(Ci**

x Gi) / ∑Ci where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21
Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
Course 7	3	O	10	3X10=30
	19			159

Thus, **SGPA = 159 ÷ 19 = 8.37**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	C	5	3X5=15
Course 7	2	B+	7	2X7=21
Course 8	2	O	10	2X10=20
	24			175

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

Course	**Credit**	**Grade Letter**	**Grade Point**	**Credit Point (Credit x Grade point)**
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36
Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade point)
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			**199**

Thus, **SGPA = 199 ÷ 24 = 8.29**

b. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completionof the required number of credits (160) for B. Tech degree in Engineering & Technology is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : **CGPA = ∑(Ci x Si) / ∑Ci**

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	21	6.83	21 x 6.83 = 143.43
2	23	7.29	23 x 7.29 = 167.67
3	22	8.11	22 x 8.11 = 178.42
4	24	7.40	24 x 7.40 = 177.6
5	22	8.29	22 x 8.29 = 182.38
6	24	8.58	24 x 8.58 = 205.92
7	22	9.12	22 x 9.12 = 200.64
8	10	9.25	10 x 9.25 =92.50
Cumulative	**168**		**1348.56**

Thus,

$$CGPA = \frac{2222\times66.8888+2288\times77.2222+2222\times88.2222+2222\times77.2244+2222\times88.2222+2222\times88.5588+2222\times22.2222+2244\times22.2255}{226666} = \frac{22882266.5588}{226688} = 8.02$$

c. Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.02 x 10=80.2

d. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA securedby the candidate and is given as follows.

CGPA	Grade (Numerical Index) G	Letter Grade	Performance	FGP Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction

8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

e. **Provisional Grade Card**: The tentative / provisional grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average (SGPA).**

f. **Final Grade Card:** Upon successful completion of B Tech Degree a Final Grade card consistingof grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14.2 Attendance Requirement

14.2.1. All students must attend every lecture, tutorial and practical classes.

14.2.2. In case a student is on approved leave of absence (e.g:- representing the University in sports, games or athletics, placement activities, NCC, NSS activities and such others)and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

14.2.3. Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted toappear to the end semester examination and such student shall seek re-admission

15. Re-Registration and Re-Admission:

15.1 In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for semester end examination and he / she shall haveto seek re-admission to that semester during subsequent semester / year within a stipulatedperiod.

15.2 In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seekre-admission to such dropped semester.

16. Absence during Internal Test:

In case a student has been absent from an internal tests due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned

Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), he/she can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. He/she can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the Grievance committee is final.

i. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation and announcement of results, such students can approach Grievance Committee for redressal of grievances.

For every program there will be one grievance committee. The composition of the grievance committee is as follows:-

- The Controller of Examinations - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

18. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc., as part of the program shall be eligible to appear for Semester End Examination

19. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 30% (15 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after

the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

20. Provision to Carry Forward the Failed Subjects / Courses:

Students who have failed in courses totaling 16 credits or fewer across both odd and even semesters combined will be allowed to proceed to the next semester of the following year(s)of their academic program.

For vertical progression, students have to clear all the courses of first year to be eligible to take admission to third year and they have to clear all the courses till second year to be eligible to take admission to fourth year. For lateral entry students, they have to clear all the courses of second year to be eligible to take admission to fourth year.

Case 1: A student who has failed in a maximum of 16 credits in 1st and 2nd semester together shall move to the 3rd semester of the succeeding year.

Case 2: A student who has failed in a maximum of 16 credits from semester 1 to 4 together shall move to the 5th semester of the succeeding year only if he/she successfully completes all the courses of first and second semester.

Case 3: A students who has failed in a maximum of 16 credits from semester 3 to 6 together shall move to the 7th semester of the succeeding year only if he/she successfully completes all the courses of third and Fourth semester.

21. Re-evaluation of Answer Scripts and Announcement of Re-evaluation Results

After declaration of the results of programs within next 10 days, if any candidate wishes to apply for Photocopy/Revaluation (only theory courses), s/he shall apply to the Controller of Examinations, by paying the prescribed fees notified by the University from time to time. The photocopies of the said answer books shall be made available within next TEN working days after the last date prescribed for receipt of the application at the Office of the Controller of Examinations. Photocopies will not be issued for practical/drawing/audit courses.

22. Results of Re-Evaluation will be announced within TWENTY working days (except for third evaluation).

23. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

24. All assessments must be done by the respective Schools as per the guidelines issued by the Controller of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

25. Re-joining a Program: A student who discontinues the academic program for any reason and re-joins the program at a later date shall be governed by the rules, regulations, courses of study and syllabi in force at the time of his/her re-joining the program.

ABOUT THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

The school has a rich blend of experienced and committed faculty who are well qualified in various aspects of Computer Science and Engineering apart from the numerous state-of-the-art digital classrooms and laboratories having modern computing equipment. The school offers B.Tech. in Computer Science and Engineering, B.Tech in Artificial Intelligence and Data Science, B. Tech in Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology), M.Tech in Computer Science and Engineering (Full Time) and M.Tech in Computer Science and Engineering (Part-Time).

In addition, the school has a unique academic collaboration with the University of Alabama in Huntsville to jointly offer an MS program in Computer Science. In addition, the department has a research center in which students can conduct cutting edge research leading to a Ph.D degree.

Curricula of both undergraduate and postgraduate programs have been designed through a collaboration of academic and industry experts in order to bridge the growing gap between industry and academia. This makes the program highly practical-oriented, and thus industry-resilient. The B.Tech program aims to create quality human resources to play leading roles in the contemporary, competitive industrial and corporate world.

The master's degree focus on quality research and design in the core and application areas of computing to foster a sustainable world and to enhance the global quality of life by adopting enhanced design techniques and applications. This thought is reflected in the various courses offered in the masters' programs.

Vision

Department of Computer Science and Engineering aspires to create a pool of high-calibre technologists and researchers in the field of computer science and engineering who have potential to contribute for development of the nation and society with their expertise, skills, innovative problem-solving abilities and strong ethical values.

Mission

MD1: To create center of excellence where new ideas flourish and from which emerge tomorrow's researchers, scholars, leaders, and innovators.

MD2: Provide quality education in both theoretical and applied foundations of computer science and engineering, related inter-disciplinary areas and train students to effectively apply the knowledge to solve real-world problems.

MD3: Amplify student's potential for life-long high-quality careers and make them competitive in ever-changing and challenging global work environment.

MD4: Forge research and academic collaboration with industries and top global universities in order to provide students with greater opportunities.

MD5: Support the society by encouraging and participating in technology transfer.

Program Educational Objectives (PEOs)

The program helps to develop critical, analytical, innovative, creative and problem-solving abilities amongst its graduates. The programme makes the graduates employable as Software Engineers across sectors. With further education and earning of higher-level degrees help the graduates to pursue a career in academics or scientific organisations as researchers.

The Program Educational Objectives (PEOs):

After few years of graduation, the graduates of B. Tech. Computer Science and Engineering(Internet of Things and Cyber Security including Block Chain Technology) will:

- PEO-1: Have a successful professional career in industry, government, academia and defence as an innovative engineer in a team.
- PEO-2: Develop code and solutions to industry and societal needs in a rapid changing technological environment and communicate with clients as an entrepreneur.
- PEO-3: Pursue higher studies and continue to learn by participating in conferences, seminars, etc.

Program Outcomes (POs)

On successful completion of the program, the graduates of B. Tech. Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) program will be able to:

PO-1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals for the solution of complex problems in Computer Science and Engineering using IoT, Cybersecurity and Blockchain technologies.

PO-2: Problem analysis: Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9: Individual and teamwork: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively with the engineering community and with society at large. Be able

to comprehend and write effective reports documentation. Make effective presentations and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

PO-12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

On successful completion of the program, the graduates of B. Tech. Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) program will be able to:

PSO-1: Demonstrate the knowledge of Data structures and Algorithms, Operating Systems, Embedded Systems, Artificial Intelligence and Machine Learning, Internet of Things, Cyber Security, Blockchain and Networking for efficient design of intelligent systems.

PSO-2: Use of modern tools and techniques in the areas of the Internet of Things, Cyber Security and Blockchain technologies.

PSO-3: Pursue advanced skills and research to innovate novel tools and systems for societal needs.

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

HANDBOOK

B. Tech. in Computer Science and Engineering

2023-27

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SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
SCHEME OF INSTRUCTIONS (2023 – 2027 BATCH)
B. Tech CSE
I Semester (Physics Cycle)

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/MC/ SDC	Credit Pattern				Contact Hours /Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	

1	B23AS0103	Multivariable Calculus and Linear Algebra	FC	3	0	0	3	3	50	50	100	BSC
2	B23AS0106	Physics for Computer Science	FC	3	0	0	3	3	50	50	100	BSC
3	B22EN0102	Introduction to Accounting	FC	1	0	0	1	1	25	25	50	HSMC
4	B23CS0104	Introduction to Data Science	HC	2	0	0	2	2	50	50	100	ESC
5	B22EE0101	Basics of Electrical and Electronics Engineering	HC	3	0	0	3	3	50	50	100	ESC
6	B22ED0101	Elements of Civil Engineering and Mechanics	HC	3	0	0	3	3	50	50	100	ESC
7	B22ME0101	Computer Aided Engineering Drawing	HC	2	0	1	3	4	50	50	100	ESC
8	B22AS0109	Physics for Computer Science Lab	FC	0	0	1	1	2	25	25	50	BSC
9	B23CS0108	Data Science Lab	HC	0	0	1	1	2	25	25	50	ESC
10	B22EE0102	Basics of Electrical and Electronics Lab	HC	0	0	1	1	2	25	25	50	ESC
TOTAL				17	0	4	21	25	400	400	800	
TOTAL SEMESTER CREDITS				21								
TOTAL CUMULATIVE CREDITS				21								
TOTAL CONTACT HOURS				25								
TOTAL MARKS				800								

II Semester (Chemistry Cycle)

III SEMESTER

	Course Code	Title of the Course	HC/FC / SC/OE /MC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B23AS0203	Probability and Statistics	FC	3	0	0	3	3	50	50	100	BSC
2	B23AS0104	Engineering Chemistry	FC	3	0	0	3	3	50	50	100	BSC
3	B22AH0103	Communication Skills	FC	0	0	1	1	2	25	25	50	HSMC
4	B22CI0104	Programming with C	HC	3	0	0	3	3	50	50	100	ESC
5	B22ME0103	Elements of Mechanical Engineering	HC	3	0	0	3	3	50	50	100	ESC
6	B22EN0101	IoT and Applications	HC	1	0	1	2	3	50	50	100	ESC
7	B23ME0102	Innovation & Entrepreneurship	FC	1	0	1	2	3	50	50	100	HSMC
8	B22AS0105	Engineering Chemistry Lab	FC	0	0	1	1	2	25	25	50	BSC
9	B22CI0108	Programming with C Lab	HC	0	0	1	1	2	25	25	50	ESC
10	B22ME0104	Engineering Workshop	HC	0	0	1	1	2	25	25	50	ESC
11	B22CS0201	Skill Development Course-1	SDC	0	0	2	2	4	50	50	100	SDC
12	B22ME0105	Tree Plantation in Tropical Region: Benefits and Strategic Planning	FC	1	0	0	1	1	25	25	50	HSMC
TOTAL				15	0	8	23	30	475	475	950	

TOTAL SEMESTER CREDITS	23
TOTAL CUMULATIVE CREDITS	44
TOTAL CONTACT HOURS	30
TOTAL MARKS	**950**

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22AS0301	Discrete Mathematics	FC	3	0	0	3	3	50	50	100	BSC
2	B22CS0301	Professional Ethics	HC	2	0	0	2	2	50	50	100	HSMC
3	B22ME0304	Entrepreneurship	HC	1	0	0	1	1	25	25	50	HSMC

4	B22AS0304	Environmental Science	MC	2	0	0	0	2				HSMC
5	B22EF0301	Operating systems	HC	3	0	0	3	3	50	50	100	PCC
6	B22EF0302	Programming with python	HC	3	0	0	3	3	50	50	100	PCC
7	B22EF0303	Data Structures and Algorithms	HC	3	0	0	3	3	50	50	100	PCC
8	B22EF0304	Analog and Digital Electronics	HC	3	0	0	3	3	50	50	100	PCC
9	B22EF0305	Programming with python Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0306	Data Structures and Algorithms Lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EF0307	Analog and Digital Electronics Lab	HC	0	0	1	1	2	25	25	50	PCC
Total				**20**	**0**	**3**	**21**	**26**	**400**	**400**	**800**	
TOTAL SEMESTER CREDITS				**21**								
TOTAL CUMULATIVE CREDITS				**65**								
TOTAL CONTACT HOURS				**26**								
TOTAL MARKS				**800**								

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22AS0401	Graph Theory and Optimization Techniques	FC	3	0	0	3	3	50	50	100	BSC
2	B22AH0302	Universal Human Values	HC	2	0	0	2	2	50	50	100	HSMC
3	B22EF0401	Technical Documentation	HC	1	0	0	1	1	25	25	50	PCC
4	B22LSM0301	Indian Constitution	MC	2	0	0	0	2				HSMC
5	B22EF0402	Object Oriented Programming with Java	HC	3	0	0	3	3	50	50	100	PCC
6	B22EF0403	Database Management System	HC	3	0	0	3	3	50	50	100	PCC
7	B22EF0404	Computer Organization and Architecture	HC	3	0	0	3	3	50	50	100	PCC
8	B22EFS41X	Professional Elective 1	SC	3	0	0	3	3	50	50	100	PEC
9	B22EF0405	Java Programming Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0406	Database Management System Lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EF0407	Microcontroller and IoT Lab	HC	0	0	1	1	2	25	25	50	PCC
12	B22EF0408	Skill Development course 2	SDC	0	0	2	2	4	50	50	100	SDC
TOTAL				**20**	**0**	**5**	**23**	**30**	**450**	**450**	**900**	
TOTAL SEMESTER CREDITS				**23**								
TOTAL CUMULATIVE CREDITS				**88**								
TOTAL CONTACT HOURS				**30**								
TOTAL MARKS				**900**								

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE	Credit Pattern		Examination	Course category

			/MC/SDC	L	T	P	Total Credit	Contact Hours/ Week	CIE Marks	SEE Marks	Total Marks	(As per AICTE)
1	B22XXO51X	Open Elective – 1 (multidisciplinary)	OE	3	0	0	3	3	50	50	100	POE
2	B22PAM0501	Indian Heritage and Culture (MC)	MC	2	0	0	0	2				HSMC
3	B22EF0501	Theory of Computation	HC	3	0	0	3	3	50	50	100	PCC
4	B22EF0502	Big Data Analytics	HC	3	0	0	3	3	50	50	100	PCC
5	B22EF0503	Computer Networks	HC	3	0	0	3	3	50	50	100	PCC
6	B22EF0504	Machine Learning and Applications	HC	3	0	0	3	3	50	50	100	PCC
7	B22EFS51X	Professional Elective - 2	SC	3	0	0	3	3	50	50	100	PEC
8	B22EFS52X	Professional Elective - 3	SC	3	0	0	3	3	50	50	100	PEC
9	B22EF0505	Big Data Analytics Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0506	Computer Networks Lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EF0507	Machine Learning Applications Lab	HC	0	0	1	1	2	25	25	50	PCC
12	B22EF0508	Skill Development course 3	SDC	0	0	2	2	4	50	50	100	SDC
TOTAL				**23**	**0**	**5**	**26**	**33**	**475**	**475**	**950**	

TOTAL SEMESTER CREDITS	**26**
TOTAL CUMULATIVE CREDITS	**114**
TOTAL CONTACT HOURS	**33**
TOTAL MARKS	**950**

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE /MC/SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22XXO61X	Open Elective-2 (General)	OE	3	0	0	3	3	50	50	100	POE
2	B22EF0601	Cryptography and Network Security	HC	3	0	0	3	3	50	50	100	PCC
3	B22EF0602	Web Technology	HC	3	0	0	3	3	50	50	100	PCC
4	B22EF0603	Agile Software Development and DevOps	HC	3	0	0	3	3	50	50	100	PCC
5	B22EF0604	Cloud Computing	HC	3	0	0	3	3	50	50	100	PCC
6	B22EFS61X	Professional Elective -4	SC	3	0	0	3	3	50	50	100	PEC
7	B22EFS62X	Professional Elective- 5	SC	3	0	0	3	3	50	50	100	PEC
8	B22EF0605	Cryptography and Network Security Lab	HC	0	0	1	1	2	25	25	50	PCC
9	B22EF0606	Web Technology Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0607	Cloud Computing Lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EF0608	Mini Project (research based)	HC	0	0	2	2	4	50	50	50	PCC
Total				**21**	**0**	**5**	**26**	**31**	**475**	**475**	**900**	
TOTAL SEMESTER CREDITS				**26**								
TOTAL CUMULATIVE CREDITS				**140**								
TOTAL CONTACT HOURS				**31**								
TOTAL MARKS				**950**								

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/ FC /SC /OE /MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22XXO71X	Open Elective – 3	OE	3	0	0	3	3	50	50	100	POE
2	B22XXO72X	Open Elective - 4 (MOOC)	OE	3	0	0	3	3	50	50	100	POE
3	B22EF0701	Computer Vision	HC	3	0	0	3	3	50	50	100	PCC
4	B22EF0702	Skill Development Course - 4 (MOOC)	SDC	1	0	1	2	3	50	50	100	SDC
5	B22EF0703	Internship	HC	0	0	2	2	4	50	50	100	PCC
6	B22EF0704/5	Project – Phase 1 / Start-up	HC	0	0	3	3	6	50	50	100	PCC
Total				**10**	**0**	**6**	**16**	**22**	**300**	**300**	**600**	

TOTAL SEMESTER CREDITS	**16**
TOTAL CUMULATIVE CREDITS	**156**
TOTAL CONTACT HOURS	**22**
TOTAL MARKS	**600**

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE /MC/SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22EF0801	Major Project Phase-2 / Start-up	HC	0	0	12	12	24	50	50	100	PCC
Total				**0**	**0**	**12**	**12**	**24**	**50**	**50**	**100**	
TOTAL SEMESTER CREDITS				**12**								
TOTAL CUMULATIVE CREDITS				**168**								
TOTAL CONTACT HOURS				**24**								
TOTAL MARKS				**100**								

Total Cumulative Credits: 168

Open Electives

V Sem	**Open Elective 1**	Data Structures and Algorithms (B22EFO511)	Unix Shell Programming (B22EFO512)			
VI Sem	**Open Elective 2**	Machine Learning using python (B22EFO611)	Operating Systems (B22EFO612)			
VII Sem	**Open Elective 3**	Java Programming (B22EFO711)	Networking Fundamentals (B22EFO712)			
VII Sem	**Open Elective 4**	NPTEL/SWAYAM Courses (General)				

Professional Electives

Softcore/ Semester	**T1 (DATA SCIENCE)**	**T2 (SYSTEM DESIGN AND COMMUNICATIONS)**	**T3 (IOT AND ROBOTICS)**	**T4 (COMPUTING)**	**T5 (PROGRAMMING)**
IV(PE1)	Artificial Intelligence (B22EFS411)	System Software (B22EFS412)	Sensors and Interfacing (B22EFS413)	Operation Research (B22EFS414)	Design and Analysis of Advanced Algorithms (B22EFS415)
V(PE2)	Neural Networks &Deep Learning (B22EFS511)	System Modeling and Simulation (B22EFS512)	IOT Architecture and Protocols (B22EFS513)	Object Oriented Modeling and design (B22EFS514)	Computer Graphics with OpenGL (B22EFS515)
V(PE3)	Natural Language Processing and Applications (B22EFS521)	Embedded and real time Systems (B22EFS522)	Robotics and Operating System (B22EFS523)	Multimedia Systems (B22EFS524)	C# & .Net Programming (B22EFS525)
VI(PE4)	Bioinformatics (B22EFS611)	Advances in Computer Networks (B22EFS612)	Advanced Python Programming (B22EFS613)	Edge and Fog Computing (B22EFS614)	Augmented Reality and Virtual Reality (B22EFS615)
VI(PE5)	Social Network Analysis (B22EFS621)	Compiler Design (B22EFS622)	Blockchain Technology and Applications (B22EFS623)	High Performance and Quantum Computing (B22EFS624)	Soft Computing (B22EFS625)

Skill Development Courses

Semester	**Type of Course**	A	B	C	D	E

II Sem	**Skill Development Course 1**	C++ Programming	UNIX Shell Programming	R Programming	Advanced Excel and Tableau	Matlab/SPSS
IV Sem	**Skill Development Course 2**	Android Programming	MongoDB and NoSQL Databases	DevOps	Drone Technology and IoT	Robotic Process Automation
V Sem	**Skill Development Course 3**	Ethical Hacking	Software Testing	AWS Cloud Services (Practitioner Level)	Natural Language Processing Tools	Web Application Development
VIII Sem	**Skill Development Course 4**	NPTEL SWAYAM Courses/Global Certifications				

Nomenclature: **L:** Lecture, **T:** Tutorial, **P:** Practical/Practice/Hands-on, **HC**: Hard Core, **SC**: Soft Core, **FC**: Foundation Core, **OE**: Open Elective, **SDC:** Skill Development Course, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination, **BSC**: Basic Science Course, **HSMC**: Humanities, Social science and Management Course, **ESC**: Engineering Science Course, **PCC**: Program Core Course, **PEC**: Professional Elective Course, **MC**: Mandatory Course, **PROJ**: Project work/Internship

***Note*:** SDC-1 will be hands-on based skill enhancement course that create expertise in the domain of respective engineering

COURSE OVERVIEW:

The course Differential Calculus deals with the basic aspects differential calculus. The students of Computer Science are equally benefited with this course as stepping stone to the broad areas of calculus. This course familiarize students with important concepts coming under differential calculus and to develop strong foundations on these concepts. In Computer Science, Calculus is used for machine learning, data mining, scientific computing, image processing, and creating the graphics and 3D visuals for simulations.

Course Title	Multivariable Calculus and Linear Algebra				Course Type		FC	
Course Code	B23AS0103	Credits	3		Class		I Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	0	0	0	Theory	Practical	CIE	SEE
	practice	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

Calculus is also used in a wide array software program that require it. Linear algebra provides concepts that are crucial to many areas of computer science, including graphics, image processing, cryptography, machine learning, optimization, graph algorithms, information retrieval and web search.

COURSE OBJECTIVE (S):

1. Explain the scalar and vector point functions and their operations.
2. Illustrate how to find angle between polar curves with a suitable example.
3. Demonstrate the use of radius of curvature of the curves can be best suited for machine learning techniques with big data analytics.
4. Describe the concepts of Linear algebra and calculus theory.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	Pos	PSOs
CO-1	Apply Taylor's and Maclaurin's series for finding series expansions of functions and approximating values.	1,2,4	1
CO-2	Identify the curve forms and evaluate the radius of curvature of the given curve.	1,2,4	1
CO-3	Evaluate the limit using L' Hospital rule after identifying an indeterminate form.	1,2,4	1
CO-4	Solve the given system of equations by Gauss elimination and Gauss Jordon method for the consistent equations.	1,2,4	1
CO-5	Determine the Eigen values, the corresponding Eigen vectors and diagonalize the given square matrix.	1,2,4	1
CO-6	Apply Rayleigh's Power method to find the largest Eigen value and the corresponding Eigen vector.	1,2,4	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1			√			
CO-2			√			

CO-3					√	
CO-4			√			
CO-5					√	
CO-6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3		1									1		
CO-2	3	3		2									1		
CO-3	3	2		1									1		
CO-4	3	3		1									1		
CO-5	3	3		1									1		
CO-6	3	2		1									1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT – 1 **Vector Calculus:** Velocity, Acceleration, Tangent and normal vectors, Gradient, Divergence, Curl, Solenoidal and Irrotational vectors, Scalar potential, Vector identities(Basic identities)**.** ****** *Applications: vector theory for data transmission, social network analysis*.
UNIT – 2 **Differential Calculus**: nth derivatives of standard function (without proof, *simple problems), Leibnitz theorem(without proof)-simple problems, Taylors series and McLaurin's series expansion for a function of one variable (only problems), Indeterminate forms 'solve using L- Hospital's rule. ******** *Applications: creating graphs or visuals, simulations, coding in applications, creating statistic solvers.*
UNIT– 3 **LinearAlgebra-1:** Echelon form, Normal form of a matrix, Rank of Matrix, Gauss-Jordon method to find inverse of a matrix, Gauss elimination and Gauss-Jordon method to solve system of equations. Linear Algebra for statistics. ****** *Application: Image processing, computer graphics, encryption, and decryption of the codes.*
UNIT – 4 **Linear Algebra-2:** Linear transformation, Eigen values and Eigen Vectors up to 3*3 matrices, Diagonalization for 2*2 matrices, Rayleigh power method to determiner largest Eigen value and the corresponding Eigen vector, Complex matrices. ****** *Application: Matrix operation in Machine Learning, Face recognition using eigen values and eigen vectors*.

****** *Application: (i) Additional information providing to students only for knowledge.*

(ii) Major part of assignments questions chosen from applications.

(iii) Students' presentations/seminars topics chosen from applications.

TEXT BOOKS:

1. Theodore Shifrin, "Multi-Variable Calculus and Linear Algebra with Applications", Wiley, 1st edition, Volume 2, 2018.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition,2013.

4. Ron Larson, “Multivariable Calculus, Cengage Learning”, 10th Edition, 2013.

REFERENCE BOOKS:

1. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill Publications, 19th Reprint edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, “Advanced Engineering Mathematics”, Narosa Publishing House, 4th edition, 2016.
3. Stanley I. Grossman, “Multivariable Calculus, Linear Algebra, and Differential Equations”, 2nd edition, Academic Press 1986.

JOURNALS/MAGAZINE:

https://www.sciencedirect.com/journal/linear-algebra-and-its-applications

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/111/107/111107108/
2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ma07/
3. https://nptel.ac.in/courses/111/106/111106051/
4. https://nptel.ac.in/courses/111/104/111104092/
5. https://nptel.ac.in/courses/111/104/111104085/

SELF-LEARNING EXERCISES:

Vector spaces, Curvilinear co-ordinates: Cylindrical and spherical co-ordinates

LIST OF EXPERIMENTS

EXP. NO.	LIST OF EXPERIMENT
1.	Finding gradient, divergent, curl and their geometrical interpretation
2.	2D plots for Cartesian and polar curve
3.	Finding Curvature and Radius of Curvature of a Given Curve
4.	Find Higher order derivative of the given function.
5.	Evaluate the given limit of function (L-Hospital’s rule).
6.	Find Rank of the given matrix
7.	Numerical solution of system of linear equations, test for consistency and graphical method.
8.	Solution of system of linear equations using Gauss-Elimination method
9.	Solution of diagonally dominant system of linear equations using Gauss-Siedel iteration
10.	Compute Eigen value and Eigen vectors and find the largest and smallest eigen value by Rayleigh power method.

Course Title	**Physics for Computer Science**				**Course Type**	**FC**
Course Code	**B23AS0106**	**Credits**	**3**		**Class**	**I Semester**
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes	Assessment in Weightage

Course Structure	Lecture	3	3	3	Per Semester			
	Tutorial	-	-	-	Theory	Practical	CIA	SEE
	Practice	-	-	-				
	Total	**3**	**3**	**3**	**42**		**50 %**	**50 %**

COURSE OVERVIEW

This course introduces the basic concepts of Physics and its applications to Computer Science Engineering courses by emphasizing the concepts underlying four units: Wave Mechanics, Lasers and optical fibers, EM wave and spectrum, Display Technology and Quantum computation. The subject has basic laws, expressions and theories which help to increase the scientific knowledge to analyze upcoming technologies.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Impart the knowledge about wave mechanics, electromagnetic waves, and its applications.
2. Demonstrate the different applications of lasers, and optical fibers.
3. Discuss different types of display technologies, touch screen techniques and its applications.
4. Explain the importance of quantum computation as an emerging technology.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply knowledge of wave mechanics, its importance, and applications.	1,2,3	1
CO2	Understand the wave function and applications of Schrödinger wave equation for energy Eigen values of a free particle.	1,2,3	1
CO3	Understand the light-matter interaction and requirement for lasing action.	1,2,3	1
CO4	Classify EM waves based on the frequency range, optical fibers and derive expression for NA, number of Modes and attenuation.	1,2,3	1
CO5	Summarize capacitive and resistive display technologies.	1,2,3	1
CO6	Analyze the working and application of quantum computation	1,2,3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2		√				
CO3		√				
CO4		√				
CO5	√					
CO6			√			

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3											1	
CO2	3	2	1											1	
CO3	3	2	1											1	
CO4	3	2	1											1	
CO5	3	2	2											1	
CO6	3	2	3											1	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY:

Contents
UNIT – 1
Wave mechanics: Introduction to Wave mechanics, De-Broglie hypothesis. Expression for de-Broglie wavelength of an electron in terms of accelerating potential. Phase velocity and group velocity, Relation between phase velocity and group velocity. **Quantum Physics:** Wave function, properties of wave function and physical significance. Probability density and Normalization of wave function, Schrodinger time- dependent and independent wave equation, Eigen values and Eigen functions. Applications of Schrödinger wave equation – energy Eigen values of a free particle, Particle in one dimensional infinite potential well with numerical examples. Quantum mechanics applications in computer science. (
UNIT – 2
Lasers: Lasers Interaction between radiation and matter (induced absorption, spontaneous and stimulated emission). Expression for energy density at thermal equilibrium in terms of Einstein's coefficients. Characteristics of laser light, Conditions for laser operation (population inversion and Meta stable state). Requisites of laser system, semiconductor laser and its applications. **Electromagnetic Waves**: Basic idea of displacement current, Electromagnetic waves, their characteristics, Electromagnetic spectrum (7 types of EM waves) including elementary facts. Applications of EM waves

UNIT – 3
Optical fibers: Construction and light propagation mechanism in optical fibers (total internal reflection and its importance), Acceptance angle, Numerical Aperture (NA), Expression for numerical aperture in terms of core and cladding refractive indices, Condition for wave propagation in optical fiber, V-number and Modes of propagation, Types of optical fibers, Attenuation and reasons for attenuation, Applications: Explanation of optical fiber communication using block diagram, Optical source (LED) and detector (Photodiode) and their applications. Advantages and limitations of optical communications.
UNIT – 4
Display technology: Touch screen technologies: Resistive and capacitive touch screen and Displays: CRT, Field emission display, Plasma display, LED display, OLED display, LCD display, 3D digital billboard, introduction to haptics. **Quantum Computation**: nano films (two-dimensional), Quantum wires (one-dimensional), Quantum dots (zero-dimensional). Classical bits, the idea of "Qubit", geometric visualization of the qubit via Bloch sphere, Quantum logic gates, Qubit as a two-level system.

TEXT BOOKS:

1. William T. Silfvast, "Laser Fundamentals", Cambridge University press, New York, 2004
2. 2.D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", 10th edition, John Wiley and Sons, New York, 2013
3. R. K. Gaur and S.L. Gupta, "Engineering Physics", DhanpatRai Publications (P) Ltd, New Delhi. 2014.
4. M.N. Avadhanulu and P.G. Kshirsagar, "A textbook of Engineering Physics", S. Chand and Company, New Delhi, 2014.
5. P. Lorrain and O. Corson, "EM Waves and Fields",3rd edition, CBS Publishers.

REFERENCE BOOKS:

1. Charls Kittel, "Introduction to Solid State Physics", 8th Edition Wiley, Delhi, ,2004
2. Arthur Beiser, "Concepts of modern Physics", 8th edition, Tata McGraw Hill publications, New Delhi, 2011
3. S. O. Pillai, "Solid State Physics", New Age International publishers, New Delhi, 2010
4. Janglin Chen, Wayne Cranton, Mark Fihn, "Handbook of Visual Display Technology", 2nd edition Springer Publication, 2012.

JOURNALS/MAGAZINE:

1. https://www.codemag.com/Magazine/ByCategory/Python
2. http://ijaerd.com/papers/special_papers/IT032.pdf
3. https://iopscience.iop.org/article/10.1088/176596/423/1/012027https://ieeexplore.ieee.org/document/4160250
4. Python for scientific computing

SWAYAM/NPTEL/MOOCs:

1. https://www.mooc.org/
2. https://www.coursera.org/

Self-Learning Exercises:

Introduction to optics, nano devices, quantum tunneling, semiconductor energy gap. characteristics of materials used in manufacture of laptops/desktops (display, internal circuit connection), laser printer working.

Course Title	Introduction to Accounting			Course Type	FC
Course Code	B22EN0102	Credits	1	Class	I semester

	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	-	-	-				
	Total	**1**	**1**	**1**	**14**	**-**	**50%**	**50%**

COURSE OVERVIEW

The course introduces the basic framework of accounting to all students to understand accounting concepts and constraints, and help them in preparation of financial records, statements and analysis of the major financial statements.

COURSE OBJECTIVES:

This course enables graduating students to

1. Educate students about the accounting principles and practices.
2. Orient about accounting recording and identification of income, expenses, Assets and Liabilities.
3. Get detailed knowledge of the practice of accounting in different forms of business
4. Gain the ability of using accounting information as a tool in applying solutions for managerial problems, evaluating the financial performance, and interpreting the financial structure.
5. Make students to Apply quantitative skills to analyse and solve business problems and to take advantage of business opportunities.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Acquire conceptual knowledge of basics of accounting and Identify events that need to be recorded in the accounting records	1,2,4,11	1
CO2	Identify and analyse the reasons for the difference between cash book and pass book balances	1,2,4,11	1
CO3	Equip with the knowledge of accounting process and preparation of final accounts	1,2,4,11	1
C04	Develop the ability to use accounting information to solve a variety of business problems	1,2,4,11	1
C05	Describe, explain, and integrate fundamental concepts underlying accounting and finance management	1,2,4,11	1
C06	Explain the need for the bank reconciliation statement and cash balance.	1,2,4,11	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓	✓			
CO2	✓	✓	✓			
CO3	✓	✓	✓			
C04	✓	✓	✓			
C05	✓	✓	✓			
C06	✓	✓	✓			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1		1							1		1		
CO2	1	1		1							1		1		
CO3	1	1		1							1		1		
C04	1	1		1							1		1		
C05	1	1		1							1		1		
C06	1	1		1							1		1		

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT – 1 **INTRODUCTION TO ACCOUNTING & ACCOUNTING PROCESS** Introduction – Meaning and Definition-Objectives of Accounting – Functions of Accounting – Users of Accounting information-Limitations of Accounting – Accounting Principles –Accounting Concepts and Conventions. Meaning – Process of Accounting – Kinds of Accounts – Rules – Transaction Analysis – Journal – Ledger – Balancing of Accounts – Trail Balance Problems, Accounting Concepts: Entity, Money Measurement, Going Concern, Accounting Period, Cost Concept, Dual Aspect, Accounting Mechanism – Single Entry and Double Entry. (Only Theory)
UNIT – 2 **RECORDING OF BUSINESS TRANSACTIONS** - Voucher and Transactions: Origin of Transactions – Source documents and Vouchers, Preparation of vouchers; Accounting equation approach – Meaning and Analysis of transactions using accounting equation; Rules of debit and credit- Capital & Revenue Transactions. The Accounting Process Recording of Transactions: Books of original entry – Journal (Simple problems), types of subsidiary books (i) Cash book – Simple, Cashbook with bank column and Petty cashbook, (ii) Purchases book, Sales book, Purchases returns book, Sale returns book; Ledger: Meaning, Utility, Format; Posting from journal and subsidiary books; Trial Balance- P& L Account and Balance sheet -Bank Reconciliation Statement: Meaning, Need and Preparation, Correct cash balance. (Simple problems)

Reference Books:

1. Tulsian, P.C. “Financial Accounting”, 20th Edition, Pearson Education, 2016
2. S.N. Maheshwari, and. S. K. Maheshwari. “Financial Accounting”. 5th Edition, Vikas Publishing House, New Delhi, 2012.
3. Dr. Jawaharlal, “ Accounting theory and practices”, 4th Edition, HPH, 2022.
4. Bhushan Kumar Goyal and HN Tiwari,” Financial Accounting”, International Book House, 2021

Course Title	Introduction to Data Science				Course Type	HC
Course Code	B23CS0104	Credits	2		Class	I Semester
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes	Assessment

Lecture	2	2	2	Per Semester		Weightage	
Tutorial	-	-	-				
Practice	-	-	-	Theory	Practical	CIE	SEE
Total	**2**	**2**	**2**	**28**	**-**	**50%**	**50%**

COURSE OVERVIEW:

Data Science is an interdisciplinary, problem-solving oriented subject that is used to apply scientific techniques to practical problems. The course orients on preparation of datasets and programming of data analysis tasks. This course covers the topics: Set Theory, Probability theory, Tools for data science, ML algorithms and demonstration of experiments either by using MS-Excel/Python/R.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamental concepts of Excel.
2. Illustrate the use of basic concepts of Data Science in the real-world applications.
3. Demonstrate the use of SQL commands in real world applications.
4. Discuss the functional components of Data Science for real world applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the basic concepts of Data Science in developing the real-world applications.	1 to 4, 12	1,2,3
CO2	Apply the SQL commands in developing the real-world applications.	1 to 5,12	1,2,3
CO3	Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data.	1 to 5	1, 2, 3
CO4	Demonstrate visualization of Data using python libraries	1 to 5, 8 to 10	1,2, 3
CO5	Find modeling Error in Linear Regression.	1 to 5	1, 2, 3
CO6	Use statistical principles to solve mean and standard deviations for given data.	1 to 4, 12	1,2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember(L1)	**Understand(L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			✓			
CO2			✓			
CO3			✓	✓		
CO4			✓	✓	✓	✓
CO5		✓				
CO6			✓			

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	2	2	2								2	3	1	1
CO2	2	3	2	1	2	2						2	3	2	2
CO3	2	3	3	2	2								3	3	3
CO4	3	3	3	2	2			2	2	2			3	3	3
CO5	2	3	2	2	2								3	3	3
CO6	3	3	2	2								2	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT – 1 **Introduction to Microsoft Excel:** History and importance of Microsoft Excel, Creating Excel tables, understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Sorting, Filtering, Grouping, Ungrouping and Subtotal. Introduction to formulas and functions in Excel. Logical functions (operators) and conditions. Visualizing data using charts in Excel. Import XML Data into Excel, How to Import CSV Data (Text) into Excel, How to Import MS Access Data into Excel, Working with Multiple Worksheets.
UNIT – 2 **Introduction to Data Science:** What is Data Science? Applications of Data Science, Data science life cycle, Tools for data science, definition of AI, types of machine learning (ML), list of ML algorithms for classification, clustering, and feature selection. Probability theory, bayes theorem, bayes probability; Cartesian plane, equations of lines, graphs; exponents. Introduction to SQL: SQL Commands experimental demonstrations-DDL, DML, DCL, TCL, DQL. Import SQL Database Data into Excel.
UNIT – 3 **Data Relationship Methods:** Introduction to Correlation, Description of linear regression and Logistic Regression, Introducing the Gaussian, Introduction to Standardization, Standard Normal Probability Distribution in Excel, Calculating Probabilities from Z-scores, Central Limit Theorem, Algebra with Gaussians, Markowitz Portfolio Optimization, Standardizing x and y Coordinates for Linear Regression, Standardization Simplifies Linear Regression, Modeling Error in Linear Regression, Information Gain from Linear Regression. .
UNIT – 4 **Data visualization using scatter plots, charts, graphs, histograms, and maps:** Statistical Analysis: Descriptive statistics-Mean, Standard Deviation for Continuous Data, Frequency, Percentage for Categorical Data. **Introduction to Python:** Python basics, Strings, Lists, Tuples, Sets, Dictionaries. Introduction to python libraries - Numpy, Matplotlib, Pandas, Scikit-Learn, Implementation of ML.

TEXT BOOKS:

1. B.S. Grewal, “Higher Engineering Mathematics”,43rdEdition, Khanna Publishers, 2015.
2. Ramakrishnan and Gehrke, “Database Management systems”, 3rdEdition, McGraw Hill Publications, 2003.
3. “Mastering Data Analysis in Excel” - https://www.coursera.org/learn/analytics-excel.
4. Kenneth N. Berk, Carey, “Data Analysis with Microsoft Excel”, S. Chand & Company,2004.
5. Joel Grus,”Data science from scratch - First principles with Python” , OâReily, 2015.

REFERENCE BOOKS:

1. B.V. Ramana, “Higher Engineering Mathematics”, 19th edition, Tata McGraw Hill Publications, 2013.
2. ErwinKreyszig, “Advanced Engineering Mathematics”, 9th edition, Wiley Publications, 2013.
3. Seymour Lipschutz, John J. Schiller, “Schaum's Outline of Introduction to Probability and Statistics”, McGraw Hill Professional, 1998.

JOURNALS/MAGAZINES:

1. https://www.journals.elsevier.com/computational-statistics-and-data-analysis
2. https://www.springer.com/journal/41060International Journal on Data Science and Analytics
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8254253IEEE Magazine on Big data and Analytics

SWAYAMNPTEL/MOOCs

1. Excel Skills for Business: Essentials, Macquarie University (https://www.coursera.org/learn/excel-essentials)
2. SQL for Data Science, University of California, Davis(https://www.coursera.org/learn/sql-for-data-science)
3. Data Science Math Skills, Duke Universityhttps://www.edx.org/course/subject/data-science
4. https://onlinecourses.nptel.ac.in/noc19_cs60/preview

SELF-LEARNINGEXERCISES:

1. Relational database management system.
2. Advanced MS-Excel

Course Title	**Basics of Electrical & Electronics Engineering**				**Course Type**	**HC**
Course Code	B22EE0101	Credits	3		Class	I Semester
	LTP	Credits	Contact	Work	Total Number of	Assessment in

Lecture	3	3	3	Classes		Weightage	
Tutorial	-	-	-	Theory	**Practical**	CIE	SEE
Practice	-	-	-				
Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW

Basic Electrical & Electronics Engineering covers basic concepts of electrical engineering and electromagnetism. This course introduces the student to the working AC and DC Machines. It also helps the student to understand the basics in digital electronics by applying the knowledge of logic gates and learning the applications of diodes in rectifiers, filter circuits. Further, it has a self-learning component on BJT's.

COURSE OBJECTIVES

The objectives of this course are to:

1) Explain and to make the students familiar about the basics of Electrical Circuits.
2) Illustrate the basics of magnetic circuits and construction, working principle of DC machines, Transformers.
3) Illustrate the characteristics of Diodes and their applications.
4) Discuss the characteristics and applications of BJT's.
5) To familiarize the students about Number systems.
6) To validate the logical expressions using Boolean algebra.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO-1	Summarize the basics of electrical engineering terminology and the usage.	1-2	1
CO-2	Apply KCL and KVL to Solve Electrical Circuits		
CO-3	Demonstrate the working principle of DC Machines and Transformers and provide applications of DC Machines, Transformers.	1-2,4	1
CO-4	Analyze the characteristics of PN junction diode, Zener diode and their application	1-2,4	1
CO-5	Analyze the working principle and characteristics in three configurations of BJT	1-2	1
CO-6	Apply the concept of Number system and Arithmetic operations in digital system	1-2	1

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO-1	3	1											1		
CO-2	3	3		2									1		
CO-3	3	2		2									1		
CO-4	3	3											1		
CO-5	3	2											3		
CO-6	3	2	3										3		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT – 1 **Introduction to Electrical Engineering**: Basics of DC Circuits: Ohms law, Kirchhoff's Current Law, Kirchhoff's Voltage law, Numerical examples as applicable. Basics of AC Circuits: Sinusoidal voltage and currents, Magnitude and phase, polar and rectangular representation, RL, RC and RLC series and parallel circuits, power factor, phasor diagrams, three phase AC –types of three phase connection (star and delta), Comparison between single phase and three phase AC, Numerical examples as applicable.
UNIT – 2 **Magnetic Circuits and Electrical Machines**: Magnetic Circuits: Definition of magnetic circuit and basic analogy between electric and magnetic circuits, Faradays laws, permittivity, permeability, EMF, MMF equations, Reluctance. Electrical machines: DC

Generator, DC Motors, Transformers - Principle of operation, Construction and EMF equations, types and applications. Induction motor: Concept of RMF, Working principle, types and applications Numerical examples as applicable

Unit-3

Semiconductor Diodes and Transistors: Semiconductor Diodes :P-N junction diode, V-I Characteristics, Half-wave rectifier, Full-wave rectifier, Bridge rectifier, Capacitor filter circuit, Zener diode voltage regulators, Clipping and clamping circuit, Numerical examples as applicable.

Transistors: Bipolar junction Transistors BJT configuration: BJT Operation, Common Base, Common Emitter and Common Collector, Characteristics, Numerical examples as applicable.

Unit-4

Digital Electronics and Number System: Introduction, Switching and Logic Levels, Digital Waveform. Number Systems and its conversions: Decimal Number System, Binary Number System, Octal Number System, Hexadecimal Number System. Binary addition, Binary subtraction. Boolean Algebra Theorems, De Morgan's theorem. Digital Circuits: Logic gates, Algebraic Simplification, Realization of all logic and Boolean expressions.

TEXT BOOKS

1. Nagrath I.J. and D. P. Kothari, "Basic Electrical and Electronics Engineering", Second Edition Tata McGraw Hill, 2020.
2. Hayt and Kimberly, "Engineering Circuit Analysis", 8th Edition, Tata McGraw Hill, 2013.
3. Kulshreshtha D.C., "Basic Electrical Engineering", Second Edition, Tata McGraw Hill, 2019.
4. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
5. D.P. Kothari, I. J. Nagrath, "Basic Electronics", Second Edition, McGraw Hill Education (India) Private Limited, 2017.

REFERENCE BOOKS

1. Hughes, "Electrical Technology", International Students 9th Edition, Pearson, 2005.
2. Robert L. Boylestad and Louis Nashelsky, "Introduction to Electricity, Electronics and Electromagnetics" Prentice Hall, 5th edition, 2001

SWAYAM/NPTEL/MOOCS

1. https://nptel.ac.in/courses/108108076
2. **https://nptel.ac.in/courses/108101091**
3. **https://www.udemy.com/course/basic-electrical-engineering-part-1**

Course Title	**Elements of Civil Engineering and Mechanics**				**Course Type**	**HC**
Course Code	**B22ED0101**	**Credits**	**3**		**Class**	**I Semester**
	LTP	Credits	Contact	Work	Total Number of	Assessment in

Lecture	3	3	3	Classes		Weightage	
Tutorial	-	-	-	Theory	**Practical**	CIE	SEE
Practice	-	-	-				
Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course introduces the students to basic concepts of Engineering Mechanics, which are essential for all Engineers. The course familiarizes students shall be learning about mechanical interaction between bodies. That is, we will learn how different bodies apply forces on one another and how they then balance to keep each other in equilibrium, and forces and types of forces, centroid and moment of inertia Students will learn about basic concept of forces, force systems, beams, trusses, properties of geometric shapes.

COURSE OBJECTIVE (S):

The objectives of this course are to

1. Understand a broad concept of Engineering Mechanics.
2. Enable students to apply fundamentals and basic concepts of rigid body mechanics to solve problems of bodies in rest.
3. Enable the students to apply conditions of static equilibrium to analyze physical system of coplanar forces.
4. Analyze the civil engineering structures namely determinate beams and trusses.
5. Provide an overview of centroid and moment of inertia of plane area
6. Understand the concept of dynamics and fluid mechanics in civil engineering.

COURSE OUTCOMES (COs)

After completion of this course, the students will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand basics of mechanics related to Particle, Continuum and Rigid body; Forces, Couple & moment of couple.	1,2	2
CO2	Compute the resultant of system of forces in plane and space acting on bodies.	1,2,5	2,4
CO3	Analyze civil engineering structures using static equilibrium conditions.	1,2,3,4,5	2,4
CO4	Compute the reactions developed at the supports of beams and member forces of trusses.	1,2,3,4,5	2,4
CO5	Determine the centroid and moment of inertia of different geometrical shapes.	1,2,3,4,5	2,4
CO6	Solve the engineering problems using dynamic equilibrium condition.	1,2,3,4,5	2,4

BLOOM'S LEVEL OF THE COURSE OUTCOME

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓				
CO2	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	
CO6	✓	✓	✓	✓	✓	

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3												1		
CO2	3	3			1									3		1
CO3	3	3	1	1	3									3		3
CO4	3	3	2	1	3									3		3
CO5	3	3	2	1	3									3		2
C06	3	3	1	1	3									3		3

Note: 1-Low, 2-Medium, 3-High

Contents
Unit-1 **Introduction to Civil Engineering:** Scope of Civil Engineering. Effect of the infrastructural facilities on socio-economic development of a country. **Introduction to Engineering Mechanics**: Basic idealizations; Force and its characteristics, Force System and its classification, Principle of superposition of forces, Principle of transmissibility of forces, Moment of a force, couple, moment of a couple, characteristics of couple, Equivalent force - couple system (theory only). Analysis of Force Systems: Resolution of forces, Composition of forces - Definition of Resultant, Composition of coplanar -concurrent force system, Parallelogram Law of forces.
Unit-2 **Analysis of Force system:** Composition of coplanar - non- concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar concurrent and non-concurrent force systems. **Equilibrium of Coplanar Forces:**Definition of static equilibrium, Conditions of static equilibrium for different coplanar force systems, Concept of Free Body Diagram and Lami's theorem with problems.
Unit-3 **Centroid**: Introduction to the concept, Centroid of plane figures, Locating the centroid of rectangle, triangle and semicircle using method of integration, Centroid of composite sections; Numerical problems. **Moment of Inertia**: Introduction to the concept, polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem, Moment of Inertia of rectangle, circle, semi-circle and triangle from method of integration, Moment of inertia of composite areas: Numerical problems.
Unit-4 **Analysis of structures:** Types of beams, loads, support and problems on beams. Plane trusses: Method of joints with numerical. **Introduction to Dynamics**: Introduction to Kinematics and Kinetics, Rectilinear motion: uniform motion, uniformly accelerated motion, motion under gravity, Concept of Dynamic Equilibrium with problems. **Introduction to Fluid Mechanics:** Introduction, method of describing fluid motion, definitions of types of fluid flow, stream line, path line and stream tube.

Text Books:

1. T R Jagadeesh, “Elements of Civil Engineering”, Sapna book house
2. BK Kolhapure, “Elements of Civil Engineering”, Eastern Book Promoters
3. M.N. Shesha Prakash and Ganesh.B. Mogaveer, “Elements of Civil Engineering and Engineering Mechanics”, PHI Learning, 3rd Revised edition.
4. Engineering Mechanics by RS Khurmi, S Chand and Company.
5. Fluid Mechanics by P.N. Modi and R.K. Bansal.

Reference Books:

1. A. Nelson, “Engineering Mechanics-Statics and Dynamics”, Tata Mc-Graw Hill Education Private Ltd, New Delhi, 2009
2. S. S. Bhavikatti, “Elements of Civil Engineering”, New Age International Publisher, New Delhi, 3rd edition 2009.
3. Hydraulics and Fluid Mechanics Including Hydraulics Machines by Dr. P.N. MODI & S.M. SETH (Author).

Course Title	Computer Aided Engineering Drawing	Course Type	HC

Course Code	B22ME0101	Credits	3		Class		I Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	1	2	2				
	Total	3	4	4	28	28	50 %	50 %

COURSE OVERVIEW

Engineering Graphics or Drawing is known as language of engineers. All phases of engineering process require the conversion of new ideas and design concepts into the basic line language of graphics. There are many areas such as civil, mechanical, electrical, architectural, computer, electronics and industrial applications where knowledge and skills of the drawing play major roles in the design and development of new products or construction. This course emphasizes on orthographic projection of point, line, plane surfaces and solids. It also provides knowledge about representing the object in terms of 3D view and also development of the objects.

COURSE OBJECTIVES

The objectives of this course are to

1. Introduce the concepts like dimensioning, conventions and standards of engineering drawings in order to become professionally efficient.
2. Enable students to learn about the software tool for preparing engineering drawings
3. Teach the concepts and principles of orthographic projections, development of lateral surfaces and isometric projection of simple solids.
4. Communicate the concepts/ideas through the language of technical drawing and sketching.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Draw orthographic projection of point, line manually and also by using CAD software.	1,2,5,10	1
CO2	Draw orthographic projection of plane surfaces manually and also by using CAD software.	1,2,5, 10	1
CO3	Draw orthographic projection of simple solids manually and also by using CAD software.	1,2,5, 10	1
CO4	Draw sectional views of prisms, pyramids, cone and cylinder manually and also by using CAD software.	1,2,5, 10	1
CO5	Draw the development of lateral surfaces of the solids manually and also by using CAD software.	1,2, 3,5,10	1
CO6	Create isometric view of the solids manually and also by using CAD software.	1,2,3,5,10	1

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			2					3			3		
CO2	3	2			2					3			3		
CO3	3	2			2					3			3		
CO4	3	2			2					3			3		
CO5	3	2	2		2					3			3		
CO6	3	1	2		2					3			3		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
Unit-1 **Introduction** – Geometrical constructions, engineering drawing standards, Introduction to CAD Software. Points, Line and Plane Surface: Orthographic projection of points in first and third Quadrant only. Orthographic projection of straight lines inclined to both horizontal and vertical planes. Orthographic projection of regular plane surfaces when the surface is inclined to both HP and VP.
Unit-2 **Solids:** Orthographic projection of regular solids like prisms, pyramids cone and cylinder when the axis is inclined to both HP and VP.
Unit-3 **Sections of solids:** Drawing sectional views and true shape of section, Development of Lateral Surfaces of Solids: Parallel line method for prisms and cylinders, Radial line method for pyramids and cones
Unit-4 **Isometric Projections:** Isometric projections of simple and combined solids.

PRACTICE:

Sl. No	Practice	Tools and Techniques	Expected Skill /Ability
1.	Use of solid edge software and familiarization of tools	Solid Edge Software	Use of commands to draw the drawings
2.	Draw the projection of point locating in first and third quadrant	Solid Edge Software	Analysing and software skill
3.	Draw the projection of lines locating in first quadrant	Solid Edge Software	Draw the views of the line and software skill
4.	Draw the projection of rectangular and pentagonal lamina inclined to both HP and VP	Solid Edge Software	analysing and software skill
5.	Draw the projection of hexagonal and circular lamina inclined to both HP and VP	Solid Edge Software	analysing and software skill
6.	Draw the projection of prisms inclined to both HP and VP	Solid Edge Software	Interpretation and software skill

Sl. No	Practice	Tools and Techniques	Expected Skill /Ability
7.	Draw the projection of pyramids inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
8.	Draw the projection of cone and cylinder inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
9	Draw the projection of section of solids in simple position	Solid Edge Software	Analysing and Software Skill
10	Develop the lateral surface of prisms and cylinder	Solid Edge Software	Creative and Software Skill
11	Develop the lateral surface of pyramids and cone	Solid Edge Software	Creative and Software Skill
12	Draw the isometric projection of simple plane surface and simple solids	Solid Edge Software	Analysing and software skill
13	Draw the isometric projection of two co-axial solids	Solid Edge Software	Analysing and software skill

TEXT BOOKS

1. K S Narayanswamy and Mahesh L, “Engineering Drawing”, WILEY Publishers, 1st Edition, 2017.

2. K. R. Gopalakrishna and Dr. M S Reddy, “Engineering Graphics-1”, Subhas Publications, 2015.
3. Bhatt N.D., Panchal V.M and Ingle P.R, “Engineering Drawing”, Charotar Publishing House Pvt. Ltd, 53rd Edition, 2019.

REFERENCE BOOKS

1. Luzadder and Duff, “Fundamental of Engineering Drawing”, Printice Hall of India Pvt. Ltd. 11th Edition, 2001.
2. Shah, M.B. and Rana B.C., “Engineering Drawing and Computer Graphics”, Pearson Education, 2008.

SWAYAM/NPTEL/MOOCS

1. https://nptel.ac.in/courses/112/103/112103019/
2. https://www.udemy.com/course/ed/

Course Title	Physics for Computer science Lab				**Course Type**		**FC**	
Course Code	**B22AS0109**	**Credits**	**1**		**Class**		**I Semester**	
Course Structure	LTP	Credits	Contact Hours	Workload	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	1	2	2				
	Total	**1**	**2**	**2**	**0**	**28**	**50%**	**50%**

COURSE DESCRIPTION:

Engineering Physics is very important and necessary basic subject for all branches of engineering students. It provides the fundamental knowledge of basic principles of Physics which is required for basic foundation in engineering education irrespective of branch. This course introduces the experimental concepts of Physics and its applications to Computer Science Engineering courses by emphasizing the following concepts: electrical properties, semiconductor physics, dielectrics, and optical properties. This course provides This course provides basic understanding about the working of different electronic components. This course also teaches students to simulate the working of some electronic components.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Demonstrate the principles covered in your study material in physics.
2. Provide familiarity with apparatus and enable them to handle the instruments and apparatus with purpose.
3. Identify the process to study conditions for a given experiments.
4. Develop an attitude of perfection in practical tasks.
5. Simulate the working of different electronic components using mobile or a computer.

COURSEOUTCOMES (COs)

After the completion of the course the student will be able to:

CO#	CourseOutcomes	POs	PSOs
CO1	Constructing simple circuits and perform experiments to study voltage-current response.	1, 2,3 4	1,2,3
CO2	Determine the band gap of a semiconducting material.	1,2, 3,5	2, 3
CO3	Determine the dielectric constant of the material.	2,3, 4, 8,	1, 2, 3
C04	Analyze the response of the circuit by combining the electrical/electronic components.	2,3, 4,8,	1, 2, 3
CO5	Determineparticle size of the powder and wavelength of the LASER.	1 to 5	1, 2, 3
CO6	Simulate the working of electronic circuits	1 to 5, 8 to 10	1,2, 3

BLOOM'SLEVELOFTHECOURSEOUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	**Understand (L2)**	**Apply(L3)**	**Analyze(L4)**	**Evaluate(L5)**	**Create(L6)**
CO1						✓
CO2			✓	✓		
CO3			✓	✓		
C04			✓	✓	✓	✓
CO5				✓	✓	
CO6			✓	✓	✓	✓

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2						3	3			1		
CO2	3	3	2						3	3			2		
CO3	3	2							3	3			1		

CO4	3	2		2					3	3			1		
CO5	3	2							3	3			2		
CO6	3	2				2			3	3			1		

List of Experiments

No	Title oftheExperiment	Tools and Technics	Expected Skill/Ability
1	Determine the value of Planck's constant using LEDs.	LED's, voltmeter and power-supply, Planck's constant apparatus set up, patch cards	Circuit construction and mathematical calculations
2	Study the i-v characteristics of a Zener diode.	Zener diode, DC supply, Ammeters and voltmeters	Circuit construction and mathematical calculation, graph plotting
3	Study the i-v characteristics of a "npn" Transistor in common emitter configuration.	Transistor, DC supply, Ammeters and voltmeters.	Circuit construction, Perform, and plotting of data.
4	Study the i-v characteristics of a Photo Diode.	Photo diode, LED light source, DC supply, Ammeters and voltmeters	Circuit construction, Perform, and plotting of data
5.	Determine the electrical resistivity by 4-probe method	4 probe set up, ammeter, voltmeter, heater,	Circuit construction, Perform, and plotting of data
6	Determine the resonance frequency and quality factor of the given LCR connected in a) Series & b) Parallel.	Signal generator, inductor, capacitor, resistor and ameter	Circuit construction, Perform, and plotting of data
7	Determine numerical aperture of the given optical fiber.	Diode laser, digital dc micrometer two OFC (1.5m &2.5m), optical sensor	Circuit construction, Perform, and plotting of data
8	Calculate the particle size by forming diffraction haloes using LASER.	Lycopodium Powders, glass plate, diode laser, screen	Circuit construction, Perform, and plotting of data
9	Determine the dielectric constant by the method of charging and discharging of a capacitor	Capacitor, timer, voltmeter	Circuit construction, Perform, and plotting of data
10	Determine of wavelength of the light emitted by the given LASER using a grating.	Diode laser, grating, screen	Circuit construction, Perform, and plotting of data

Part B: Demo and Simulation.

No	Title of the Experiment	Tools and Technics	Expected Skill/Ability
1	Calculate the band gap of the material of the given semiconductor component.	Beaker with hot water, thermometer, component and multimeter	Circuit construction, Perform, and plotting of data
2	Verify Stefan's law of black body radiation.	Incandescent bulb, ammeter and voltmeter	Circuit construction, Perform, and plotting of data
3	Simulate the characteristics of simple electronic components (Resistor, Diode, Zener Diode, Transistor, Tunnel diode, LCR and JFET)	Everycircuit (android app) Tina (Online simulator)	Visualize, simulate and analyse

Text Books

1. M.N. Avadhanulu and P.G. Kshirsagar, “A Text book of Engineering Physics”, S. Chand & Company Ltd, New Delhi, 10th revised Ed

2. Gaur and Gupta, “Engineering Physics”, Dhanpat Rai Publications 2017

REFERENCE BOOKS:

1. Arthur Beiser, “Concepts of Modern Physics”, Tata McGraw Hill Edu Pvt Ltd- New Delhi, 6 th Ed 2006

2. S O Pillai, “Solid State Physics”, New Age International Publishers, 8th Ed

3. S M Sze, Physics of Semiconductor devices, Wiley, 2004

<table>
<tr><td>Course Title</td><td colspan="4">Data Science Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B23CS0108</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Workload</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td></tr>
</table>

	Total	**1**	**2**	**2**	**0**	**28**	**50**	**50**

COURSE DESCRIPTION:

Data Science is an interdisciplinary, problem-solving oriented subject that is used to apply scientific techniques to practical problems. The course orients on preparation of datasets and programming of data analysis tasks. This course covers the topics: ML algorithms, SQL and demonstration of experiments by using MS-Excel and MySQL and Python .

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamental concepts of Excel.
2. Explain the algorithms of Machine learning.
3. Demonstrate the use of SQL commands in real world applications.
4. Discuss the functional components of Data Science for real world applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the concepts of Microsoft Excel in developing the real-world applications.	1 to 5, 8 to 10	1,2,3
CO2	Apply the SQL Queries in developing the real-world applications.	1 to 5, 8 to 10	2, 3
CO3	Build the solutions for real world problems, perform analysis, interpretation and reporting of data using regression algorithms.	1 to 5, 8 to 10	1, 2, 3
C04	Design ER diagrams for database.	1 to 5, 8 to 10	1, 2, 3
CO5	Use Excel to solve Multiple Linear Regression.	1 to 5, 8 to 10	1, 2, 3
CO6	Demonstrate visualization of Data using python libraries	1 to 5, 8 to 10	1,2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply(L3)**	**Analyze(L4)**	**Evaluate(L5)**	**Create(L6)**
CO1			✓			
CO2			✓			

CO3			✓	✓		
C04			✓	✓	✓	✓
CO5		✓				
CO6			✓			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2			1	3	3			3	3	3
CO2	2	2	2	2	2			1	3	3			3	3	3
CO3	3	3	2	2	2			1	3	3			3	3	3
CO4	3	3	3	2	2			1	3	3			3	3	3
CO5	3	3	3	2	2			1	3	3			3	3	3
CO6	3	3	3	2	2			1	3	3			3	3	3

Practice:

<table>
<tr><th>No</th><th>Title of the Experiment</th><th>Tools and Technics</th><th>Expected Skill/Ability</th></tr>
<tr><td>1</td><td>The height (in cm) of a group of fathers and sons are given below, Findthe lines of regression and estimate the height of son when the height of father is 164 cm.
<table>
<tr><td>Hgt of Father</td><td>158</td><td>166</td><td>163</td><td>165</td><td>167</td><td>170</td><td>167</td><td>172</td><td>177</td><td>181</td></tr>
<tr><td>Hgt of Son</td><td>163</td><td>158</td><td>167</td><td>170</td><td>160</td><td>180</td><td>170</td><td>175</td><td>172</td><td>175</td></tr>
</table></td><td>MS Excel</td><td>Create and perform operations on Excel data set by applying Linear regression</td></tr>
<tr><td>2</td><td>Using the data file DISPOSABLE INCOME AND VEHICLE SALES,perform the following:
i) Plot a scatter diagram.
ii) Determine the regression equation.
iii) Plot the regression line (hint: use MS Excel's Add Trend line feature.
iv) Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900.
v) Compute the coefficient of determination and the coefficient of correlation</td><td>MS Excel</td><td>Perform prediction and visualiza-tion of data</td></tr>
</table>

<table>
<tr>
<td>3</td>
<td>Managers model costs in order to make predictions. The cost data in the data file INDIRECT COSTS AND MACHINE HOURS show the indirect manufacturing costs of an ice-skate manufacturer. Indirect manufacturing costs include maintenance costs and setup costs. Indirect manufacturing costs depend on the number of hours the machines are used, called machine hours. Based on the data for January to December, perform the following operations.

i) Plot a scatter diagram.
ii) Determine the regression equation.
iii) Plot the regression line (hint: use MS Excel's Add Trend line feature).
iv) Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.
v) Compute the coefficient of determination and the coefficient of correlation.</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
<tr>
<td>4</td>
<td>Apply multiple linear regression to predict the stock index price which is a dependent variable of a fictitious economy based on two independent / input variables interest rate and unemployment rate.

<table>
<tr><th>Year</th><th>Month</th><th>Interest rate</th><th>Un employment rate</th><th>Stock index price</th></tr>
<tr><td>2022</td><td>10</td><td>2.75</td><td>5.3</td><td>1464</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
<tr>
<td>5.</td>
<td>Calculate the total interest paid on a car loan which has been availed from HDFC bank. For example, Rs.10,00,000 has been borrowed from a bank with annual interest rate of 5.2% and the customer needs to pay every month as shown in table below. Calculate the total interest rate paid for availed of Rs.10, 00,000during 3 years.

<table>
<tr><th>Sl.no</th><th>A</th><th>B</th></tr>
<tr><td>1</td><td>Principal</td><td>Rs.10,00,000</td></tr>
<tr><td>2</td><td>Annual interest rate</td><td>5.2%</td></tr>
<tr><td>3</td><td>Year of the loan</td><td>3</td></tr>
<tr><td>4</td><td>Starting payment number</td><td>1</td></tr>
<tr><td>5</td><td>Ending payment number</td><td>36</td></tr>
<tr><td>6</td><td>Total interest paid during period</td><td>?</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Create Excel data and perform EMI estimator</td>
</tr>
<tr>
<td>6</td>
<td>Create a supplier database of 10 records with SUPPLIER_ID as primary key, SUPPLIER_NAME, PRODUCTS, QUANTITY, ADDRESS, CITY, PHONE_NO and PINCODE, Where SUPPLIER_NAME, PRODUCTS, QUANTITY and PHONE_NO should not be NULL.</td>
<td>SQL</td>
<td>Creating Tables</td>
</tr>
<tr>
<td>7</td>
<td>Create the customer database of a big Market with CUSTOMER_ ID as primary key, CUSTOMER_NAME, PHONE_NO, EMAIL_ID, ADDRESS, CITY and PIN_ CODE. Store at least twenty customer’s details where CUSTOMER_NAME and PHONE_NO are mandatory and display the customer data in alphabetical order.</td>
<td>SQL</td>
<td>Creating and retrieving Tables</td>
</tr>
<tr>
<td>8</td>
<td>Apply the linear regression, compare the average salaries of batsman depending on the run rate scored/ recorded in the matches. Assume your own database.</td>
<td>MS Excel</td>
<td>Apply Linear regression</td>
</tr>
<tr>
<td>9</td>
<td>Apply Multiple linear regression to predict the factory products which is A, B and C are independent variables and cost dependent variable.</td>
<td>MS Excel</td>
<td>Apply Linear regression</td>
</tr>
<tr>
<td>10</td>
<td>Logistic Regression-case study</td>
<td>MS Excel</td>
<td>Apply Logistic regression</td>
</tr>
<tr>
<td>11</td>
<td>Design the ER diagram and create schema of the REVA library Management system.</td>
<td>Entity Relationship</td>
<td>Entity Relationship</td>
</tr>
</table>

12	form Exploratory Data Analysis to predict customer churn in telecommunications company using Python libraries such as Pandas, and Matplotlib to aid in this process? (Use datasets from Kaggle/NCBI.)	Jupyter/Colab - Python	Apply Exploratory Data Analysis

PART_B:Projects

No	Title of the Experiment	Tools and Technics	Expected Skill/Ability
1	Big Mart sales forecasting	MS Excel	Apply Linearregression
2	Bangalore crime analysis	MS Excel	Apply Linearregression

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publishers, 2015.
2. Ramakrishnan and Gehrke, "Database Management systems", 3rd Edition, McGraw Hill Publications, 2003.
3. "Mastering Data Analysis in Excel" - https://www.coursera.org/learn/analytics-excel.
4. Kenneth N. Berk, Carey, "Data Analysis with Microsoft Excel", S. Chand & Company,2004.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", 19th edition, Tata McGraw Hill Publications, 2013.
2. ErwinKreyszig, "Advanced Engineering Mathematics", 9th edition, Wiley Publications, 2013.
3. Seymour Lipschutz, John J. Schiller, "Schaum's Outline of Introduction to Probability and Statistics", McGraw Hill Professional, 1998.

JOURNALS/MAGAZINES:

1. https://www.journals.elsevier.com/computational-statistics-and-data-analysis
2. https://www.springer.com/journal/41060 International Journal on Data Science and Analytics
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8254253 IEEE Magazine on Big data and Analytics

Course Title	Basics of Electrical & Electronics Lab				Course Type		HC	
Course Code	B22EE0102	Credits	1		Class		I Semester	
Course Structure	LTP	Credits	Contact	Work	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**50%**	**50%**

COURSE OVERVIEW

Basic Electrical & Electronics Engineering lab covers the concept of various types of electrical apparatus, tools and conduction of experiments to Analyze, Design of KCL & KVL, two-way switch or staircase wiring, Determination of VI characteristics Zener Diode, Silicon Diode, Half Wave rectifier using Diode, study& analyses of Lead & lag component, verification of logic gates.

COURSE OBJECTIVES

The objectives of the course are to

1. Establish a broad concept of various types of electrical apparatus, tools and instrumentation.
2. Provide hands on experience with electrical apparatus and electrical safety norms.
3. Train students to read and understand schematics so as to make electrical connection for different appliances.
4. Train students in collecting and interpreting experimental data.
5. Enhance written skills of students.

COURSE OUTCOMES (CO'S)

On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	PO's	PSO's
CO-1	Use appropriate electrical tools for electrical connections and repair of electrical equipment's.	1,2,4,5,9,10	1
CO-2	Recognize various symbols in a schematic and make connection as per the schematic	1,2,9,10	1
CO-3	List out various safety procedures	4,5,9,10	1
CO-4	Make use of various measuring instruments to collect experimental data	2,4,9,10	1
CO-5	Analyse the results obtained from experiments.	2,3,9,10	1
CO-6	Demonstrate the ability to critically evaluate the performance of electrical appliances.	1,2,9,10	1

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3		3	3				3	3			1		
CO-2	3	3							3	3			1		
CO-3				3	3				3	3			1		
CO-4		3		3					3	3			1		
CO-5		3	2						3	3					
CO-6	3	2							3	3					

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

List Experiment

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	To verify KCL and KVL	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
2	Study and Analysis of Lead & Lag networks by using R-C components.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
3	Two-way switch/ staircase wiring. To study & verify the connection procedure for two-way switch or staircase wiring	Two-way switch or staircase wiring Kit	Connection, Working & application of Two-way switch
4	Study and analysis the Characteristics: light sensor and temperature sensor	Sensor kit	Characteristics of sensors
5	Study and analysis of V-I Characteristics of Zener PN Junction diodes (Both Forward and Reverse Characteristics).	VI characteristics of Zener Diode kit	VI characteristics of Zener Diode
6	Study and analysis of Transistor as switch	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
7	Design half wave, Full wave-center tap and Bridge rectifier with and without capacitive filter and measure efficiency and ripple factor.	Rectifier kit	Determine the efficiency, Voltage regulation, ripple factor of rectifiers
8	Design of Clippers and clampers with reference voltages	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
9	Study and analysis of input output characteristic of CE configuration of BJT.	Characteristics of BJT in Common Emitter Configuration	Input & Output Characteristics of BJT
10	Verification of basic logic gates using discrete components	Trainer kit	Universal gates will be realized using basic gates

Demo:

1. To Study the importance of Earthing during accidental shorting of line wire and the body of equipment.
2. To study the Importance and mechanism of MCB.

TEXT BOOKS

1. Nagrath I.J. and D. P. Kothari, “Basic Electrical Engineering”, Third Edition Tata McGraw Hill, 2009.
2. Hayt and Kimberly, “Engineering Circuit Analysis”, 8th Edition, Tata McGraw Hill, 2013.
3. Kulshreshtha D.C., “Basic Electrical Engineering”, Tata McGraw Hill, 2009.
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall, India, 2009.

REFERENCE BOOKS

1. Theodore Wildi, “Electrical Machines, Drives, and Power, 5thSystems”, Pearson Edition, 2007.
2. Hughes, “Electrical Technology”, International Students 9th Edition, Pearson, 2005.

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/108108076
2. https://nptel.ac.in/courses/108101091
3. https://www.udemy.com/course/basic-electrical-engineering-part-1

	Course Code	Title of the Course	HC/FC / SC/OE /MC	Credit Pattern				Contact Hours / Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B23AS0203	Probability and Statistics	FC	3	0	0	3	3	50	50	100	BSC
2	B23AS0104	Engineering Chemistry	FC	3	0	0	3	3	50	50	100	BSC
3	B22AH0103	Communication Skills	FC	0	0	1	1	2	25	25	50	HSMC
4	B22CI0104	Programming with C	HC	3	0	0	3	3	50	50	100	ESC
5	B22ME0103	Elements of Mechanical Engineering	HC	3	0	0	3	3	50	50	100	ESC
6	B22EN0101	IoT and Applications	HC	1	0	1	2	3	50	50	100	ESC
7	B23ME0102	Innovation & Entrepreneurship	FC	1	0	1	2	3	50	50	100	HSMC
8	B22AS0105	Engineering Chemistry Lab	FC	0	0	1	1	2	25	25	50	BSC
9	B22CI0108	Programming with C Lab	HC	0	0	1	1	2	25	25	50	ESC
10	B22ME0104	Engineering Workshop	HC	0	0	1	1	2	25	25	50	ESC
11	B22CS0201	Skill Development Course-1	SDC	0	0	2	2	4	50	50	100	SDC
12	B22ME0105	Tree Plantation in Tropical Region: Benefits and Strategic Planning	FC	1	0	0	1	1	25	25	50	HSMC
TOTAL				**15**	**0**	**8**	**23**	**30**	**475**	**475**	**950**	
TOTAL SEMESTER CREDITS				**23**								
TOTAL CUMULATIVE CREDITS				**44**								
TOTAL CONTACT HOURS				**30**								
TOTAL MARKS				**950**								

Title	Probability and Statistics				Course Type	FC
Course Code	B23AS0203	Credits	3		Class	II semester
	LTP	Credits	Contact Hours	Work Load	Total Number of	Assessment

Course Structure	Lecture	3	3	3	Classes Per Semester		Weightage	
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50%**

COURSE OVERVIEW:

The course Probability and Statistics for Computer Science treats the most common discrete and continuous distributions, showing how they find use in decision and estimation problems, and constructs computer algorithms for generating observations from the various distributions. Probability in the design and analysis of randomized algorithms. Common randomized algorithms are things like Quicksort and Quickselect. Probabilistic method can also useful to prove various important results. Probabilistic methods used to prove some partition theorems that were then used to create efficient data structure.

COURSE OBJECTIVE (S):

1. Describe Curve fitting and regression in various problems in Computer Science and engineering fields.
2. Illustrate the applications of Probability and statistics in various computer science and engineering Fields like data mining, classification problems etc
3. Discuss Sampling theory concepts to solve various engineering problems like structured and unstructured data models
4. Demonstrate Stochastic problem as Markov model as a problem solving methods for systematic model buildings.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO-1	Solve the problems of Curve fitting and regression in various problems in Computer Science and Engineering fields.	1,2,4	1
CO-2	Apply the concepts of Probability and statistics in various computer science engineering fields like data mining, classification problems etc	1,2,4	1
CO-3	Develop a stochastic problem as Markov model as a problem solving methods for systematic model buildings.	1,2,4	1
CO-4	Make use of sampling theory concepts to solve various engineering problems like structured and unstructured data models.	2,3,4	1
CO-5	Use Discrete time Markov chain to model computer systems.	1,2,4	1
CO-6	Analyse queuing models using queuing theory.	1,2,4	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		1									3		
CO2	3	3		1									3		
CO3	3	3		1									2		
CO4		3		1									1		
CO5	2			1									1		
CO6		3		1									2		

Note: 1-**Low**, 2-Medium, 3-High

COURSE CONTENT
THEORY

Contents

UNIT – 1

Curve Fitting: Curve fitting by the method of least squares and fitting of the curves of the form,
$y = ax + b$, $y = ax^2 + bx + c$, $y = ae^{bx}$ (*$y = ax^b$ and $y=ab^x$)
Statistical Methods: Correlation-Karl Pearson's coefficient of correlation- problems. Regression analysis- lines of regression, problems. Rank correlation.
** ***Application:*** *Curve fitting and statistics for data science*

UNIT – 2

Probability distributions: Random variables, Discrete and continuous probability distributions. Binomial, Poisson, normal distributions (only problems) and *exponential (definition with one /two examples).
** ***Application:*** *Probability distribution in machine learning, Computer vision: object recognition and image segmentation Computer graphics: behaviour of light and other physical phenomena in computer graphics*

UNIT – 3

Joint Probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.
Stochastic processes- Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability-simple problems.
** **Application:** *Stochastic processes and Markov processes in Operating System*

UNIT – 4

Sampling theory: Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution. Chi-square distribution as a test of goodness of fit.
** ***Application**: **S**ampling process in computer graphics, sampling theory in machine learning*

** *Application: (i) Additional information providing to students only for knowledge.*

(ii) Major part of assignments questions chosen from applications.

(iii) Students' presentations/seminars topics chosen from applications.

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", 43rd edition Khanna Publishers, 2015.
2. ErwinKreyszig, "Advanced Engineering Mathematics", 9th edition Wiley Publications, 2013.
3. Seymour Lipschutz, John J. Schiller., "Schaum's Outline of Introduction to Probability and Statistics", McGraw Hill Professional, 1998.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", 19th Reprint edition, Tata McGraw Hill Publications, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", 4th edition, Narosa Publishing House, 2016.
3. V.Sundarapandian, "Probability, Statistics and Queueing theory", PHI Learning, 2009
4. Dr. B. Krishna gandhi, Dr. T.K.V. Iyengar, Dr. M.V.S.S.N. Prasad&S. Ranganatham.,"Probability and Statistics"S. Chand Publishing, 2015.
5. J. K. Sharma "Operations Research theory and applications", 5th edition, Macmillan publishers, ,2013.

JOURNALS/MAGAZINES

1. https://www.hindawi.com/journals/jps/
2. https://www.journals.elsevier.com/statistics-and-probability-letters
3. http://www.isoss.net/japs/

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/data-science/probability-and-statistics
2. https://nptel.ac.in/courses/111/105/111105041/
3. https://onlinecourses.swayam2.ac.in/cec20_ma01/preview

SELF-LEARNING EXERCISES:

1. Curve fitting for application problems, Regression analysis for a bivariate data.
2. Probability distribution- Geometric, gamma- distributions, Joint probability distribution of continuous random variables.
3. Sampling analysis of real time problems. Applications to computer science: Data mining, classification problems etc

LIST OF EXPERIMENTS

EXP. NO.	LIST OF EXPERIMENT
1.	Compute of a Table of Grouped Frequency, Mean, Mode and Median
2.	Compute Variance and Standard Deviation for Grouped Data
3.	Fit a curve for the given data by least square method
4.	Use correlation analysis to determine whether two quantities are related to justify fitting the data.
5.	Generate binomial random variables using the default parameter values, plot its PMF
6.	Generate Poisson random variables using the default parameter values, plot its PMF
7.	Generate normal random variables using the default parameter values, plot its PDF.
8.	Select sample of size n from the population N with replacement, without replacement
9.	Generate random numbers for given sampling distribution by using t distribution
10.	Generate random numbers for given sampling distribution by using Chi-square distribution

Course Title	Engineering Chemistry				Course Type		FC	
Course Code	B23AS0104	Credits	3		Class		II Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50%**

COURSE OVERVIEW:

Engineering chemistry covers very relevant topics compatible with ECE students and make them aware of importance of various aspects of basic science in engineering. The subject of Engineering chemistry covers area of light and matter interaction, clean energy storage and conversion devices, corrosion phenomenon and control which is widely an interdisciplinary subject of discussion. Further the course focus on the chemistry of engineering materials, and various applications. This area of science is very much interdisciplinary in its nature and gives a platform for students to strengthen their engineering knowledge to enlighten on the energy conversion and storage devices, which have become very attractive field of research in engineering stream. The subject deals with various engineering materials, their properties and applications in the field of engineering.

COURSE OBJECTIVE (S):

The Engineering chemistry course is designed to fulfil the following objective;

1. It provide the basic knowledge on Interaction of light and matter to know the electronic transitions in materials and storage and conversion devices.
2. Corrosion and metal finishing, explains the phenomenon of corrosion and its Prevention. It also covers the importance of metal finishing in various industries and fabrication of PCB
3. Polymers are all about the properties of various polymeric materials and their Commercial significance. The chapter reveals about technical and commercial Importance of composite materials.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the phenomenon of light and matter interaction to study the materials	1**,2,3**	1
CO2	Demonstrate the electrochemical processes & illustrate the method of preparation of solar grade silicon.	1**,2,3,7**	1
CO3	Select different materials in controlling the corrosion & fabrication of printed circuit boards (PCB).	1**,2,3,7**	1
CO4	Illustrate the properties of polymers, nano materials, composite materials and their applications in various fields.	1**,2,3**	1
CO5	Know the doping in photovoltaic devices & applications of Jablonski energy diagram.	1**,2,3,6**	1
CO6	Use of promising materials for electrochemical energy storage and engineering, and environmental remedies.	1**,2,3,7**	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√		√		
CO3		√				
CO4		√				
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**										**1**		
CO2	**2**	**1**	**1**				1						**1**		
CO3	**1**	**2**	**1**				1						**1**		
CO4	**3**	**2**	**1**										**1**		
CO5	2	2	1			1							**1**		
CO6	3	2	1				1						**1**		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT - 1
Light and Matter Interaction Electro-magnetic spectrum-Applications in Engineering, Interaction of EM radiation with matter, work function of matter, Electrons in matter. Bonding theories: MOT, Band structure of matters HOMO-LUMO. Photochemical and thermal reactions: Laws of photochemistry, quantum yield, high and low quantum yield reactions. Jablonski diagram – photo physical and photochemical processes, photo-sensitization, photo- polymerization and commercial application of photochemistry.
UNIT - 2
Clean Energy Storage and Conversion Devices Introduction to electrochemistry, basic concepts of Batteries and characteristics. Classification: Primary (Dry cell, Li-MnO_2) and Secondary (Pb-acid, Li-ion) batteries. Super capacitors: classification, construction and applications in hybrid **vehicles**. Fuel cells: Alkaline fuel cells, Solid oxide fuel cells and phosphoric acid fuel cell. Photo-conversion devices: Photovoltaic cell and antireflective coating. Production of single crystal semiconductor by Crystal pulling technique (Czochralski technique), difference between single and polycrystalline materials, zone refining process of Si.

UNIT - 3

Concepts of Corrosion

Thermodynamics and Kinetics of electrochemical corrosion – Theory for corrosion, galvanic series, thermodynamics aspects of corrosion reactions, Nernst equation, dry and wet corrosion and the cell formation, potential- pH diagram (Fe and Al), kinetics of corrosion reactions, Over voltage, polarization, passivity, immunity.

Types of corrosion – Galvanic corrosion, pitting, crevice corrosion, and intergranular corrosion.

Corrosion control – Cathodic protection (Sacrificial anode and impressed current methods), Anodic protection. Protective coatings – Metal coatings (hot dip: tinning and galvanizing), spray techniques, role of inhibitors. Metal finishing: Introduction, technological importance. Electroplating: Variables of electroplating bath, Electroplating of Gold. Electroless plating: Distinction between electroplating and electroless plating processes. Electroless plating of copper and applications.

UNIT – 4

Chemistry of Engineering Materials

Polymer composites: Carbon fiber, Kevlar synthesis and applications, Conducting polymers: synthesis, electron transport mechanism and applications in poly acetylene and poly aniline. **Liquid crystals:** Introduction classification and applications in electronic display devices. **Nano materials:** Introduction, classification based on dimensionality, quantum confinement. Size dependent properties- surface area, magnetic properties (GMR phenomenon), and thermal properties. Synthesis, Properties and applications of Fullerenes, CNT and Graphene.

Sensors: Physical and chemical sensors, Biosensors for bio electronic applications.

Text Books:

1. Jain and Jain, “Engineering Chemistry”, Dhanapat Rai Publications, 16th Edition, 2015.
2. SS Dara and SS Umare,” Engineering Chemistry,”S. Chand Publications, 17th Edition, 2014.
3. R.V. Gadag & Nithyananda Shetty, “Engineering chemistry”, Ik International Publishing house, 3rd Edition, 2014.

Reference Books:

1. Fontana. M.G., “Corrosion Engineering”, Tata McGraw Hill, 3rd Edition, 2005.
2. Charles P. Poole Jr and Frank J. Owens,” Introduction to Nanotechnology”, Wiley-Interscience, 1st edition, 2003.
3. V.R. Gowrikar, N.N. Vishwanathan and J. Sreedhar,” Polymer chemistry”, NEW AGE International Pvt Ltd, 2021.

JOURNALS/MAGAZINES:

https://www.sciencedirect.com/journal/water-science-and-technology

https://iwaponline.com/wst

https://www.scitechnol.com/nanomaterials-molecular-nanotechnology.php

https://www.journals.elsevier.com/journal-of-energy-storage

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/105/105/105105201/
2. https://nptel.ac.in/courses/112/108/112108150/

Course Title	Communication Skills				Course Type		FC	
Course Code	B22AH0103	Credits	1		Class		II Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**28**	**0**	**50%**	**50%**

Course Description: This course is aimed to develop basic communication skills in English in the learners, to prioritize listening and reading skills among learners, to simplify writing skills needed for academic as well as workplace context, to examine that the learners use the electronic media such as internet and supplement the learning materials used in the classroom.

COURSE OBJECTIVE (S):

The Course objectives are to

1. Develop basic communication skills in English.
2. Emphasize the development of speaking skills amongst learners of Engineering and Technology
3. Impart the knowledge about the use of electronic media such as the internet and supplement the learning materials used in the classroom.
4. Inculcate the habit of reading and writing leading to effective and efficient communication.

COURSE OUTCOMES: (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate speaking ability with clarity, confidence, and comprehension an communicate with one or many listeners using appropriate communicative strategie (Speaking Skills).	10	
CO2	Develop the ability to write cohesively, coherently, and flawlessly avoidin grammatical errors, using a wide vocabulary range, organizing their ideas logically o a topic (Writing skills).	10	
CO3	Make use of reading different genres of texts by adopting various reading strategie (Reading Skills).	10	
CO4	Take part in interviews confidently and develop accurate writing skills.	10	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1	√	√				
CO2	√	√				
CO3	√	√				
CO4	√	√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1										3					
CO2										3					
CO3										3					
CO4										3					

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT – 1 **Functional English:** Language as a Tool of Communication, - Effective Communication-Modes of Communication- Email communication - Giving Instructions.
UNIT – 2 **Interpersonal Skills:** Traits of good Listener types of Listening-- Formal letters (Accepting/ inviting/ declining); Personal letters (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends/relatives, - Process descriptions (general/specific).
UNIT - 3 **Multitasking Skills:** Types of Speaking- Paralinguistic Features-Types of paragraphs (cause and effect / compare and contrast / narrative / analytical); Report Writing (Feasibility/ Project report - report format – recommendations/ suggestions, PPT).
UNIT – 4 **Persuasive Skills:** Reading and Interpretation- SQ3R- Making inference from the reading passage; predicting the content of a reading passage, - Different types of Essay Writing, applying for a job; Writing a cover letter with résumé / CV.

Text Books:

1. Thorpe, Edgar and Showick Thorpe" Objective English". Pearson Education, 2013.
2. Dixson, Robert J. "Everyday Dialogues in English". Prentice Hall India Pvt Ltd., 1988.
3. Turton, Nigel D. "ABC of Common Errors" Mac Millan Publishers, 1995.
4. Ashraf Rizvi, "Effective Technical Communication" McGraw-Hill Education (India) Pvt. LTD., New Delhi, 2018.

Reference Books:

1. Bansal, R.K. and J.B. Harrison. Spoken English. Orient Blackswan, 2013.
2. 2.Raman, Meenakshi and Sangeeta Sharma. Technical Communication. Oxford University Press, 2015.
3. 3.Samson, T. (ed.) Innovate with English. Cambridge University Press, 2010.

Course Title	Programming with C				Course Type		HC	
Course Code	B22CI0104	Credits	3		Class		II Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	-	-	-				
	Total	3	3	3	42	-	**50%**	**50%**

COURSE OVERVIEW:

Algorithms and flowcharts are the fundamental tools for problem solving which can be used by the computers. The computer programs can be developed using algorithms and flowcharts to provide solutions to problems. C Language is a general-purpose, structured and procedure oriented programming language. It is one of the most popular computer languages today because of its structure and higher-level abstraction C. This course introduces algorithms, flowcharts and various C Programming language constructs for the development of real world applications.

COURSE OBJECTIVE (S):

The objectives of this course are to

1. Explain algorithms, flowcharts and different programming constructs of C to be used for Development of applications.
2. Illustrate the use of iterative statements and conditional Statements for solving the real world problems.
3. Demonstrate the use of functions with parameter passing mechanisms for solving the real world problems.
4. Discuss the use of structures, unions, pointers and file operations for solving the real world Problems.
5. Learn new algorithms and technologies in C Programming and apply for suitable application development.
6. Develop solutions by using C Programming to the complex problems, either individually or as a part of team and report the results.

COURSE OUTCOMES (COs)

On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the programming constructs of C language to solve a given problem.	1-3	1
CO2	Apply the concepts of matrices to develop data processing and analysis solutions in various application domains.	1-5	1
CO3	Develop text processing based applications using string operations.	1-3,5	2,3
CO4	Create solutions for real world problems using Pointers, Union, Structures and file operations.	1-5	2,3
CO5	Use algorithms and technologies in C Programming for suitable application development	1-5	2,3
CO6	Develop solutions by using C Programming to the complex problems, either individually or as a part of the team and report the results	1-5,9	2,3

BLOOM'S LEVEL OF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1				✓		
CO2			✓			
CO3			✓			

CO4						✓
CO5		✓	✓			
CO6						✓

COURSE ARTICULATIONMATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3										3		
CO2	1	3	2	2	2								3		
CO3	2	2	2		1									3	3
CO4	3	3	3	1	1									3	3
CO5	3	3	3	2	2										
CO6	3	3	3	2	2				3				3	3	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT-1
Algorithm: Definition, Purpose of writing an algorithm, Rules for writing an algorithm, Advantage of writing algorithm and examples. Flowchart: Definition, Notations used to write a flow chart, Advantage and disadvantages of writing the flowchart and examples. Introduction to "C": Introduction to GitHub, Structure of C program with example, C language & its features, C tokens, data types in C, variables, constants, input and output functions
UNIT-2
Operators and Expressions: Unary operator, assignment operator, arithmetic operator, relational operators, logical operators &bitwise operator, conditional operator, increment and decrement operator, special operator. Conditional Statements: if statement, if-else statement, nested if, switch statement. Unconditional Statements: break and continue statement, goto statement, return statement Iterative Statements (loops): while loop, do-while, for loop, differences between while, do-while and for loop.
UNIT-3
Arrays, functions & Strings: one dimensional array, two dimensional array, Linear and binary search and bubble sorting. Functions: Structure of a function, types of functions, parameter passing mechanisms, Command line arguments. Strings: string operations with and without using inbuilt string functions.
UNIT-4
Structures & Union: Derived types- structures- declaration, definition and initialization of structures, accessing structures, neste structures, arrays of structures, union, typedef. Pointers: Introduction to pointers. File Operations: Formatted Input & Output, Character Input and Output Functions, Direct Input and Output Functions, File Positioning Functions, Error Functions

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, PRENTICE HALL
2. SOFTWARE SERIES, 2005.
3. Herbert Schildt, "C: The Complete Reference", 4th edition, TATA McGraw Hill, 2000.
4. B.S. Anami, S.A. Angadi and S. S. Manvi, "Computer Concepts and C Programming: A
5. Holistic Approach", second edition, PHI,2008.

REFERENCE BOOKS:

1. Balaguruswamy," Programming in ANSI C", 4th edition, TATA MCGRAW Hill, 2008.
2. Donald Hearn, Pauline Baker," Computer Graphics C Version", second edition, Pearson Education, 2004.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6294 (IEEE Journal/Magazine on IT Professional)
2. https://ieeexplore.ieee.org/document/1267572 (IEEE Computing in Science and Engineering)

SWAYAM/NPTEL/MOOCs:

1. https://online courses.nptel.ac.in/noc20_cs06/preview (Problem Solving through Programming in C)
2. https://www.edx.org/course/c-programming-getting-started (C Programming Getting started)
3. https://www.coursera.org/specializations/c-programming (Introduction to C programming)

SELF-LEARNINGEXERCISES

1. **Fundamentals of computer graphics**: output primitives–Line, Circle and Ellipse drawing algorithms- Attributes of output primitives.
2. **Inline Assembly Language Program:** Simple inline assembly, Extended Assembly Syntax Microsoft C Compiler.

Course Title	Elements of Mechanical Engineering				Course Type		HC	
Course Code	B22ME0103	Credits	3		Class		II Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50%**

COURSE OVERVIEW

Elements of Mechanical Engineering is a basic course of Mechanical Engineering discipline. It focuses on overall view of mechanical engineering area's like thermal, design and manufacturing streams. The course is designed to understand basic concept like formation of steam and compute the steam properties like specific volume, enthalpy, and internal energy using steam tables. The students are introduced to internal combustion engines, turbines (water, steam and gas) and refrigeration-air conditioning system. The students will be imparted to calculate BP, IP, mechanical efficiency of IC engines. The students are exposed to the machine elements like springs, belt drives and gear drives. Acquainted with different machine tools like lathe, drilling machines and CNC machines. The students will be exposed to joining processes like Soldering, Brazing and Welding and various power transmission systems. Students are introduced to the engineering materials and modern manufacturing Technology like 3D printing technology.

COURSE OBJECTIVES

The objectives of this course are to

1. Develop the basic knowledge on heat & work, steam formation, working principle of boilers, turbines, IC engines and refrigeration - air conditioning systems.
2. Incorporate the concept of different types of machine elements like springs, belt drives & chain drives.
3. Give exposure in the field of engineering materials and manufacturing processes.
4. Incorporate the concepts of modern manufacturing processes like CNC, 3D printing technology and its applications
5. Acquire a basic understanding role of Mechanical Engineering in the industry and society.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Evaluate the properties of steam and performance parameters of IC engines.	1, 2	1,2
CO2	Describe the working principle of boilers, turbines, refrigeration and air conditioning systems	1	1
CO3	Classify the engineering materials and discuss the concept of casting, CNC machine, laser engraving and 3D printing technology.	1	1
CO4	Compare the different kinds of machine tools and select the suitable machine tool for processing the materials and different metal joining process for the different applications	1,2	1,2
CO5	Discuss the application of machine elements and Calculate the speed ratio of belt drives and Gear Drives.	1,2	1,2
CO6	Describe the need of mechatronics approach in industry and application of robots.	1	1

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1											**1**		
CO2	2												1		
CO3	2												1		
CO4	3	1											1	1	
CO5	3	1											1	1	
CO6	1												1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT-1
Introduction to Energy Systems: Concept of heat and work, Steam formation, Types of steam, Steam properties, numerical on steam properties, Introduction to boilers, working of Babcock and Wilcox boiler.
UNIT-2
Prime Movers: Types and working principle of turbines, IC Engines, numerical on IC engines. **Introduction to Refrigeration and Air Conditioning:** Working principle of refrigeration system, working of domestic refrigerator and window air conditioner
UNIT-3
Materials and Manufacturing Processes: Introduction to engineering materials and classifications, casting, Machine Tools- lathe & drilling machine, metal joining process-welding, brazing and soldering, modern manufacturing technology-CNC machines, laser engraving and 3D printing.
UNIT-4
Machine Elements: Types and applications of springs, belt drives, gear drives and chain drives, numerical on belt drives and gear trains. **Introduction to Mechatronics and Robotics:** Need of Mechatronics in industries, measurement system, open and closed loop control system, Robot anatomy, applications of Robotics.

TEXT BOOKS

1. K R Gopala Krishna, Sudheer Gopala Krishna and S C Sharma, “Elements of Mechanical Engineering”, Subhash Publishers, 13th Edition, 2015.

2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, 2000.

REFERENCE BOOKS

1. SKH Chowdhary, AKH Chowdhary and Nirjhar Roy, “The Elements of Workshop Technology - Vol I & II”, Media Promotors and publisher, 11th edition, 2001.
2. William Bolton, “Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering”, Pearson, 2015.
3. K. K. Appukuttan, “Introduction to Mechatronics”, Oxford University Press, 2007.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture

2. International Journal of Refrigeration.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering

Course Title	IoT and Applications				Course Type		HC	
Course Code	B22EN0101	Credits	2		Class		II Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-				
	Practical	1	2	2	Theory	Practical	CIE	SEE
	Total	**2**	**3**	**3**	**14**	**28**	**50%**	**50%**

COURSE OVERVIEW:

The Internet of Things (IoT) expands access to the world-wide web from computers, smart phones, and other typical devices to create a vast network of appliances, toys, apparel, and other goods that are capable of connecting to the Internet. This introductory course focuses on IoT architecture, its domains and communication protocols. The course is supported with hands on sessions that incorporates different types sensors interfaced with IoT board to build IoT projects to solve real time problems. The case study of deployment of IoT in various applications are provided.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the architecture of Internet of Things.
2. Inculcate knowledge of IoT devices, Sensors and Communication Protocols in various application domains.
3. Gain expertise in interface of various sensors to IoT Boards.
4. Discuss the various applications of IoT.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the component of IoT architecture	1,2,3,4,5	1,2
CO2	Interpret various Applications of IoT	1,2,3,4,5	1,2
CO3	Identify IoT development boards, sensors & actuator	1,2,3,4,5	1,2
CO4	Identify communication technologies, protocols, and cloud services	1,2,3,4,5,9,10	1,2
CO5	Demonstrate the interfacing of sensors & actuators to IoT board	1,2,3,4,5,9,10	1,2
CO6	Develop simple IoT projects and modules	1,2,3,4,5,9,10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√	√			
CO3	√	√	√			
CO4	√	√	√	√		
CO5	√	√	√	√		
CO6	√	√	√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1								3	3	
CO2	2	3	1	1	1								3	3	
CO3	3	2	1	1	3								2	2	
CO4	3	2	1	1	3				2	2		2	1	1	
CO5	3	1	2	1	2				2	2		2	2	1	
CO6	3	2	2	1	2				2	2	2	2	1	1	

Note: 1-Low, 2-Medium, 3-High

Course Content Theory:

Contents
UNIT – 1
IoT Basics Previous technologies before IoT, Introduction to IoT, How IoT works, Components of IoT Infrastructure, Basic elements of general IoT Architecture, Characteristics of IoT, benefits and challenges of IoT, Applications of IoT.
UNIT – 2
IoT Enabling Technologies IoT Development Boards: Arduino, Add-on ESP module, Node MCU, Raspberry Pi; Sensors and Actuators: Temperature Sensor, PIR Sensor, Ultrasonic senor; Communication Technologies: Bluetooth, ZigBee, LoRa, WiFi, Cellular; Protocols: HTTP, MQTT, CoAP; IoT Cloud Platforms: Arduino Cloud, Thing Speak, Blink Cloud

PRACTICE:

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
	Introduction to Arduino Board & getting stared with Arduino IDE software	Hardware & software	Identifications of various parts of Arduino
1	Write a program to blink an LED a) Infinite number of times with ON & OFF duration of 1 sec b) infinite number of times with ON time duration 2 sec and OFF time duration 0.5 sec c) Only 3 times with ON and OFF duration 2 sec	Arduino UNO, Arduino IDE, LED's	Arduino coding
2	Write a program to blink 4 LED in the given pattern Pattern: L1 L2 L3 L4 ON OFF OFF OFF ON ON OFF OFF ON ON ON OFF ON ON ON ON OFF ON ON ON OFF OFF ON ON OFF OFF OFF ON OFF OFF OFF OFF Pattern: L0 L1 L2 L3 ON OFF OFF OFF ON ON OFF OFF ON ON ON OFF ON ON ON ON ON ON ON OFF ON ON OFF OFF ON OFF OFF OFF OFF OFF OFF OFF	Arduino UNO, Arduino IDE, LED's	Arduino coding, Looping structure

3	Write a program to blink an LED with different times and duration using the concept of user defined function	Arduino UNO, Arduino IDE, LED's	Arduino coding, user define function
4	Write a program to interface motion sensor and display its status using g LED. If motion is detected it turn on LED otherwise keeps the turn off the LED.	Arduino UNO, Arduino IDE, LED, PIR sensor	Interface PIR sensor
5	a) Write a program to increase and decrease the brightness of LED. b) Write a program to control the brightness of LED using	Arduino UNO, Arduino IDE, LED, Potentiometer	
6	a) Write a program to interface LDR to Arduino board and display the voltage across LDR on serial monitor b) Write a program to control the brightness of LED based on the intensity of light on LDR	Arduino UNO, Arduino IDE, LED, LDR	Interface LDR sensor
7	a) Write a program to interface temperature sensor and display the values on the serial monitor b) Write a program display range of temperature on LCD	Arduino UNO, Arduino IDE, LCD, Temperature sensor	Interface Temperature sensor
8	Write a program to interface ultrasonic sensor and display the distance from an object.	Arduino UNO, Arduino IDE, Ultrasonic sensor	Interface Ultrasonic sensor
	Challenging Experiments		
9	a) Introduction to ESP module & programming using Arduino IDE software b) Write a program to demonstrates how to use Wifi module ESP8266-01 to blink LED (with simple LED)	ESP8266 Arduino Uno, LED, Arduino IDE	Interface of LED to ESP Module, Program ESP using Arduino IDE
10	Write a program to demonstrate how ESP8266 can be used as an HTTP client and HTTP server to control and monitor the status of an LED	ESP8266, Arduino Uno, LED, Arduino IDE	Understand about Client Server Model
11	Write a program demonstrate how ESP8266 can be used as HTTP Webserver and get commands from the client (mobile/Laptop) directly.	ESP8266, Arduino Uno, LED, Arduino IDE	Understand about Client Server model, Create Webserver
12	Write a program to demonstrate how to implement Publisher/Subscriber method (MQTT) to control and monitor the ESP8266 GPIO2 LED	ESP8266, Arduino Uno, LED, Arduino IDE	Understand about Publisher/Subscriber Model
13	Write a program to demonstrate how ESP8266 can be used to log sensor data into thinkspeak cloud.	ESP8266, Arduino Uno, LED, Arduino IDE, ThingSpeak Cloud Service	Connect to cloud and storing data.
Part-B (Case Study/ Projects - Sample Topics)			

1. **IoT based Automated Table Lamp** 2. **IoT based Light Dimmer and Speed Controller** 3. **IoT based Energy Monitor and Over Current Cut-off** 4. **IoT based Smart Home Controller Using Blynk** 5. **IoT based Motion Detector Using Cayenne** 6. **IoT based Air Pollution Meter** 7. **IoT based Smart Camera** 8. **IoT based Pet Feeder** 9. **IoT based Electronic Door Opener** 10. **IoT based Underground Cable Fault Detector** 11. **IoT based Air & Sound Pollution Monitoring System** 12. **IoT based Weather Reporting System** 13. **IoT based Toll Booth Manager System** 14. **IoT based Heart Attack Detection & Heart Rate Monitor** 15. **IoT based Person/Wheelchair Fall Detection** 16. **IoT based Water Quality Monitoring System**	17. **IoT based Patient Health Monitoring** 18. **IoT based Garbage Monitoring System** 19. **IoT based Liquid Level Monitoring System** 20. **IoT based Biometric Attendance System** 21. **IoT based Irrigation Monitoring & Controller System** 22. **IoT based Gas Pipe Leakage Detector** 23. **IoT based Alcohol & Health Monitoring System** 24. **IoT based Streetlight Controller System** 25. **IoT based Traffic Signal Monitoring & Controller System** 26. **IoT based Fire Department Alerting System** 27. **IoT based Antenna Positioning System** 28. **IoT based Garbage Monitoring with Weight Sensing** 29. **IoT based Colour Based Product Sorting Machine** 30. **IoT based Smart Mirror with News & Temperature** 31. **IoT based Car Parking System** 32. **IoT based Automatic Vehicle Accident Detection and Rescue System**

TEXTBOOKS:

1. Vijay Madisetti, Arshdeep Bahga , “Internet of Things: A Hands-On- Approach “ Second edition 2014, ISBN: 978 0996025515.

REFERENCE BOOKS:

1. Raj Kamal,” Internet of Things: Architecture & design Principle”, McGraw Hill Education 2017.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/learn/iot
2. https://www.coursera.org/learn/interface-with-arduino

Course Title	Innovation & Entrepreneurship				Course Type		FC	
Course Code	B23ME0102	Credits	2		Class		II Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	**2**	**3**	**3**	**14**	**28**	**50%**	**50%**

COURSE OVERVIEW

NEN Ignite is an entrepreneurship program based on experiential learning that aims to support startups' founders through a structured pathway from Idea Discovery to Pitch Deck. A 14 weeks, 36-42 hours of classroom/digital, highly experiential and practice based entrepreneurship training Course, by Wadhawani Foundation and will be delivered by WF facilitators / NEN Trained Entrepreneurship Faculty.

COURSE OBJECTIVES

The objectives of this course are to:

1. Discover an entrepreneurial opportunity
2. Articulate a compelling value proposition
3. Build a sustainable business model and business plan
4. Create and validate an MVP with potential customers
5. Select an appropriate Go-to-Market Strategy
6. Pitch the business idea to different stakeholders

COURSE OUTCOMES (CO'S)

On successful completion of this course; the student shall be able to:

CO	Course Outcomes	POs	PSOs
CO1	Identify the different aspects that can impact their business	**3,9,10,11,12**	**1**
CO2	Acquire in-depth knowledge about tools to build any business idea	**3,9,10,11,12**	**1**
CO3	Acquire in-depth knowledge about the different growth tools to grow their business.	**3,9,10,11,12**	**1**
CO4	Create a financial plan for their business	**3,9,10,11,12**	**1**
CO5	Create a pitch deck for their business and present it to different stakeholders	**3,9,10,11,12**	**1**

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			**2**						**2**	**2**	**3**	**2**	**2**		
CO2			**2**						**2**	**2**	**3**	**2**	**2**		
CO3			**2**						**2**	**2**	**3**	**2**	**2**		
CO4			**2**						**2**	**2**	**3**	**2**	**2**		
CO5			**2**						**2**	**2**	**3**	**2**	**2**		

Contents:

UNIT -1

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioural; entrepreneurial challenges. Taking product or service ideas to creating value: Why should one choose to become an entrepreneur, Entrepreneurial mind-set, Intrapreneurship.

Orientation for WE Ignite program, Ice Breaking session, self-work Instructions and timelines Platform Demo Introduction to Ignite program flow and milestones , Introduction to Entrepreneurship and Human centred Approach to Design Thinking , Are you enterprising?. New generations of entrepreneurship viz. social entrepreneurship, Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship etc., Barriers to entrepreneurship, Creativity and entrepreneurship, Innovation and inventions, Skills of an entrepreneur, Decision making and Problem Solving

100 Rupee Venture; Debrief of Group Activity- Presentation and Sharing Learning Experience

Unit - 2

Entrepreneurial Opportunities: Opportunities. Discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering. Problem Identification and Opportunity Discovery.
Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, Effectuation and Causation
Customer and Markets : Customer Discovery: Exploring Customer Personas & Market Estimation for your Ideas, Create a compelling value proposition & Competitive Advantage

UNIT- 3

Build your MVP : Building a MVP that customers Love
Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analysing business models; Business model canvas, Introduction to lean start-ups, Business Pitching
Business Model: Developing strong business models Create and present your Lean Canvas

Financial Feasibility: Introduction to Business plan and its components; Basics of Finance.

Unit 4

Institutional Support for Entrepreneurship:

Organization Assistance to an entrepreneur, New Ventures, Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) license, Environmental Clearance, National Small Industries Corporation (NSIC), e-tender process, Excise exemptions and concession, Exemption from income tax, The Small Industries Development Bank of India(SIDBI), Incentives for entrepreneurs

Go To market Strategy: Getting products to market: Channels & Strategies; Managing growth and Targeting Scale: Understand the Unit economics for your venture; Funding Strategy: Securing funding for your Startup and Preparing for pitch.

TEXT BOOK:

1.Wadhwani Foundation Curriculum K. Ramachandran, “Entrepreneurship Development”, Tata Mc. Graw Hill, 2008

2.Sangeeta Sharma, “Entrepreneurship Development” PHI Publications, 2016

REFERENCE BOOKS:

1.Baringer and Ireland, “Entrepreneurship”, Pearson, 11th Edition, 2020.

2.Drucker F Peter: “Innovation and Entrepreneurship”, 1985.Heinemann, London.

3.Doanld F Kuratko & Richard M Hodgeth, “Entrepreneurship in the New Millennium”, India Edition - South-Western,

4.Cengage Learning Entrepreneurship –by Robert D. Hisrich (Edition-9)

5.Entrepreneurship- Theory, Process & Practice –by Kuratko & Hodgetts, Thompson South-Western Publication

6.Technology Entrepreneurship Taking Innovation to the Marketplace – by Thomas N. Duening, Robert D. Hisrich and Michael A. Lechter, Elsevier

JOURNALS/MAGAZINES

1. International Small Business Journal: **https://journals.sagepub.com/home/isb**

2. Journal of Development Entrepreneurship: **https://www.worldscientific.com/worldscinet/jde**

SWAYAM/NPTEL/MOOCs:

1.Entrepreneurship: **https://nptel.ac.in/courses/110/106/110106141/**

Course Title	Engineering Chemistry Lab				Course Type		FC	
Course Code	B22AS0105	Credits	1		Class		II Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practice	CIE	SEE
	Practice	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**50%**	**50%**

COURSE OVERVIEW:

Engineering chemistry LAB covers very relevant experiment which is related to the topics compatible with ECE students and make them aware of importance of various aspects of basic science in engineering. The practice gives insights on areas of light and matter interaction, optical properties of materials, clean energy, electrical conduction in solutions, corrosion phenomenon and control which is widely an interdisciplinary subject of discussion. Further the course focus on the chemistry of engineering materials, and various applications. This area of science is very much interdisciplinary in its nature and gives a platform for students to strengthen their engineering knowledge to enlighten on the importance of science which very essential for research in engineering stream.

COURSE OBJECTIVE (S):

The Engineering chemistry lab course is designed to fulfil the following objective;

Engineering chemistry lab covers the very basic knowledge and experimental required for engineering students to understand its importance of Science in technology.

1. It provide the basic knowledge and experimental skill on Interaction of light and matter to know the electronic transitions in materials and storage and conversion devices.
2. Corrosion and metal finishing, explains the phenomenon of corrosion and its Prevention. It also covers the importance of metal finishing in various industries and fabrication of PCB.
3. Electrochemical methods will be used to fabricate materials as thin films and various sensing techniques for lab analysis
4. Preparation of semiconducting and conducting materials, polymers and understand their Commercial significance.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Estimate the amount of metal ions present by interaction of light source.	1,2,3,9,10	1
CO2	Demonstrate the electrolytic process in electrochemical cell for the purpose of energy storage and energy conversion devices.	1,2,3,9,10	1
CO3	Describe the corrosion phenomenon and list out various precautions to be taken in the selection of materials in controlling corrosion.	1,2,3,9,10	1
CO4	Preparation of commercially important polymers, Nano materials, composite materials and their applications	1,2,3,9,10	1
CO5	Analyse various water quality parameters in daily life suitable for portability.	1,2,3,8	1

CO6	Preparation of thin film and bulk solid state conductors and semiconductors relevant to device applications	1,2,3,9,10	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2		√		√		
CO3		√			√	
CO4		√				
CO5		√		√		
CO6		√				

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1						3	3			1		
CO2	2	1	2						3	3			1		
CO3	1	2	1						3	3			1		
CO4	2	2	3						3	3			1		
CO5	2	2	2					3	3	3			1		
CO6	1	2	1						3	3			1		

Note: 1-Low, 2-Medium, 3-High

Practice

No	Title of the Experiment	Tools and Technics	Expected Skill/Ability
1	Verification of Beer-Lambert's Law by detection of Copper by spectroscopy.	Calorimeter, Visible spectroscopy, cuvettes	Understand the theory of interaction of light with matter and the electronic transitions in material .Experimentally verify the Beer Lambert law and quantify the amount of substance
2	Estimation of Iron by Potentiometric sensor.	Potentiometer, electrodes, reference electrodes	Understand the theory of potential changes and measure and interpret the potential changes associated with change in chemical composition. This is relevant in electrochemical energy storage and conversion devices like batteries, capacitors, fuel cells
3	Estimation of concentration of acid mixture by Conductometric sensor.	Conductometer, conducting electrolytes	Understand the theory, circuit connection and perform the experiment, Interpret the ionic conductivity in the solution

4	Determination of pH/pKa of solutions using glass membrane electrode sensor.	pH meter, glass electrodes, pH sensing electrochemical cell setup	Understand the electrochemical theory, perform the experiment to sense and evaluate the pH of the give solution. Interpret the importance of pH in engineering materials and their application
5	Faraday's law verification by using Electrodeposition of Cu/Ni/Zn on stainless steel.	DC power supply units, Electrochemical cells, different coating substrate	Understand the theory of soft electrochemical deposition of thin films and perform the experiment on deposition different conductive substrates
6	Determination of percentage of iron in corrosion products.	Ostwald Viscometer	Understand the theory of viscosity and perform the experiment to estimate viscosity of different fluids.
7	Estimation of percentage of Copper in brass alloy by iodometric method	Cu-Zn containing alloy, Iodometric technique	Understand the theory and perform the experiment, collect the data and interpret amount of copper present in the given engineering material
8	Evaluation of Dissolved Oxygen by Winkler's method and hence assessment of quality of water.	Indicators, Industrial and domestic effluents	Understand the theory of Winkler's method and the iodometric estimation.
9	Estimation Of Total Hardness Of Water By Complexometric Method Using EDTA	Hard water, Complexing agents	Understand the theory and perform the experiment to understand and interpret water quality. Devise the easy method for removing the hardness causing agent through complexometry
10	Preparation of semiconducting nanomaterials and characterization.	UV-Vis Spectrophotometer	Understand the theory and perform the experiment to estimate the alkalinity of the industry feed water. Understand the need neutral water, adverse effects of alkaline water
11	Determination of band gap of bulk and Semiconducting materials by UV-Visible spectroscopy.	UV-Visible Spectrophotometer	A better understanding the optical band gap of the materials. Able to perform experiment with UV-Vis spectrophotometer and interpret the spectra and relate with the electronic band structure
12	Synthesis of Conducting Polyaniline from aniline by Chemical method.	Simple oxidation method.	A better understanding of conducting polymers and their relevant applications in devices
13	Preparation of Conducting polyaniline thin film by electro polymerization.	C power supply units, electrochemical reduction techniques, different conducting substrate	To demonstrate the soft and simple electrochemical method for preparation of thin conductive films on desired substrates
14	Preparation of Dye – sensitized solar cell.	FTO, Dyes, Electrolytes, I-V measurement unit, Solar simulation setup	To demonstrate the fabrication of lab scale DSSC and understand the function of photoelectrochemical cell

PART_B: Projects

No	**Title of the Experiment**	**Tools and Technics**	**Expected Skill/Ability**
1	Investigation of ionically conducting media	Conductometer, different ionic conductance media	To demonstrate the effect of ionic conductance and understand the importance in electrochemical energy devices
2	pH and Potentiometric sensor	pH meter, Potentiometer	To demonstrate the effect of pH on engineering materials and the potential changes with change in chemical composition
3	Assembly of energy storage devices	Batteries, DC power supply units	To assemble and perform cell voltage and discharge experiments

Text Books

1. V R Gowariker, N V Viswanathan, Jayadev Sreedhar," Polymer Science", Wiley eastern ltd, 4th Edition, 2021.

2. Sudha Rani, S.K. Bashin, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company; 3rd edition, 2012.

Reference Books:

1. J. Mendham, Vogel's "Quantitative Chemical Analysis", 6th Edition, 2009.

Course Title	Programming with C Lab				Course Type		HC	
Course Code	B22CI0108	Credits	1		Class		II Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	1	2	2				
	Total	1	2	2	-	28	**50%**	**50%**

COURSE OVERVIEW:

Algorithms and flowcharts are the fundamental tools for problem solving which can be used by the computers. The computer programs can be developed using algorithms and flowcharts to provide solutions to problems. C Language is a general-purpose, structured and procedure oriented programming language. It is one of the most popular computer languages today because of its structure and higher-level abstraction C. This course introduces algorithms, flowcharts and various C Programming language constructs for the development of real world applications.

COURSE OBJECTIVE (S):

1. Explain algorithms, flowcharts and different programming constructs of C to be used for Development of applications.
2. Illustrate the use of iterative statements and conditional Statements for solving the real world problems.
3. Demonstrate the use of functions with parameter passing mechanisms for solving the real world problems.
4. Discuss the use of structures, unions, pointers and file operations for solving the real world Problems.
5. Learn new algorithms and technologies in C Programming and apply for suitable application development.
6. Develop solutions by using C Programming to the complex problems, either individually or as a part of team and report the results.

COURSE OUTCOMES (COs)

On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the programming constructs of C language to solve a given problem.	1-3	1
CO2	Apply the concepts of matrices to develop data processing and analysis solutions in various application domains.	1-5	1
CO3	Develop text processing based applications using string operations.	1-3,5	2,3
CO4	Create solutions for real world problems using Pointers, Union, Structures and file operations.	1-5	2,3
CO5	Use algorithms and technologies in C Programming for suitable application development	1-5	2,3
CO6	Develop solutions by using C Programming to the complex problems, either individually or as a part of the team and report the results	1-5,9	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				✓		
CO2			✓			
CO3			✓			
CO4						✓
CO5		✓	✓			
CO6						✓

COURSE ARTICULATIONMATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3						3	3			3		
CO2	1	3	2	2	2				3	3			3		
CO3	2	2	2		1				3	3				3	3
CO4	3	3	3	1	1				3	3				3	3
CO5	3	3	3	2	2				3	3					
CO6	3	3	3	2	2				3	3			3	3	2

Note:1-Low,2-Medium,3-High

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1	Calculator allows you to easily handle all the calculations necessary for everyday life with a single application. Write a C program using switch statement to design a basic calculator that performs the basic operations such as addition, subtraction, multiplication and division.	Condition statement	Apply switch and if-else
2	People frequently need to calculate the area of things like rooms, boxes or plots of land where quadratic equation can be used. Write a C program to find the coefficients of a quadratic equation and compute its roots.	Conditional branching statement	If or if-else or else-if ladder
3	Consider the age of 3 persons in a family, Write a C program to identify the eldest person among three of them.	Condition checking	Apply if-else
4	Consider student's marks in Computer based Test. Write a C Program to display the grade obtained by a student in Computer Test based on range of marks.	Condition checking	Apply if-else, switch

5	In a stock market at the end of the day, summation of all the transactions is done. Write a C program using arrays to a) Display transactions IDs from1 to 'n'. b) Find the sum of 'n' natural numbers	Looping, sum	Apply for loop and arrays
6	In computer based applications, matrices play a vital role in the projection of three dimensional image into a two dimensional screen, creating the realistic seeming motions. Write a C program using 2-dimensional array to check for compatibility of two matrices and perform matrix Multiplication.	Condition checking, matrix operations	Apply if-else, looping and 2-D array
7	Implement a Program to read N integer numbers into a single dimensional array, sort them in ascending order using bubble sort technique and print both the given array and the sorted array with suitable headings.	Sorting	Use 1-D array, looping
8	Suppose students have registered for workshop, and their record is maintained in ascending order based on student ID's. Write a C program to find whether a particular Student has registered for that particular workshop or not using binary search.	Searching	Use 1-D array, looping
9	In a memory game, you first enter a first string and again enter second string, Write a C program to check whether both the strings are same or not.	Comparison, condition	Use string, if
10	Write a C program to define a structure named Student with name and DOB, where, DOB in turn is a structure with day, month and year. Using the concept of nested structures display your name and date of birth.	Nested structure	Use structure to store the data

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, PRENTICE HALL
2. SOFTWARE SERIES, 2005.
3. Herbert Schildt, "C: The Complete Reference", 4th edition, TATA McGraw Hill, 2000.
4. B.S. Anami, S.A. Angadi and S. S. Manvi, "Computer Concepts and C Programming: A
5. Holistic Approach", second edition, PHI,2008.

REFERENCE BOOKS:

1. Balaguruswamy," Programming in ANSI C", 4th edition, TATA MCGRAW Hill, 2008.
2. Donald Hearn, Pauline Baker," Computer Graphics C Version", second edition, Pearson Education, 2004.

Course Title	Engineering Workshop				Course Type		HC	
Course Code	B22ME0104	Credits	1		Class		II Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	**1**	**2**	**2**				
	Total	1	2	2	0	28	50 %	50 %

COURSE OVERVIEW

Workshop practice provides the basic working knowledge of the production and properties of different materials used in the industry. It also explains the use of different tools, equipment's, machinery and techniques of manufacturing, which ultimately facilitate shaping of these materials into various usable forms. Also to provide the basic knowledge on working and function of two wheeler and four wheeler vehicle engine and power transmission system.

COURSE OBJECTIVES

1. To make student familiar with automobile engine terminology and to have visualization of shape, size and working of engine parts.
2. To introduce the use of tools and instrument and their selection for carrying out the fitting, sheet metal work and welding work.
2. To introduce the processes used of convert of raw material in to product.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Visualise the parts of two wheeler engine and analyse the sequence of parts connected and their functional relationship.	1, 2, 9	1
CO2	Identify and explain the function of the major components of engine and power transmission system of Toyota Innova and Toyota Fortuner cars	1,2,9	1,2
CO3	Prepare the fitting model as per the given engineering drawing by using appropriate fitting tools.	1, 2, 9	1
CO4	Develop the simple sheet metal models as per drawing specification using sheet metal tools.	1,2,3,9	1,2
CO5	Demonstrate the working and application of laser engraving, 3D printing and welding processes.	1, 9	1,2
CO6	Draw the layout of workshop and prepare a technical document about the process to be followed in engineering workshop.	1,10	1

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1							2				1		
CO2	2	1							2				1	1	
CO3	2	1							2				1		
CO4	2	1	1						2				1	1	
CO5	2								2				1	1	
CO6	2									3			1		

Note: 1-Low, 2-Medium, 3-High

Part-A

1. Dismantling and assembly of 2-wheeler (2–stroke) engine Parts.

2. Identification of parts of an engine of Toyota Innova and Toyota Fortuner

3. Calculation of speed ratio of belt, chain and gear drives.

4. Study of power train of bicycle, 2-wheeler and 4-wheeler.

5. Demonstration of laser engraving process and 3D printing process.

Part-B

1. Study of fitting tools and preparation of fitting models.

2. Study of sheet metal tools and development of pen stand and funnel

3. Hands on training on welding.

4. Study of power tools.

TEXT BOOKS

1. K.R. Gopalkrishna, "Elements of Mechanical Engineering", Subhash Publishers, 12th Edition, 2012.
2. SKH Chowdhary, AKH Chowdhary and Nirjhar Roy, "The Elements of Workshop Technology - Vol I & II", Media Promotors and publisher, 11th Edition, 2001.

REFERENCE BOOKS

1. David A. Crolla, "Automotive Engineering-Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann is an imprint of Elsevier, 1st Edition, 2009.
2. R.S.Parmar, "Welding Processes and Technology", Khanna Publishers, New Delhi, 2003.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture

2. https://www.shutterstock.com/search/disassembled-bike-engine

3. https://pdfcoffee.com/ex5-assembly-and-disassembly-of-ic-engine-parts-pdf-free.html

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/cours

Course Title	Tree Plantation in Tropical Region: Benefits and Strategic Planning				Course Type		FC	
Course Code	B22ME0105	Credits	1		Class		II Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	1	1	1	14	0	50%	50%

Course Description: This course introduces significance of trees that provide us with a great many ecosystem services, including air quality improvement, energy conservation, stormwater interception, and atmospheric carbon dioxide reduction. These benefits must be weighed against the costs of maintaining trees, including planting, pruning, irrigation, administration, pest control, liability, cleanup, and removal.

Students are expected to involve in planting a tree and nurturing till the completion of their degree program. Successful maintenance of tree is considered to be one of the eligibility criterions for the award of university degree.

This course is a part of "**REVA Vanamahotsava – One Student, One Tree"**

COURSE OBJECTIVE (S):

The Course objectives are to

1. Develop basic understanding of role of trees in climate change
2. Emphasize on the selection and placing a tree for maximum benefit to environment
3. Involve in planting a tree and nurture till the completion of the degree program
4. Generate experiential report on the tree plantation process involved

COURSE OUTCOMES: (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Interpret the possible key benefits of trees arresting climate change and global warming	7,9	
CO2	Develop the ability to identify the type of a tree to be planted in urban area agricultural fields and forestry areas	7,9	
CO3	Make use of reading different literature on climate change and global warming by adopting various reading strategies (Reading Skills)	7,9	
CO4	Take part in planting a tree and nurturing it and Generate report on tree plantatio process involved	7,9	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1		✓		✓		
CO2		✓	✓	✓		
CO3		✓		✓		
CO4		✓		✓		✓

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1							3		3						
CO2							3		3						
CO3							3		3						
CO4							3		3						

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
Unit 1: Introduction: The tropical region, Benefits and costs of urban and community forests
Unit 2: General Guidelines for Selecting and Placing Trees Guidelines for Energy Savings, Guidelines for Reducing Carbon Dioxide, Guidelines for Reducing Stormwater Runoff, Guidelines for Improving Air Quality Benefits, Guidelines for Avoiding Conflicts with Infrastructure, Guidelines for Maximizing Long-Term Benefits, Trees for Hurricane-Prone Areas **Activity based learning** Every student has to thoroughly understand the significance of planting a tree, identify type of tree and place to be planted, plant a tree and nurture till the completion of the degree.

Text Books:

1. Kelaine E. Vargas, E. Gregory McPherson, James R. Simpson, Paula J. Peper, Shelley L. Gardner, and Qingfu Xiao, "Tropical community tree guide: Benefits, Costs and Strategic Planting", U.S. Department of Agriculture, Forest Service Pacific Southwest Research Station Albany, California, 2008

Reference Books:

1. Peter Wohlleben, The Heartbeat of Trees, Penguin Books, 2021
2. Daniel Chamovitz, "What a Plant Knows: A Field Guide to the Senses", 2020

Evaluation of this course

As per 9.27 of the **"Academic Regulations UG -Engg 2022",** following evaluation procedure is applicable to this course.

9.27 Summary of Internal Assessment, Semester End Examination and Evaluation Schedule is provided in the table given below (for theory courses having Credit 1).

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	When	Syllabus Covered	Max Marks	Reduced to	Date by which the process must be completed
1	Test-1	During 8th Week	First 50%	25	12.5	8th week
2	Test -2	During 15th Week	Remaining 50%	25	12.5	15th Week
5	SEE	18th to 20th Week	100%	50	25	20th Week

Additional guidelines for conducting this course

Since this course is aimed as a special drive to restore climate change and arresting global warming, following guidelines have been framed to conduct this course as activity-based learning to build greener nation through student community. Successful implementation of this drive meets one of the very important Sustainable Development Goals (SDG's) of UN Envision 2030 on Climate Change and Global warming. This is also one of the requirements in NEP 2020 and UGC/AICTE.

1. Classes will be conducted by the nominated faculty (one hour per week) as per the syllabus.
2. Flipped classes, field experiences, group discussions and seminars can be used by the faculty so as to engage the students through student centric learning mechanisms
3. Students should be involved into understanding cause and effects of climate change, types of pollutions, and environmental hazards
4. Quizzes and debates on climate change and global warming can be arranged for each section
5. Students should plant the suitable tree and nurture
6. "Team Vanamahotsava" – A Central assistance team from REVA University will support for identifying trees, place and organizing plantation drives.
7. Regular progress review is planned to be monitored by digital system – an advanced version of current progress monitoring App.
8. School Directors are responsible to oversee all the arrangements and progress monitoring of this drive.
9. Frequent school level and university level branding shall be arranged to give awareness of this noble drive among all the stake holders such as parents, alumni, industry and academic partners, government sectors, NGO's, ministries, and the society.
10. Regular plant maintenance drive can be planned by "Team Vanamahotsava". However, planting a tree and its nurture responsibility solely rests on individual students.
11. Successful maintenance of tree is considered to be one of the eligibility criterions for the award of university degree.

2nd Year

Detailed Syllabus

III SEMESTER

Course Code	Title of the Course	HC/FC /SC/OE/MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
			L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
B22AS0301	Discrete Mathematics	FC	3	0	0	3	3	50	50	100	BSC
B22CS0301	Professional Ethics	HC	2	0	0	2	2	50	50	100	HSMC
B22ME0304	Entrepreneurship	HC	1	0	0	1	1	25	25	50	HSMC
B22AS0304	Environmental Science	MC	2	0	0	0	2				HSMC
B22EF0301	Operating systems	HC	3	0	0	3	3	50	50	100	PCC
B22EF0302	Programming with python	HC	3	0	0	3	3	50	50	100	PCC
B22EF0303	Data Structures and Algorithms	HC	3	0	0	3	3	50	50	100	PCC
B22EF0304	Analog and Digital Electronics	HC	3	0	0	3	3	50	50	100	PCC
B22EF0305	Programming with python Lab	HC	0	0	1	1	2	25	25	50	PCC
B22EF0306	Data Structures and Algorithms Lab	HC	0	0	1	1	2	25	25	50	PCC
B22EF0307	Analog and Digital Electronics Lab	HC	0	0	1	1	2	25	25	50	PCC
Total			**20**	**0**	**3**	**21**	**26**	**400**	**400**	**800**	
TOTAL SEMESTER CREDITS			**21**								
TOTAL CUMULATIVE CREDITS			**65**								
TOTAL CONTACT HOURS			**26**								
TOTAL MARKS			**800**								

Course Title	Discrete Mathematics			Course Type	FC
Course Code	B22AS0301	Credits	3	Class	III Semester

Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

A course designed to prepare mathematics, computer science and engineering majors for a background in abstraction, notation and critical thinking for the mathematics most directly related to computer science. Topics include: logic, relations, functions, basic set theory, countability and counting arguments, proof techniques, mathematical induction, combinatorics, discrete probability, recursion, recurrence relations, elementary number theory.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Learn the logical structure of statements symbolically including the proper logical connectives and quantifiers.
2. Make familiar with the techniques of combinatorics.
3. Familiarize with various Algebraic structures and algebraic operations.
4. Understand the concepts of Lattices and boolean algebra.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Prove the logical statements using the laws of logic.	1,2,3	1
CO2	Construct the truth table for compound statements and able to exemplify tautology, contradiction and contingency.	1,2,3	1
CO3	Construct a generating function and solve a recurrence relation.	1,2, 3	1
CO4	Apply the principles pigeonhole, inclusion and exclusion for solving combinatorial problems.	1,2,3	1
CO5	Apply mathematical skills to understand the fundamental concepts of algebraic structures.	1,2,3	1
CO6	Outline the concepts of Lattices and Boolean algebra.	1,2,3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2						√
CO3						√

CO4			√			
CO5			√			
CO6		√				

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1										1		
CO2	3	2	2										1		
CO3	3	1	2										1		
CO4	3	2	3										1		
CO5	3	2	1										1		
CO6	3	2	3										1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

Logic and proofs: Propositional Logic – Propositional equivalences - Predicates and Quantifiers –Nested Quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy, Applications in computer science.

UNIT – II

Combinatorics: Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications, Applications in computer science.

.UNIT – III

Algebraic structures: Algebraic systems – Semi groups and monoids - Groups – Subgroups –Homomorphism's – Normal subgroup and cosets – Lagrange's theorem – Definitions and examples of Rings and Fields, Applications in computer science.

UNIT – IV

Lattices and Boolean algebra: Partial ordering – Posets – Lattices as posets – Properties of lattices -Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra, Applications in computer science.

TEXT BOOKS:

1. Kenneth H Rosen, Discrete mathematics and its application, McGraw Hill, Sept. 2002.
2. Englewood cliffs, Graph theory and its applications tp Engineering and computer science, Prentice Hall, 1974.

REFERENCE BOOKS:

1. V.Krishnamurthy, Combinatorics: Theory and Applications, East-West Press Pt. Ltd., Delhi, 1986.
2. J. Tremble, Manohar, Discrete Mathematical Structures with applications to computer Science McGraw Hill pub. 1975.
3. Richard Kohar, Basic Discrete Mathematics: Logic, Set Theory, and Probability, World Scientific Publishing Company, 1st Edition, 2017
4. Oscar Levin, Discrete mathematics: An Open Introduction, CreateSpace Independent Publishing Platform, 2nd edition, 2016

JOURNALS/MAGAZINES:

1. https://www.scimagojr.com/journalrank.php?category=2607
2. https://www.sciencedirect.com/journal/discrete-mathematics
3. https://www.tandfonline.com/toc/tdmc20/current
4. https://www.worldscientific.com/worldscinet/dmaa

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs37/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs49/preview
3. https://www.classcentral.com/course/swayam-discrete-mathematics-5217
4. https://www.careers360.com/courses-certifications/swayam-mathematics-courses-brp-org

<table>
<tr><td>Course Title</td><td colspan="4">Professional Ethics</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22CS0301</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>2</td><td>2</td><td>28</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

To enable the students to imbibe and internalize the values and ethical behavior in the personal and professional lives

COURSE OBJECTIVE (S):

1. Understand the professional rules of conduct for Engineers.
2. Appreciate codes of conduct, professional rules of conduct.
3. Recognize the conflict of interest and develop strategies.
4. Understand the importance of communication with all stake holders.
5. Apply practical strategies for handling ethical dilemmas.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understanding basic purpose of profession, professional ethics and various moral and social issues.	1,2,6,8 to 12	
CO2	Awareness of professional rights and responsibilities of a Engineer, safety and risk benefit analysis of a Engineer.	1,2,4,6,8 to 12	
CO3	Acquiring knowledge of various roles of Engineer in applying ethical principles at various professional levels.	1,6,8,9,10, 12	
CO4	Professional Ethical values and contemporary issues.	1,6,8,12	
CO5	Apply practical strategies for handling ethical dilemmas.	1,4,6,8,10, 12	
CO6	Appreciate codes of conduct, professional rules of conduct.	1,4,8,12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4		√				
CO5			√			
CO6		√				

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	--	--	--	3	--	3	2	2	1	3			
CO2	2	3	--	1	--	2	--	3	2	2	1	3			
CO3	2	--	--	--	--	2	--	3	2	2	0	2			
CO4	2	--	--	--	--	1	--	3	--	--	--	2			
CO5	2	--	--	1	--	1	--	3	1	--	--	2			
CO6	2	--	--	1	--	--	--	3	--	--	--	2			

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT-II

Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT-III

Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession

UNIT-IV

Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation.

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck,2e, Cambridge University Press 2015.

REFERENCE BOOKS:

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr.,Michael S Pritchard, Michael J Rabins, 4e , Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e,PHI, 2008.

Course Title	Environmental Science				Course Type	MC	
Course Code	B22AS0304	Credits	-		Class	III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Lecture	-	2	2			
	Tutorial	-	-	-	Theory	CIE	SEE
	Practical	-	-	-			
	Total	-	2	2	28	-	-

COURSE OVERVIEW:

Environmental Science is focussed on a holistic understanding of earth systems in order to learn from the past, comprehend the present and influence the future. It is the study of how physical, chemical and biological processes maintain and interact with life, and includes the study of how humans affect nature. As environmental science is at the cross-roads of the natural sciences, it provides an enriching alternative to a single-subject honours degree, and can open the door to an exciting range of career options. This approach enables us to tackle necessary problems, such as ensuring that human needs are met in a sustainable way, so that everyone has access to clean water and air, and the resources required for agriculture and industrial activity.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Familiar with current and emerging environmental engineering and global issues and have an understanding of ethical and societal responsibilities.
2. Recognize the need for engaging in life-long learning.
3. Study various types of energy (conventional & non-conventional) resources and natural resources.
4. Acquire knowledge with respect to biodiversity, threats, conservation and appreciate the concept of ecosystem.
5. Know about sources, effects and control measures of environmental pollution, degradation, and waste management.
6. Explore the ways for protecting the environment.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand, analyse and execute favourable environmental conditions and the role of individual, government and NGO in environmental protection.	1,2,3,7	1

CO2	List the causes, effects & remedial measures of environmental pollution, degradation & find ways to overcome them by suggesting the pollution controlled products.	1,2,3,7	1
CO3	Get motivation to find new renewable energy resources with high efficiency through active research and innovation.	1,2,3,7	1
CO4	Critically analyse the ecological imbalances and provide recommendations to protect the environment.	1,2,3,7	1
CO5	Explore the condition of environmental degradation and waste management techniques and take promising measures to make our environment ecofriendly.	1,2,3,7	1
CO6	Identify new methodologies for conservation of our natural resources and ecosystem.	1,2,3,7	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		✓				
CO2		✓				
CO3		✓				
CO4		✓				
CO5		✓				
CO6		✓				

COURSE ARTICULATION MATRIX

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	3	1				2						1		
CO 2	3	2	2				2						1		
CO 3	2	2	2				3						1		
CO 4	2	2	1				3						1		
CO 5	3	2	2				2						1		
CO 6	2	1	1				3						1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

ENVIRONMENT & ENVIRONMENTAL PROTECTION:

Basics of environment: Introduction & definition to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the

environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment.

Environmental protection: Role of Government - Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Environmental Legislations, Initiative and Role of Non-government organizations in India and world.

UNIT – 2

Environmental pollution, degradation & Waste management:

Environmental Pollution: Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Automobile Pollution-Causes, Effects & control measures.

Environmental degradation: Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect, Montreal and Kyoto protocols, The Chemical Weapons Convention (CWC).

Waste management: Municipal solid waste, Bio-medical waste and Electronic waste (E-Waste).

UNIT – 3

Energy & Natural resources:

Energy: Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, Non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy.

Natural resources:

Water resource - Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance

Mineral resources - Types of minerals, Methods of mining & impacts of mining activities

Forest wealth - Importances, Deforestation-Causes, effects and controlling measures

UNIT – 4

Ecology, ecosystem & field work:

Ecology - Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Components of ecosystem-abiotic and biotic

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots.

India as a mega-biodiversity nation; Endangered and endemic species of India

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity.

Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids

Field work:

Visit to waste water/sewage treatment plant (STP) and biogas plant at REVA university campus, and/or Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.

REFERENCE BOOKS:

1. R.J. Ranjit Daniels and Jagadish Krishnaswamy, “Environmental Studies”, Wiley India Private Ltd., New Delhi, Co-authored & Customised by Dr.MS Reddy & Chandrashekar, REVA University, 1st Edition, 2017.
2. R.J. Ranjit Daniels and Jagadish Krishnaswamy, “Environmental Studies”, Wiley India Private Ltd., New Delhi, 2nd Edition, 2014.
3. Benny Joseph, “Environmental Studies”, Tata McGraw – Hill Publishing Company Limited, 2nd Edition, 2008.
4. Dr.S.M.Prakash, “Environmental Studies”, Elite Publishers, Mangalore, 2nd Edition, 2009.
5. Rajagopalan R, “Environmental Studies – from Crisis to cure”, Oxford University Press, 3rd Edition, 2016.
6. Anil Kumar Dey and Arnab Kumar Dey, “Environmental Studies”, New age international private limited publishers, 2nd Edition, 2007.
7. Michael Allaby, “Basics of environmental Science”, Routledge-Tayler & Francis E-Library, 2nd Edition, 2002.
8. Dr.Y.K Singh, “Environmental Science”, New age international private limited publishers, 1st Edition, 2006.

Online Resources/Links:

1. http://library.envirolink.org/
2. https://www.youtube.com/watch?v=5QxxaVfgQ3k
3. https://www.springer.com/journal/11356
4. Learn Environmental Science with Online Courses, Classes, & Lessons | edX

Course Title	Operating Systems				Course Type		HC	
Course Code	B22EF0301	Credits	3		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course starts with a brief historical perspective of the evolution of operating system and then covers the major components of most of the operating systems. The operating system provides a well-known, convenient, and efficient interface between user programs and the bare hardware of the computer on which they run. The operating system is responsible for allowing resources (e.g., disks, networks, and processors) to be shared, providing common services needed by many different programs (e.g., file service, the ability to start or stop processes, and access to the printer) and protecting individual programs from one another. Emphasis is given to three major OS subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging, swapping) and file systems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the major components and different services of Operating system.
2. Implement process management and scheduling schemes.
3. Discuss synchronization and deadlock techniques in real time applications.
4. Demonstrate memory management techniques for machine architecture.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the major components and services of Operating System.	1 to 5,12	1
CO2	Summarize process scheduling, scheduling algorithm and multithreading of Operating System.	1 to 5,12	1,2
CO3	Assess the Performance of different CPU Scheduling algorithm for the given real-world applications.	1 to 5,12	1,2
CO4	Apply the concept of synchronization and deadlock process.	1 to 5,12	1,2
CO5	Build method sto overcome synchronization problems and to avoid deadlocks.	1 to 5, 9,12	1,2
CO6	Compare and contrast the physical and virtual memory management techniques.	1 to 5,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					

CO2		✓				
CO3						✓
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	1							1	2		
CO2	2	2	2	2	1							1	3	1	
CO3	2	1	2	3	1							1	3	1	
CO4	2	1	2	2	1							1	2	1	
CO5	1	2	1		1							1	2	2	
CO6	1	2	2	1	1							1	1	1	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Operating System Principles: Evolution of Operating Systems, Structural overview, Types of Operating System and operations, Computing environments, Operating System Services, User - Operating System interface, System calls and system programs, Operating System structure.

UNIT – 2

Process Management: Process concept, process scheduling, Operations on processes, Inter process communication; Multi-Threaded Programming, Overview, Multithreading models, Thread Libraries, threading issues. Process scheduling: Basic concepts, scheduling criteria, scheduling algorithms.

UNIT – 3

Synchronization and Deadlock: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization: The Bounded-Buffer Problem, The Readers–Writers Problem.Deadlock definition, Deadlock characteristics, Deadlock Prevention, Deadlock Avoidance: banker's algorithm, Deadlock detection and Recovery.

UNIT – 4

Memory Management: Memory Management Strategies, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Allocation methods, Thrashing.

Self-learning components:

Virtual machines and Introduction to Linux Operating System, Introduction to Distributed computing, Parallel computing, grid computing, cloud computing,File System.

TEXT BOOKS:

1. Abraham Silberschatz, Peter Bear Galvin, Greg Gagne, Operating System Principles, Wiley Asia Student Edition, 2009.
2. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India, seventh edition, 2011.
3. D. M. Dhamdhere; Operating Systems: A Concept-Based Approach; Tata McGraw-Hill, Third edition 2012.

REFERENCE BOOKS:

1. Frederic Magoules, Jie Pan, Kiat-An Tan, Abhinit Kumar, Introduction to Grid Computing, CRC Press, Second Edition, 2014
2. Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation. Prentice-Hall, Third edition, 2014.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/1658969
2. https://ieeexplore.ieee.org/document/1646682
3. https://ieeexplore.ieee.org/abstract/document/402081

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs04/preview
2. https://www.coursera.org/lecture/os-power-user/introduction-r0c5h
3. https://onlinecourses.swayam2.ac.in/cec20_cs06/preview

<table>
<tr><td>Course Title</td><td colspan="4">Programming with Python</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0302</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

This course provides an introduction to programming and the Python language. Students are introduced to core programming concepts like data structures, conditionals, loops, variables, and functions. This course includes an overview of the various tools available for writing and running Python, and gets students coding quickly. In the course we will also discuss Numpy and Pandas along with visualization tools.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of python programming language constructs and their applications.
2. Inculcate knowledge of parsing of regular expressions and their usage in various application domains.
3. Gain expertise in Object oriented programming and NumPy package.
4. Discuss the files, Pandas and Data Virtualization concepts.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Write simple computational programs using functions.	1,2,3,4,5,12	1, 2, 3
CO2	Write programs to compute mathematical functions (sin x, e^x and others) using if statements, loops and functions.	1,2,3,4,5,12	1, 2, 3
CO3	Write data processing scripts using string, tuples, sets, dictionaries with appropriate error handling using exceptions.	1,2,3,4,5,12	1, 2, 3
CO4	Write classes to implement given functionality using object-oriented features of python including operator overloading, inheritance, iteration protocol, context management protocol, decorators, and descriptors.	1,2,3,4,5,12	1, 2, 3
CO5	Apply features of object oriented and NumPy package to develop computationally intensive programming to analyze and interpret the data.	1,2,3,4,5,12	1, 2, 3
CO6	Write data processing and visualization scripts using numpy, pandas and matplotlib.	1,2,3,4,5,12	1, 2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4				√		
CO5				√		
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3							3	3	3	3
CO2	3	3	2	3	3							3	3	3	3
CO3	3	2	2	3	3							3	3	3	3
CO4	3	3	3	2	3							3	3	3	3
CO5	3	2	3	3	3							3	3	3	3

CO6	3	3	3	2	3							3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Python Fundamentals: Introduction to Python: History, Applications Your First Python Program, Constants, Variables, Naming conventions, simple data types, Type casting, Assignment statements, expressions, Boolean data type, Trigonometry functions, operators, precedence of operators, libraries, keywords, Python Collections, I/O statements, conditional statements, loops, functions, user defined functions.

UNIT – 2

Exception handling in Python, **Strings:** Unicode, Diving In, Formatting Strings, Format Specifiers, Other Common String Methods, Slicing a String.

Regular Expressions: Case Study: Street Addresses, Case Study: Roman Numerals, Checking for Thousands, Checking for Hundreds, Using the {n,m} Syntax, Checking for Tens and Ones.

UNIT – 3

Object Oriented Programming: Defining Classes, The init_() Method, Instantiating Classes, OOP features: Abstraction. Encapsulation, Single Inheritance, Polymorphism

Files: Reading from Text Files, Writing to text files, Reading and Writing the Binary Files.

UNIT – 4

Numpy: Introduction to numpy, Creating arrays, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output

Pandas and Data Visualization: Introduction, Series and Data Frames in pandas, Data Visualization

TEXT BOOKS:

1. Mark Pilgrim, “Dive into Python 3”, Apress special edition, second edition, 20l5.
2. Travis E. Oliphant, “Guide to NumPy”, Trelgol publishers, 2006.

REFERENCE BOOKS:

1. A B Choudhary, “Flowchart and Algorithms Basics” Mercury Learning and Information, 2020.
2. Mark Lutz, “Learning Python”, Oreilly. 2003.
3. John M. Zelle, “PYTHON Programming: An Introduction to Computer Science”, Franklin, Beedle & Associates. 2004.
4. Michael Dawson, “Python Programming for the Absolute Beginners”, 3rd Edition, CENAGE Learning.
5. Wesley J. Chun, “Core Python Programming”, 2nd Edition, Prentice Hall.
6. Steve Holden and David Beazley, “Python Web Programming”, New Riders, 2002. Springer, Kent D. Lee, “Python Programming Fundamentals”, 2nd Edition.
7. John V. Guttag, “Introduction to Computation and Programming using Python”, MIT Press, 2016.

JOURNALS/MAGAZINES:

1. IEEE Transactions on Artificial Intelligence
2. Journal of Machine Learning Research
3. Foundations and Trends in Machine Learning
4. Synthesis Lectures on Artificial Intelligence and Machine Learning
5. ACM Transactions on Intelligent Systems and Technology

SWAYAM/NPTEL/MOOCs:

1. Python for Everybody, Dr. Chuck Online MOOCs, Open Standards, Open Source and OERs
2. Programming, Data Structures and Algorithms using Python, Prof. MadhavanMukund, IIT Madras,

SELF-LEARNING EXERCISES:

1. Data Visualization
2. Basics of Deep Learning

Course Title	**Data Structures and Algorithms**				**Course Type**		**HC**	
Course Code	**B22EF0303**	**Credits**	**3**		**Class**		**III Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	3	3	3				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50%**

COURSE OVERVIEW:

The objective of this course is to provide the solid foundation in the basic concepts of data structures and algorithms. The knowledge of fundamentals of data structures and algorithms is a key to any type of software development: Application Software, System Software, Operating Systems, and Network Simulator. Apart from introducing the basic knowledge of data structures, this course, also introduces many algorithms that are designed using the fundamental algorithm design techniques such as brute force.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Introduce the insights of basic concepts of data structures andalgorithms.
2. Understand the fundamental data structures: arrays, stacks, queues, linked lists and trees.
3. Illustrate the mathematical foundation for the design and analysis of algorithms.
4. Demonstrate the concept of data structures to solve real world applications

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	**Course Outcomes**	**POs**	**PSOs**

CO1	Classify the various types of data structures.	1 to 4, 8	1,2,3
CO2	Understand the data structures like arrays, stacks, queues and linked lists.	1 to 4, 8	1,2,3
CO3	Exemplify the knowledge of data structures to solve real world problems.	1 to 5, 8 to 11	1,2,3
CO4	Demonstratethe algorithms to solve real world problems using the Algorithm Analysis Framework.	1 to 6, 8 to 12	1,2,3
CO5	Apply the knowledge of mathematical foundation of algorithm design and analysis to design a new algorithm and analyze its performance.	1 to 5, 8 to 11	1,2,3
CO6	Employ the foundation for any real world software using existing or creating new algorithm design technique.	1 to 6, 8 to 12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3		√				
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1				1					3	3	3
CO2	3	3	1	1				1					3	3	3
CO3	3	3	3	2	3			3	3	3	3		3	3	3
CO4	3	3	3	3	3	3		3	3	3	3	3	3	3	3
CO5	3	3	3	3	3			3	3	3	3		3	3	3
CO6	3	3	3	3	3	3		3	3	3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Algorithms and Data Structures: Introduction to data structures, types of data structures, data structure operations;

Arrays: Types of arrays, Representation of 1D array, Array Traversal, Insertion and Deletion, Representation of multi-D Array in memory, Matrix Operations

UNIT – 2

Linked Lists: Basic concept, linked list implementation, types, Circular Linked List;

Stacks: Introduction, Stacks- basic concept, Stack operations, Stack implementation and application.

UNIT – 3

Queues: Introduction**,** basic concept, queue operations, implementation, circular queue, Double Ended Queues;

Trees: Introduction, Basic Concept, Binary Tree, Binary Tree Representation, Binary Tree Traversal, Binary Search Tree, Tree Variants.

UNIT – 4

Introduction to Algorithms: Fundamentals of the Analysis of Algorithm Efficiency- The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes;

Brute Force: Bubble Sort, Selection Sort, Sequential Search and Brute-Force String Matching.

TEXT BOOKS:

1. E. Balaguruswamy ," Data Structures using C", Revised edition, 2011
2. Anany Levitin, " Introduction to Design and Analysis of Algorithms", 3rd edition

REFERENCE BOOKS:

1. Coreman, "Introduction to Algorithms", MIT, 3rd edition.
2. G. A. V. Pai, "Data Structures and Algorithms", TMH, 2008.
3. A. M. Padma Reddy, "Data Structures using C", Nandi Publications.

JOURNALS/MAGAZINES:

1. Random Structures and Algorithms, Wiley
2. Journals of Algorithms, Elsevier
3. Journal of Computing Sciences in Colleges, ACM
4. Journal of Discrete Algorithms

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106102064
2. https://onlinecourses.nptel.ac.in/noc22_cs92/preview
3. https://onlinecourses.nptel.ac.in/noc22_cs26/preview
4. https://nptel.ac.in/courses/106106133

SELF-LEARNING EXERCISES:

1. Balanced Search Trees

2. Parallel Algorithms

Course Title	Analog and Digital Electronics				Course Type		HC	
Course Code	B22EF0304	Credits	3		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course takes from simple transistor circuits through the analysis of variety of its applications. It also includes knowledge of operational amplifiers in building specific engineering applications. It provides simplification of Boolean expressions using K-map and Quine-Mcluskey methods. Various data processing circuits along with flip flops are discussed in detail.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the applications of transistorsin oscillatorsand amplifiers.
2. Develop an understanding of the operational amplifier and its applications
3. Become familiarized with simplifying the functions in Sum of Products as well as Product of Sums, using K-Maps and Quine McClusky methods.
4. Discuss the working of different data processing circuits and flip-flops.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the different constituents of an analog electronic circuit using discrete components.	PO1-PO5, PO12	1
CO2	Analyze the applications of transistors in oscillators and amplifiers.	PO1-PO5, PO12	1
CO3	Apply the knowledge of operational amplifiers in building specific engineering applications.	PO1-PO5, PO12	1,3
CO4	Design the digital signal circuit using various methods.	PO1-PO5, PO12	1,3
CO5	Construct the schematics and different data processing circuits to interpret its working	PO1-PO5, PO12	1,3
CO6	Understand the working of sequential circuits build using flipflops.	PO1-PO5, PO12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2				✓		
CO3			✓			
CO4					✓	
CO5			✓			
CO6		✓				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1							1	1		
CO2	2	2	2	3	1							1	2		
CO3	2	2	3	2	2							1	1		3
CO4	1	2	3	2	2							1	1		1
CO5	1	2	3	2	1							1	1		1
CO6	2	2	3	2	3							1	1		2

Note: 1-Low,2-Medium,3-High

COURSE CONTENT

UNIT – 1

Sinusoidal Oscillators and amplifiers: Classification,conditions,types,RC phase shift oscillator,Wein bridge oscillator,Hartley oscillator,Colpitts oscillator,Crystal oscillator, CE amplifier, RC coupled amplifier**.**

UNIT – 2

Operational Amplifiers: Ideal Opamp versus Practical Opamp, Performance parameters, Some Applications: Peak Detector Circuit, Comparator, Active filters-First order LPF and HPF, Phase shifters, Instrumentation Amplifier, Non-Linear Amplifier, Relaxation oscillator**.**

UNIT – 3

Principles and Minimization Techniques of Combinational Circuits: SOP, POS, truth table of K-map, pair, quad, octet. K-map simplification (3 and 4 variables), don't care condition, QuineMcClusky method.

UNIT – 4

Data Processing Circuits: Half/Full adder, Half/Full Subtractor, Multiplexers, DE multiplexers, Encoders, Decoders.

Introduction to Sequential circuits: Flip Flops- SR, JK, D and T. Characteristic table and equations. Application of shift registers (Ring and Johnson counters)

SELF LEARNING COMPONENT:

Biasing circuits, Binary adder/Subtractor, Applications of flip flops, Shift register types

TEXTBOOKS:

1. Anil K Maini, VarshaAgarwal,"Electronic Devices and Circuits", 2nd Edition, Wiley, 2009.
2. Jacob Millman, Christos Halkias, Chetan D Parikh,"Millman's Integrated Electronics – Analog and DigitalCircuits and Systems", 2nd Edition, Tata McGraw Hill, 2010.
3. Donald P Leach, Albert Paul Malvino & Goutam Saha ,"Digital Principles and Applications", 7th Edition, Tata McGraw Hill, 2010.

REFERENCE BOOKS

1. Stephen Brown, Zvonko Vranesic," Fundamentals of Digital Logic Design with VHDL", 2nd Edition, Tata McGrawHill, 2005.
2. RD Sudhaker Samuel, "Illustrative Approach to Logic Design", Sanguine-Pearson, 2010.
3. Charles H.Roth,"Fundamentals of Logic Design",Jr., 5th Edition, Cengage Learning, 2004.
4. Ronald J.Tocci, NealS.Widmer, Gregory L.Moss,"Digital Systems Principles and Applications", 10thEdition, Pearson Education, 2007.
5. M Morris Mano,"Digital Logic and Computer Design", 10th Edition, Pearson Education, 2008.
6. Jacob Millman, Christos Halkias, "Analog and Digital Circuits and Systems", 2nd Edition,Tata McGrawHill, 2010.
7. R.D.Sudhaker Samuel,"Electronic Circuits", Sanguine-Pearson, 2010.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/1085417
2. https://www.academia.edu/Documents/in/Digital_Electronics
3. https://www.mdpi.com/journal/electronics/special_issues/circuit_machine_learning

SWAYAM/NPTEL/MOOCs:

1. https://technobyte.org/digital-electronics-logic-design-course-engineering/
2. https://www.udemy.com/course/digital-electronics-logic-design/
3. https://www.javatpoint.com/digital-electronics/

<table>
<tr><td>Course Title</td><td colspan="4">Programming with python Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0305</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>-</td><td>28</td><td>25%</td><td>15%</td></tr>
</table>

COURSE OVERVIEW:

Python is a Programming Language that can be treated in a procedural way, an object-orientated way or a functional way. It can be used on a server to create web applications, create workflows, connect to database systems, read and modify files, handle big data and perform complex mathematics. It can implement object oriented features and exception handling, It can parse the strings using regular expressions. It can be used for implementing the machine learning algorithms to develop solutions for interdisciplinary problems apart from any general problems leading to automation.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of python programming language constructs and their applications.
2. Inculcate knowledge of parsing of regular expressions and their usage in various application domains.
3. Gain expertise in Object oriented programming and NumPy package.
4. Discuss the files, Pandas and Data Virtualization concepts.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply basic language constructs of python to solve logic-based problems.	1,2,3,4,5,9, 10,11,12	1,2,3
CO2	Solve problems using Object Oriented Programming concept like class and object.	1,2,3,4,5,9, 10,11,12	1,2,3
CO3	Apply features of NumPy package to develop program to analyze and interpret the data.	1,2,3,4,5,9, 10,11,12	1,2,3
CO4	Develop data science solutions with the help of files, Pandas, and Data Visualization.	1,2,3,4,5,9, 10,11,12	1,2,3
CO5	Develop sustainable solutions/projects for the needs of society, organizations, and other sectors.	1,2,3,4,5,9, 10,11,12	1,2,3
CO6	Recognize the need and engage in learning new libraries and tools in python.	1,2,3,4,5,9, 10,11,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			√			
CO2			√			
CO3			√	√		
CO4			√	√	√	
CO5						√
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	2	3	2	2				2	2	2	2	2	2	2
CO2	3	2	3	2	2				2	2	2	2	2	2	2
CO3	3	3	3	3	3				2	2	2	2	2	2	2
CO4	3	3	3	3	3				2	2	2	2	3	2	2
CO5	3	3	3	3	3				3	3	3	3	3	2	2
CO6	3	3	2	2	3				2	2	2	3	3	2	2

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	a). "LIST1" is a list that contains "N" different SRN of students read using a user defined function with the help of input () function. It is required to add SRN of "M" more students that are to be appended or inserted into "LIST1" at the appropriate place. The program must return the index of the SRN entered by user.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on list.
	b). "TUPLE1" and "TUPLE2" are two tuples that contain "N" values of different data types read using the user defined function "READ" with the help of input() function. Elements of "TUPLE1" and "TUPLE2" are to be read one at a time and the "larger" value among them should be placed into "TUPLE3". Display all tuples.		Create and perform operations on Tuples.
2.	a).SET1 and SET2 are two sets that contain unique integers. SET3 is to be created by taking the union or intersection of SET1 and SET2 using the user defined function Operation(). Perform either union or intersection by reading choice from user. Do not use built in functions union() and intersection() and also the operators "|" and "&".	Windows/Linux OS, IDE, Jupyter	Create and perform Union and Intersection, Operations on Sets.
	b).The Dictionary "DICT1" contains N Elements and each element in dictionary has the operator as the KEY and operand's as VALUES. Perform the operations on operands using operators stored as keys. Display the results of all operations.		Create dictionary and perform operation using user defined function.
3.	A substring "Substr" between index1 and index2 is to be extracted from the given input string "Str1", which is read using input (). Display the substring "Substr" using a user defined function if available in string "Str1", otherwise display NULL.	Windows/Linux OS, IDE, Jupyter	String operations.
	b) A string containing multiple words is to be read from the user one at a time, after reading perform following operations. i) Convert all the strings to uppercase and display ii) Split the words of a string using space as the separation character and display.		String operations.

4.	Consider the text file, “Std.txt”, with the details of students like SRN, NAME, SEMESTER, SECTION AND AVG_MARKS. Read the file, “Std.txt” and display the details of all the students of 4th Semester “ A” Section who have scored more than 75%.	Windows/Linux OS, IDE, Jupyter	File Handling.
	Consider the text file “Emp.txt”, with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NET_SALARY, LIC, PF and TOTALDEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input () and compute the following: OTAL_DEDUCTIONS= (LIC+PF) ROSS_SALARY= BASIC_SALARY+ DA NET_SALARY= GROSS_SALARY – TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of “Emp.txt” and display the details of each employee.		File Handling.
5.	A “CAR” has the attributes COMPANY_NAME, MODEL, COLOR, MANUFACUTING_YEAR and PRICE. A Class is required to be created for “CAR” to store the above attributes and perform the following operations: i) Get the details of “CAR” object from user and store into Array of objects ii) Display the details of “CAR” object based on “COMPANY”, “MODEL” and “PRICE”.	Windows/Linux OS, IDE, Jupyter	sses and objects usage.
	Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for “Airlilne” with the above attributes and perform the following operations: et the details of “Airline” object from user and store into Array of objects List details of all the passengers who travelled From “Bengaluru to London”. ist details of all the passengers who travelled From “Chicago to Beijing” on 10th of Feb, 2020.		sses and objects usage.
6.	‘Arr_1” is an integer array of size M x N. Size and content of the array is to be read using input() by using the user defined function READ_DATA(). It is required to display the i) Diagonal elements of ”Arr_1” lements of mth row (row no should be entered by user) iii) Elements of nth column (column no should be entered by user)	Windows/Linux OS, IDE, Jupyter	umPy arrays usability.
	he dictionary “DICT1” contains the pass percentage of each semester of B. Tech in CSE, where, ” Semester” acts as the key and “Pass Percentage” acts as the value. A Python Pandas dataframe is required to be created using the dictionary “DICT1” and display it using a user defined function.		andas Series usability.

Part-B (Mini Project: Library Management System)

ect Description

Manual process of keeping student records, book records, account details, managing employee is very difficult in library. Hence, it is required to automate the library management. The purpose of the **Library Management system** is to allow for storing details of a large number of books and allow for add, delete, search, borrow (Issue) and return facilities separately to administrator/Librarian, staff and students.

Experiments in Part B			
No	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill /Ability**
1	elop a program to create the class “USER” with the attributes USER_NAME, USER_ID, DEPARTMENT_NAME, ADDRESS, PHONE_NO, EMAIL_ID, DOB and AGE. The functions add_user(), delete_user(), edit_user(), search_user() should be part of the class. Instantiate “User” class with 10 objects. Read the attributes of each “User” object using input() and store them in the file “User_File.txt”.	ndows/Linux OS, IDE, Jupyter	eate a class user to read the attributes of user and store them in a file
2	elop a program to get the name of the “User” object whose details are to be deleted. Read the “User_File.txt” and delete the “User” object if found. Display the contents of “User_File.txt” after deletion.	ndows/Linux OS, IDE, Jupyter	eate a class user to read the attributes and delete the object.
3	elop a program to get the name of the “User” object whose details are to be edited (modified). Edit the details of the user object in the file “User”.	ndows/Linux OS, IDE, Jupyter	create a class and edit the file.
4	elop a program to create the class “BOOK” with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, DEPARTMENT_NAME and the functions add_book(), delete_book(), edit_book() and search_book(). Instantiate “Book” class with 10 objects. Read the attributes of each “BOOK” object using input () and store them in the file “Book_File.txt”.	ndows/Linux OS, IDE, Jupyter	eate a class book to read the attributes of user and store them in a file.
5	elop a program to get the name of the “BOOK” object whose details are to be deleted. Read the “Book_File.txt” and delete the “BOOK” object whose details match with the data entered. Display the contents of “Book_File.txt” after deletion.	ndows/Linux OS, IDE, Jupyter	eate a class book to read the attributes and delete the object.
6	elop a program to get the name of the “BOOK” object whose details are to be edited (modified). Edit the details of the “Book” object in the file “Book_File.txt” and display the contents after modification.	ndows/Linux OS, IDE, Jupyter	create a class and edit the file.
7	elop a program to create the class “TRANSACTION” with the attributes USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE,DUE_DATE and RETURN_DATE and the functions issue_book(), return_book() and search_book(). Instantiate “Transaction” class with 10 objects. Read the attributes of each “Transaction” object using input() and store them in the file “TransactionFile.txt”. Develop a program to issue the book as requested by the user. Update the attributes in “Transaction _File” and display the contents of file.	ndows/Linux OS, IDE, Jupyter	eate class and perform string operations.
8	elop a program to return the book. Edit the details of the user like USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE, DUE_DATE and RETURN_DATE in “TransactionFile.txt” and display the contents after modification. Compute the fine amount to be paid if return_date is not same as due_date. If both return_date and due_dateare same and put zero in fine_amount.	ndows/Linux OS, IDE, Jupyter	eate class and perform string operation.
9	elop a program to search for a book using its “author”. Display the message “available” if search is successful otherwise display the message “not available”.	ndows/Linux OS, IDE, Jupyter	eate class and object, perform file operations and regular expressions.

10	elop a program to get a list of users by referring to "User_File.txt" and "Transaction_File.txt".	ndows/Linux OS, IDE, Jupyter	eate class and object, perform file operations and regular expressions.
11	elop a program to get List of Books in stock by referring to "Book_File.txt" and "Transaction_File.txt".	ndows/Linux OS, IDE, Jupyter	eate class and object, perform file operations and regular expressions.
12	elop a program to get List of Books Issued by referring to "User_File", "Book_File" and "Transaction_File".	ndows/Linux OS, IDE, Jupyter	eate class and object, perform file operations and regular expressions.
13	elop a project by integrating User, Books, Transaction and Reports Modules.	ndows/Linux OS, IDE, Jupyter	odule integration and project development.

TEXT BOOKS:

1. Mark Pilgrim, "Dive into Python 3", 2 nd edition, Apress special edition, 2015.
2. Travis E. Oliphant, "Guide to NumPy", Trelgol publishers, 2006.

REFERENCE BOOKS:

1. A B Choudhary, "Flowchart and Algorithms Basics", Mercury Learning and Information, 2020.
2. Mark Lutz, "Learning Python", Oreilly. 2003.
3. .John M. Zelle, "PYTHON Programming: An Introduction to Computer Science", Franklin, Beedle & Associates. 2004.
4. Michael Dawson, "Python Programming for the Absolute Beginners", 3rd Edition, CENAGE Learning.
5. Wesley J. Chun, "Core Python Programming", 2nd Edition, Prentice Hall. 108
6. Steve Holden and David Beazley, "Python Web Programming", 2nd Edition New Riders, 2002. Springer".
7. John V. Guttag, "Introduction to Computation and Programming using Python", MIT Press, 2016.
8. https://www.tutorialspoint.com/computer_fundamentals/computer_fundamentals_tutorial.pdf

JOURNALS/MAGAZINES:

1. https://www.codemag.com/Magazine/ByCategory/Python
2. http://ijaerd.com/papers/special_papers/IT032.pdf
3. https://iopscience.iop.org/article/10.1088/1742-6596/423/1/012027
4. https://ieeexplore.ieee.org/document/4160250
5. Python for scientific computing

SWAYAM/NPTEL/MOOCs:

1. Coursera – Python for everybody, University of Michigan
2. Coursera – Python Basics, University of Michigan
3. https://nptel.ac.in/courses/106/106/106106182/
4. https://www.edx.org/learn/python

SELF-LEARNING EXERCISES:

1. Explore PYTHON library for IOT programming

2. More exploration on GIThub
3. Data Visualization packages
4. C modules interface

Course Title	Data Structures and Algorithms Lab				Course Type		HC	
Course Code	B22EF0306	Credits	1		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-				
	Practical	1	2	2	Theory	Practical	IA	SEE
	Total	1	2	2	-	28	25	25

COURSE OVERVIEW:

The objective of this course is to provide the solid foundation in the basic concepts of data structures and algorithm. This course helps in implementing most of the data structures such as stacks, queues, linked list, trees using C language. Some of the sorting and searching algorithms are also implemented.

COURSE OBJECTIVES:

The objectives of this lab course are to make students to:

1. Implement the concepts of matrix and palindrome.
2. Demonstrate the use of stacks, queues and lists in C.
3. Discuss and Implement the concept of trees and tree traversal.
4. Discuss the sorting and searching algorithms.

COURSE OUTCOMES:

On successful completion of this course; the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of Arrays to solve real world problems.	1,2,3,4,5,9,10, 11	1,2,3
CO2	Develop a C program for implementing the linked list and trees	1,2,3,4,5,9,10, 11	1,2,3
CO3	Build a real world application in C using stacks and queues.	1,2,3,4,5,9,10, 11	1,2,3
CO4	Apply the concepts of searching and sorting algorithms for solving real world problems.	1,2,3,4,5,9,10, 11	1,2,3
CO5	Identify the most suitable data structure for real world application.	1 to 5,9,10,12	1,2,3
CO6	Experiment with all data structures in a high-level language for problem solving.	1 to 5,9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			

CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

Course Outcomes	Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	3	2	1				3	3		3	3	2	1
CO2	3	2	3	3	1				3	3		3	3	2	1
CO3	3	1	3	3	1				3	3		3	3	2	1
CO4	3	1	3	3	1				3	3		3	3	2	1
CO5	3	3	3	3	3				3	3		3	3	3	3
CO6	3	3	3	3	3				3	3		3	3	3	3

PRACTICE:

S.N.	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill/Ability**
	PART-A		
1.	Write a C program using the “array”, a linear data structure to multiply two given matrices of same order.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
2.	Write C programs to demonstrate the operations performed on STACK ADT using an array.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
3.	Write C programs to demonstrate the operations performed on STACK ADT using a Singly Linked List.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
4.	The compilers always convert infix expression into postfix to perform further operations like parsing, lexical analysis etc. Select an appropriate data structure and develop a program to convert any fully parenthesized arithmetic infix expression into its postfix form using a stack.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
5.	Write a C program that uses both stack and queue to test whether the given string is a palindrome (Use Java Utility).	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
6.	Evaluation of postfix expressions is done by compilers during the compilation process. Design and develop a program to evaluate any valid integerexpression expressed in its postfix form, using a stack.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
7	Write a C program to demonstrate the operations performed on QUEUE ADT using an array.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
8.	Write a C program to demonstrate the operations performed on QUEUE ADT using a singly linked list.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming

9.	es are stored in memory in tree structure directory. Design and develop a program to create a directory having files with unique file-id in the hard disk, and display the files in all the three tree traversal orders using Binary Search Tree (BST).	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
10.	sign a C program to search for a pattern in a given text using brute force string matching.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
11.	sign a C program to implement bubble sort and selection sort.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming

TEXT BOOKS:

1. E. Balaguruswamy ," Data Structures using C", Revised edition, 2011
2. Anany Levitin, " Introduction to Design and Analysis of Algorithms", 3rd edition

REFERENCE BOOKS:

1. Coreman, "Introduction to Algorithms", MIT, 3rd edition.
2. V. Pai, "Data Structures and Algorithms", TMH, 2008
3. M. Padma Reddy, "Data Structures using C", Nandi Publications

Course Title	**Analog and Digital Electronics Lab**				**Course Type**		**HC**	
Course Code	**B22EF0307**	**Credits**	**1**		**Class**		**III Semester**	
B22EF0307	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**25%**	**25%**

COURSE OVERVIEW:

The course gives an introduction to analysis of elementary analog and digital circuits. It will give a basis for understanding and constructing simple systems of analog and digital electronic circuit elements. Central themes: applications of diodes and transistors, Boolean algebra, logic gates, combinatorial and sequential digital circuits, to write VHDL code to realize simple digital circuits.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Develop an understanding of the analog/digital circuits and its applications.
2. Illustrate the behavioral characteristics of various analog/digital circuits.
3. Demonstrate the simulation of analog/digital circuits.
4. Discuss the use of modern simulation tools.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the modern simulation tools used for analog/digital circuits	1,2,3,4,5,9,10,12	1,3
CO2	Constructanalog circuits using various electronic components using simulator	1,2,3,4,5,9,10,12	1,3
CO3	Analyze the working of various analog circuits and to understand their behaviors	1,2,3,4,5,9,10,12	2
CO4	Design and develop VHDL codes for data processing/sequential circuits using simulator	1,2,3,4,5,9,10,12	2
CO5	Analyze the behavioral characteristics of different data processing circuits	1,2,3,4,5,9,10,12	1,3
CO6	Analyze and Implement digital circuits using required hardware components	1,2,3,4,5,9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3				√		
CO4				√		
CO5					√	
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3				1	2		1	3		3
CO2	3	3	2	2	3				1	2		1	3		3
CO3	3	3	2	1	3				1	2		1		3	3
CO4	3	3	2	1	3				1	2		1		3	
CO5	3	3	3	2	3				1	2		1	3		3
CO6	3	2	2	2					1	2		1	3		3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	To simulate a positive clipper, double ended clipper & positive clamper circuits using diodes	Orcad	Simulation of clipper and clamper electronic
2.	To simulate a rectangular wave form generator (Op- amp relaxation oscillator) and compare the frequency and duty cycle with the design specifications	Orcad	Simulation of rectangular waveform generator
3.	To simulate a Schmitt trigger using Op-amp and compare the UTP and LTP values with the given specification	Orcad	Simulation of Schmitt trigger
4.	To simulate a Wien bridge Oscillator	Orcad	Simulation of Wein bridge oscillator
5.	determine the working of a power supply and observe the waveforms	Orcad	Simulation of power supply
6.	To build and simulate CE amplifier (RC coupled amplifier) for its frequency response and measure the bandwidth.	Orcad	Simulation of RC coupled amplifier and determining the quency response
7	lization of Half/Full adder and Half/Full Subtractors using logic gates	ICs, Trainer kit and patch cords Create and perform the adder and subtractor cuits	ICs, Trainer kit and patch cords Create and perform the adder and btractor circuits
8	ign and develop VHDL code to realize Full adder and Full Subtractors	nx	nulation knowledge of the mentioned adders and subtractors
9	en a 4-variable logic expression, simplify it using Entered Variable Map and realize the simplified logic expression using 8:1 multiplexer IC	, Trainer kit and patch cords	alization of a multiplexer
10	Design and develop the VHDL code for an 8:1 multiplexer. Simulate and verify it's working	nx	nulation knowledge of combinational logic circuit
11	ign and implement a ring counter using 4-bit shift register and demonstrate its working	, Trainer kit and patch cords	alization of shift register and ring counter
12	ign and develop the Verilog / VHDL code for switched tail counter.	nx	nulation of ring counter

TEXT BOOKS:

1. Anil K Maini, Varsha Agarwal,"Electronic Devices and Circuits", Wiley, 2009.
2. Jacob Millman, Christos Halkias, Chetan D Parikh,"Millman's Integrated Electronics – Analog and Digital Circuits and Systems", 2nd Edition, Tata McGraw Hill, 2010.

a. Donald P Leach, Albert Paul Malvino & Goutam Saha ,"Digital Principles and Applications", 7th Edition, Tata McGraw Hill, 2010.

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22AS0401	Graph Theory and Optimization Techniques	FC	3	0	0	3	3	50	50	100	BSC
2	B22AH0302	Universal Human Values	HC	2	0	0	2	2	50	50	100	HSMC
3	B22EF0401	Technical Documentation	HC	1	0	0	1	1	25	25	50	PCC
4	B22LSM0301	Indian Constitution	MC	2	0	0	0	2				HSMC
5	B22EF0402	Object Oriented Programming with Java	HC	3	0	0	3	3	50	50	100	PCC
6	B22EF0403	Database Management System	HC	3	0	0	3	3	50	50	100	PCC
7	B22EF0404	Computer Organization and Architecture	HC	3	0	0	3	3	50	50	100	PCC
8	B22EFS41X	Professional Elective 1	SC	3	0	0	3	3	50	50	100	PEC
9	B22EF0405	Java Programming Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0406	Database Management System Lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EF0407	Microcontroller and IoT Lab	HC	0	0	1	1	2	25	25	50	PCC
12	B22EF0408	Skill Development course 2	SDC	0	0	2	2	4	50	50	100	SDC
TOTAL				**20**	**0**	**5**	**23**	**30**	**450**	**450**	**900**	
TOTAL SEMESTER CREDITS				**23**								
TOTAL CUMULATIVE CREDITS				**88**								
TOTAL CONTACT HOURS				**30**								
TOTAL MARKS				**900**								

Course Title	Graph Theory and Optimization Techniques				Course Type		FC	
Course Code	B22AS0401	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course will cover the fundamental concepts of Graph Theory: simple graphs, digraphs, Eulerian and Hamiltonian graphs, matchings, paths and cycles, graph coloring, and planar graphs. There is an emphasis on applications to real world problems and on network flows.Optimization techniques are a powerful set of tools for solving complex real-world problems such as transportation and assignment problems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Achieve command of the fundamental definitions and concepts of graph theory.
2. Identify the trail, path, circuit and cycle in the connected graph
3. IdentifyEuler trail, path, Hamilton circuit and cycle.
4. Formulation of LPP and solving using some standard methods.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain basic concepts and analyse the significance of graph theory in different engineering disciplines.	1,2,3	1
CO2	Illustrate the concept of isomorphic graphs and coloring of the graph. Determine the maximum flow between the vertices for the given network.	1,2,3	1
CO3	Find chromatic number, chromatic polynomials for graphs and the planarity of the graph.	1,2, 3	1
CO4	Explain simplex method and two phase method for solving linear programming problem.	1,2,3	1
CO5	Find a basic feasible solution to the transportation problem by North- West Corner Method, MODI method and Vogel's Approximation Method (VAM).	1,2,3	1
CO6	Find initial basic feasible and optimal solution of the Transportation problems.	1 ,2,3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1		√				
CO2		√				
CO3	√					
CO4		√				
CO5	√					
CO6	√					

COURSE ARTICULATION MATRIX:

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1										1		
CO2	3	2	3										1		
CO3	3	2	2										1		
CO4	3	2	2										1		
CO5	3	2	1										1		
CO6	3	2	2										1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

Introduction to graph theory: Konigsberg's bridge problems, Utilities problem, Seating Problem, Graphs, Representation of Graphs. Directed graphs, Incidence, Adjacency, Degree, In degree, Out degree, Regular graphs, Complete graphs, Null Graph, Bipartite Graphs, Isomorphism, Directed Graphs, Sub graphs, Walk, Trail, Path, Circuit, Cycle, Connected and disconnected graphs, Components, Weakley connected and Strongly connected Components, Complement of graphs, Partition and Decompositions.

UNIT – II

Euler and Hamiltonian graphs and Graph coloring: Operation on graphs, Definition of Euler Trail, Euler Graphs, Hamiltonian path, Hamiltonian Cycle, Hamiltonian Graphs, Standard Theorems on Euler and Hamiltonian graphs, planar graph, detection of Planarity, Dual of planar graphs, Euler formula for planar graph, Graph coloring, Chromatic polynomial, Map coloring, Four Color Theorem, Five Color Theorem, Matching, Network flow, and its applications, Cut set, Cut vertex, Chord, Properties of Cut Sets, Max Flow Min Cut Theorem.

.UNIT – III

Linear Programming: Introduction, Canonical and Standard Form of LPP-Simplex Method-Big M Method- Two Phase Method-Principle of duality-Dual Simplex Method.

UNIT – IV

Transportation Problems-North- West Corner Method, Minimum-Cost Method, MODI method and Vogel's Approximation Method (VAM), Assignment problems: Hungarian Method,and unbalanced Assignment Problems.

TEXT BOOKS:

1. NasinghDeo, “Graph Theory with Applications to Engineering Computer Science”, Prentice-Hall, 2014.
2. KanthiSwarup, P.K. Gupta, ManMohan, “Operations research”, Sultan Chand & Sons. (module II), 5th edition.
3. Sharma J. K., “Operations Research: Theory and Applications”, Macmillan India Ltd.
4. Taha H. A., “Operations Research – An Introduction”, 9th ed., Prentice Hall India.

REFERENCE BOOKS:

1. Frank Harary, “Graph Theory”, Norosa, 2013.
2. J. A. Bondy and V. S. R. Murthy, “Graph Theory with Applications”, Macmillan, London, 2013.
3. S.S Rao, “Optimization Theory and Applications”, Wiley Eastern

JOURNALS/MAGAZINES:

1. https://onlinelibrary.wiley.com/journal/10970118
2. https://www.scimagojr.com/journalsearch.php?q=23898&tip=sid
3. https://en.wikipedia.org/wiki/Journal_of_Graph_Theory
4. https://www.springer.com/journal/10878
5. https://www.springer.com/journal/10957

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_ma10/preview#:~:text=Graph%20theory%20began%20in%201736,science%20and%20network%20information%20science.
2. https://onlinecourses.nptel.ac.in/noc22_cs17/preview
3. https://nptel.ac.in/courses/128106008
4. https://onlinecourses.swayam2.ac.in/cec20_ma03/preview
5. https://nptel.ac.in/courses/111105039
6. https://onlinecourses.nptel.ac.in/noc22_ma48/preview

<table>
<tr><td>Course Title</td><td colspan="4">Universal Human Values</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22AH0302</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>2</td><td>2</td><td>28</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	derstand the significance of value inputs in a classroom and start applying them in their life and profession.		
CO2	tinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.		
CO3	derstand the role of a human being in ensuring harmony in society and nature.		
CO4	Demonstrate the role of human being in the abetment of pollution.		
CO5	scribe appropriate technologies for the safety and security of the society as responsible human being.		
CO6	tinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.		

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

COURSE ARTICULATION MATRIX:

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

CO6															

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

Introduction and Value Education – Value Education, process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT – II

Understanding Harmony in the Human Being - **Harmony in Myself** - Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT – III

Understanding Harmony in the Family, Society and nature - Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in societyUndivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family!. Understanding Harmony in the Nature and Existence - Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT – IV

Implications of the above Holistic Understanding of Harmony on Professional Ethics - Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

TEXT BOOKS

1. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010.
2. A.N Tripathy, Human Values, New Age Intl. Publishers, New Delhi, 2004.
3. Bertrand Russell, Human Society in Ethics & Politics, Routledge Publishers, London, 1992.

REFERENCE BOOKS

1. Corliss Lamont, Philosophy of Humanism, Humanist Press, London, 1997.
2. I.C. Sharma, Ethical Philosophy of India, Nagin & co, Jalandhar, 1970.
3. Mohandas Karamchand Gandhi, The Story of My Experiments with Truth, NavajivanMudranalaya, Ahmadabad, 1993.
4. E G Seebauer& Robert L. Berry, Fundamentals of Ethics for Scientists &Engineers , Oxford University Press, 2010.
5. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd., 2011.

Course Title	Technical Documentation				Course Type		HC	
Course Code	B22EF0401	Credits	1		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	1	1	1	14	0	25%	25%

COURSE OVERVIEW:

Writing is a strength that all should improve on. This course creates specialized composing abilities important to impart data acquired through a cycle of specialized or test work. The course covers a wide range of topics to introduce Technical Writing and presents technical writing as an alternate career path.The course features the components that decide the level of detail of the language and ideas included. You will figure out how to compose distinctive specialized reports, e.g., lab reports, research reports, plan and plausibility reports, progress reports, counseling reports, and so forth.

COURSE OBJECTIVE (S):

Technical Writing prepares students to design effective technical documents for both written and digital media, with particular emphasis upon technical memos, problem-solving and decision-making reports, and organizational, product-support, and technical-information webs. Every type of writing has an objective.

The objectives of this course are to:

1. Provide with the confidence to use written communication in your work and personal experience beyond college,
2. Acquaint with the concept of a writer-reader relationship and identify the need for active participation from both writer and reader,
3. Teach the skills needed to successfully communicate in a modern world through written materials.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Interpret the stages of the writing process and apply them to technical and workplace writing tasks.	5, 9 10	3
CO2	Demonstrate rhetorical knowledge to create effective technical writing documents for end users.	1, 2, 4, 5, 6, 7, 11	1,3
CO3	Apply and adapt flexible writing process strategies to produce clear, high-quality deliverables in a multitude of technical writing genres.	1, 2, 3, 9, 10	1, 3
CO4	Use professional technical writing conventions of clean and clear design, style, and layout of written materials.	1, 2, 3, 5, 10	
CO5	Apply researched information that is appropriate to your field, as demonstrated by reading and analyzing documents, and citing sources correctly.	2, 10	
CO6	Write clearly, correctly, and concisely.	10	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					1				3	3					1
CO2	2	2		1	1	2	1				2		1		1
CO3	2	2	1						3	3			1		1
CO4	1	1	2		2					2					
CO5		2								3					
CO6										3					

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Techniques I - Introduction, Before You Start Writing, Understanding the Writing Process, Using the Computer to Improve Your Writing, Improving the Coherence of Your Writing

UNIT – 2

Techniques II -Writing Better Paragraphs, Writing Better Sentences, Choosing the Right Word, Creating and Integrating Graphics, Improving Page Design

UNIT – 3

Applications I – Letters, Memos, Minutes, Procedures and Manuals

UNIT – 4

Applications II – Formal Elements of Reports, Proposals, Progress Reports, Completion Reports introduce the Report Clearly.

TEXT BOOKS:

1. Mike Markel, "Writing In the Technical Fields: A step-by-Step Guide for Engineers, Scientists, and Technicians", John Wiley& Sons

REFERENCE BOOKS:

1. Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, “Handbook of Technical Writing”, Bedford/St. Martin’s, Ninth Edition, 2009
2. David Lindsay, “Scientific Writing = Thinking in Words”,Clayton SouthVIC:CSIRO Publishing,Second Edition,2020
3. Carme Bombardó Solés, Clàudia Barahona Fuentes, Marta Aguilar Pérez, “Technical Writing: A Guide for Effective Communication”, Edicions UPC, Second Edition, Barcelona, January 2008.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/6594223
2. https://ieeexplore.ieee.org/document/9219
3. https://www.tcworld.info/e-magazine/technical-writing/
4. https://journals.sagepub.com/doi/pdf/10.1177/1050651997011001003
5. https://journals.sagepub.com/doi/full/10.1177/1050651912458921

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/business-writing-immersion/
2. https://www.udemy.com/course/technical-writing/
3. https://www.coursera.org/learn/engineering-writing
4. https://www.coursera.org/specializations/leadership-communication-engineers

SELF-LEARNING EXERCISES:

Checklists, Handbook, Commonly Misused Words and Phrases, Guidelines for Speakers of English as a Second Language, Guidelines for Writing to Speakers of English as a Second Language.

<table>
<tr><td>Course Title</td><td colspan="4">Object Oriented Programming with Java</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0402</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>42</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

In this course the students shall learn Java's unique architecture which enables them to develop a single application that can run across multiple platforms seamlessly and reliably. The students shall also gain extensive experience with Java, object-oriented features and gui programming skills which helps them to provide solutions to solve real world problems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Impart elementary and the basic object oriented programming concepts and apply them in problem solving.
2. Illustrate the concept of inheritance and Polymorphism to reuse code and the implementation of packages and interfaces.
3. Introduce the concepts of exception handling and Collection.
4. Demonstrate the concept of event handling used in GUI developed using swing.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify object oriented programming features and concepts in solving the given problem.	1 to 5,9,10,12	1,2,3
CO2	Make use of concepts of inheritance and polymorphism to improve the code reusability.	1 to 5, 9,10,12	1,2,3
CO3	Develop application usingpackages and interfaces in solving complex problems.	1 to 5, 9,10,12	1,2,3
CO4	Apply the knowledge of Collections to process collective information.	1 to 5, 9 to 12	1,2,3
CO5	Implement exception handling to develop effective application	1 to 5, 9 to 12	1,2,3
CO6	Develop java-based applications using swings and event handlers	1 to 5, 9 to 12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3				3	1		3	3	3	3
CO2	3	2	3	1	3				3	1		3	3	3	3
CO3	3	2	3	2	3				3	2		3	3	3	3
CO4	3	2	3	2	3				3	2	2	3	3	3	3
CO5	3	2	3	2	3				3	2	2	3	3	3	3
CO6	3	2	3	2	3				3	3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

OOP CONCEPTS& JAVA FUNDAMENTALS: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, procedural and object oriented programming paradigm. Java programming: History of java, Java Programming environment, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions,control flow statements, simple java stand alone programs, arrays, console input and output,Introducing classes, Methods and Constructors.

Unit-2

INHERITANCE, POLYMORPHISM, PACKAGES AND INTERFACES: Basic concepts, Types of inheritance, Member access rules, Usage of this and Super key word, Method Overloading, Method overriding, Abstract classes, Dynamic method dispatch, Usage of final keyword. **Packages and interfaces:** Defining package, Access protection, importing packages, Defining and Implementing interfaces, and Extending interfaces.

Unit-3

Exception handling and The Collections Framework: Fundamentals of exception handling, Exception types, Termination or resumptive models, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception sub classes. **Collections:** Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque, Accessing a Collection via an Iterator, Using an Iterator.

Unit-4

GUI Programming with Swing and Event Handling: Introduction to Swings, Hierarchy of swing components. Containers, Top level containers - JFrame, JWindow, JDialog, JPanel, JButton, JToggleButton, JCheckBox, JRadioButton, JLabel, JTextField, JTextArea, JList, JComboBox, JScrollPane. **Event Handling-** The Delegation event model- Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes.

TEXT BOOKS:

1. HerbertSchildt, “Java™: TheComplete Reference”, McGraw-Hill,Twelfth Edition,2021.
2. Understanding OOP with Java, up dated edition, T.Budd, Pearson education.

REFERENCE BOOKS:

1. Kathy Sierra and Bert Bates Head First Java, O reilly, 2nd Edition, 2020.
2. Cay S. Horstmann, “Core Java™ Volume I—Fundamentals”, Prentice Hall, Tenth Edition, 2015.
3. Joshua Bloch, “Effective Java”, Addison-WesleyProfessional,ThirdEdition, 2017.
4. David Gallardo, Ed Burnette, Robert Mcgovern,“Eclipse in Action a guide for java developers”, Manning Publications, 2003.
5. Ed Burnette, “Eclipse IDE Pocket Guide: Using the Full-Featured IDE”, O'Reilly Media, Inc, USA, 2005.
6. Ken Kousen, “Modern Java Recipes”, O'Reilly Media, Inc.,2017.
7. Oracle Java Documentation. (https://docs.oracle.com/javase/tutorial/)

JOURNALS/MAGAZINES:

1. https://www.javadevjournal.com/
2. https://blogs.oracle.com/javamagazine/
3. https://ieeexplore.ieee.org/document/5464387
4. https://files.eric.ed.gov/fulltext/EJ1075126.pdf
5. https://www.sciencedirect.com/science/article/pii/S0167642304000590
6. https://www.informingscience.org/Publications/4322?Source=%2FJournals%2FJITEIIP%2FArticles%3FVolume%3D0-0

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
2. https://www.classcentral.com/course/swayam-programming-in-java-12930
3. https://swayam.gov.in/explorer?searchText=java

SELF-LEARNING EXERCISES:

1. The Eclipse-IDE
2. Streams
3. Multithreading
4. JavaFX
5. Networking- JDBC

Course Title	Database Management System				Course Type	HC	
Course Code	B22EF0403	Credits	3		Class	IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Lecture	3	3	3			
	Tutorial	-	-	-	Theory	CIE	SEE
	Practical	-	-	-			
	Total	3	3	3	42	50%	50%

COURSE OVERVIEW:

This course is intended to provide an understanding of the current theory and practice of database management systems. The course provides a solid technical overview of database management systems, using a current database product as a case study. In addition to technical concerns, more issues that are general are emphasized. These include data independence, integrity, security, recovery, performance, database design principles, and database administration. This course is designed to investigate how database management system techniques are used to design, develop, implement, and maintain modern database applications in organizations.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the basic concepts about the conceptual data models and ER diagrams.
2. Make use of basic concepts to build the relational models and relational algebra.
3. Apply SQL commands to create and manipulate database.
4. Analyze database design concepts using normalization techniques.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Construct the conceptual entity relationship diagrams for the real - world applications.	1 to 5, 9,10,12	1,2,3
CO2	Make use of the concepts of relational algebra to solve queries over database.	1 to 5,9,10,12	1,2
CO3	Relate conceptual model to relational model and formulate relational algebra queries	1 to 5, 9,10,12	1,2
CO4	Create the database for given real world application and solve queries over it using SQL commands.	1 to 5, 9,10,12	1,2,3
CO5	Organize database using design guidelines and normalization technique.	1 to 5, 9,10,12	1,2
CO6	Design the database model for real-world applications	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1			√			
CO2			√			
CO3			√			
CO4						√
CO5					√	
CO6						√

COURSE ARTICULATION MATRIX

Note: 1-Low, 2-Medium, 3-High

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	3				3	3		3	3	3	
CO 2	3	3	2	2	1				3	3		3	3	3	
CO 3	3	3	2	2	1				3	3		3	3	3	3
CO 4	3	3	3	3	3				3	3		3	3	3	
CO 5	3	3	1	3	1				3	3		3	3		3
CO 6	3	3	3	3	3				3	3		3		3	3

COURSE CONTENT

UNIT – 1

Introduction to databases and Conceptual Modelling: Introduction, characteristics of the database approach, data models, schemas, instances, database languages and interfaces, Using high-level conceptual data models for database design, a sample database application, entity types, attributes, keys, relationship types, weak entity types, ER diagrams, naming conventions, design issues.

UNIT – 2

Relational Data Model and Relational algebra: Relational model concepts, relational model constraints and relational database schemas, update operations, transactions, dealing with constraint violations, unary relational operations, select and project, relational algebra operations from set theory, binary relational operations, join and division, additional relational operations, examples of queries in relational algebra.

.

UNIT – 3

SQL: SQL data definition and data types, specifying constraints in SQL, basic retrieval queries in SQL, insert, delete, update statements in SQL, additional features of SQL, schema change statements in SQL, retrieving data using the SQL Select Statement, Restricting and sorting data, Using Single row functions, Joins, More complex SQL retrieval queries, views in SQL.

UNIT – 4

Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, Normal forms based on primary keys, General definitions of second and third normal forms, Other Normal forms.

TEXT BOOKS:

1. Elmasri and Navathe, “Fundamentals of Database Systems”, 5th Edition, Pearson Education, 2007.
2. Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, 3rd Edition, McGraw Hill, 2003.
3. Phill Pratt, “Concepts of Database Management, Cengage Learning”, 8th Edition, 2014.
4. Jeffrey A Hoffer, “Modern Database Management, Pearson”, 12th Edition, 2015.

REFERENCE BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: “Database System Concepts”, 6th Edition, McGraw Hill, 2010.
2. C J Date, “Database Design and Relational Theory: Normal Forms and All that Jazz”, O ‘Reilly, April 2012.
3. James Martin, “Principles of Database Management Systems”, 1985, Prentice Hall of India, New Delhi.
4. IEEE Transactions on Knowledge and Data Engineering.
5. Elsevier Data and Knowledge Engineering.
6. ACM Transactions on Database Systems.

JOURNALS/MAGAZINES:

4. https://ieeexplore.ieee.org/document/5464387
5. https://blogs.oracle.com/javamagazine/
6. https://airccse.org/journal/ijdms/index.html
7. https://www.imedpub.com/scholarly/database-management-journals-articles-ppts-list.php
8. http://www.odbms.org/odmg-standard/reading-room/magazines/
9. https://www.igi-global.com/journal/journal-database-management/1072

SWAYAM NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_cs51/preview
2. https://www.mooc-list.com/tags/database-management
3. https://onlinecourses.swayam2.ac.in/cec21_cs11/preview
4. https://www.udemy.com/topic/database-management/

Practice

Design and draw the ER Diagram for any of the two following database application with minimum 4/ 5 entities and specify the proper key and structural constraints:

1. Design a college library management project that manages and stores books information electronically according to students needs. The system helps both students and library manager to keep a constant track of all the books available in the library. It allows both the admin and the student to search for the desired book.
2. Develop a Hostel Management system for the computerization of the Hostel. The common transaction of the hostel includes the maintenance of mess bills, information about students in the hostel, enrolling of new students and their payments and dues etc are stored into the databases and reports are generated according to the user requirements
3. Develop a Hospital Management system that includes registration of patients, storing their details into the system, and computerized billing in the pharmacy, and labs. The software should have the facility to give a unique id for every patient and stores the details of every patient and the staff automatically.

4. Bank Managementcreation of a secure Internet banking system. This will be accessible to all customers who have a valid User Id and Password. This is an approach to provide an opportunity to the customers to have some important transactions to be done from where they are at present without moving to bank.
5. Super Market Information Management automation. This software should help salespersons in managing the various types of Records pertaining to his/her customer. The product should help the user to work in a highly effective and efficient environment.

Example Questions to relational Algebraic expression and SQL.

Assume the following relations:

BOOKS (DocId, Title, Publisher, Year)

STUDENTS (StId, StName, Major, Age)

AUTHORS (AName, Address)

Borrows (DocId, StId, Date)

Has-written (DocId, AName)

Describes (DocId, Keyword)

1. List the year and title of each book.
2. List all information about students whose major is CS.
3. List all books published by McGraw-Hill before 1990.
4. List the name of those authors who are living in Davis.
5. List the name of students who are older than 30 and who are not studying CS
6. Rename AName in the relation AUTHORS to Name.
7. List the names of all students who have borrowed a book and who are CS majors.
8. List the authors of the books the student 'Smith' has borrowed.
9. Which books have both keywords 'database' and 'programming'?
10. List the title of books written by the author 'Ullman'.

SELF-LEARNING EXERCISES:

Transactions and Recovery: The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions. Introduction to recovery, Recovery Concepts, Shadow Paging, The Aries Recovery Algorithm

Course Title	Computer Organization and Architecture				Course Type		HC	
Course Code	B22EF0404	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	0	50%	50%

COURSE OVERVIEW:

The course is designed to make the students capable of comprehending the fundamental design of a digital computer. Understanding the hardware that powers the code and how it interacts with the existing memory and I/O structure during execution at the physical level requires study of computer organisation and architecture. It aids students in grasping the principles of computer system design so they may expand on the capabilities of computer organisation to identify and address issues with computer architecture.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the basics of computer organisation & architecture.
2. Learn the mechanism of computer arithmetic.
3. Recognize the different memory hierarchy.
4. Study the different I/O mechanism.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Recognize and explain the significance of a digital computer's fundamental parts, I/O organisation, and memory architecture.	1,2,3,9,12	1
CO2	Describe how arithmetic algorithms are implemented in a digital computer.	1,2,3.9,12	1
CO3	Explain the types of memory systems and mapping functions used in memory systems	1,2,39,12	1
CO4	Understand the different input output mechanism and interfacing circuits.	1,2,3,9,12	1
CO5	Discuss different communication techniques used in computer architecture.	1,2,3,9,12	1
CO6	Demonstrate the control signals required for the execution of a given instruction	1,2,3,9,12	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			

CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2						3			2	3		
CO2	3	3	2						3			2	3		
CO3	3	3	2						3			2	3		
CO4	3	3	3						3			2	3		
CO5	3	2	2						3			2	3		
CO6	3	2	2						3			2	3		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Basic Structure of Computers & Basic Processing: Computer Types, Functional Units, Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Basic Operational Concepts.

Some Fundamental Concepts, Instruction Execution, Load Instructions, Arithmetic and Logic Instructions, Store Instructions.

UNIT – 2

Computer Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Carry-Lookahead Addition, Multiplication of Unsigned Numbers, Array Multiplier, Sequential Circuit Multiplier, Multiplication of Signed Numbers, The Booth Algorithm, Fast Multiplication, Bit-Pair Recoding of Multipliers, Carry-Save Addition of Summands, Integer Division, Floating-Point Numbers and Operations Arithmetic Operations on Floating-Point Numbers.

UNIT – 3

Memory: Basic Concepts, Semiconductor RAM Memories, Internal Organization of Memory Chips, Static Memories, Dynamic RAMs, Synchronous DRAMs, Structure of Larger Memories, Read-only Memories, ROM, PROM, EPROM, EEPROM, Flash Memory, Direct Memory Access, Memory Hierarchy, Cache Memories, Mapping Functions, Replacement Algorithms, Virtual Memory, Address Translation.

UNIT – 4

I/O : Accessing I/O Devices, I/O Device Interface, Program-Controlled I/O, Interrupts, Bus Structure, Bus Operation, Synchronous Bus, Asynchronous Bus, Arbitration, Interface Circuits, Parallel Interface, Serial Interface, Interconnection Standards Universal Serial Bus (USB), PCI Bus, PCI Express.

Self Learning Components: Pipelining: Basic Concept—The Ideal Case, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays.

Basic introduction to multi core processors

Text Book:

1. Carl Hamacher, Computer Organization and Embedded Systems, Sixth Edition, Tata MC Graw Hill.

REFERENCE BOOKS:

1. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier.
2. William Stallings: Computer Organization & Architecture, 7th Edition, PHI.
3. Vincent P. Heuring& Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=40
2. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=2
3. https://dl.acm.org/journal/tocs
4. https://www.sciencedirect.com/journal/future-generation-computer-systems

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs25/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs64/preview

Professional Elective -1

Course Title	Artificial Intelligence				Course Type		SC	
Course Code	B22EFS411	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course introduces the basics of Artificial Intelligence (AI), AI problems and search strategies. The students can explore knowledge representation issues and methods. This course provides algorithms for, problem solving and controlling the knowledge and also demonstrates various learning methods for constructing knowledge and taking decisions.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Learn the different search strategies and its applications in AI.
2. Illustrate the representation of knowledge in solving AI problems.
3. Implement the concepts involved in the knowledge of reasoning.
4. Demonstrate the techniques of learning, expert systems and various applications of AI.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the role of search algorithms in any AI problem solving.	1,2,3,4,5	1,2,3
CO2	Apply basic principles of AI in solutions that require problem solving, knowledge representation and learning.	1,2,3,4,5	1,2,3
CO3	Represent problems using first order and predicate logic	1,2,3,4,5,12	1,2,3
CO4	Demonstrate knowledge of reasoning and representation for solving real world problems.	1,2,3,4,5,9,12	1,2,3
CO5	Illustrate the understanding of various applications of AI techniques in learning, expert systems.	1,2,3,4,5,9,12	1,2,3
CO6	Apply and analyze the concepts of Artificial Intelligence in developing applications for NLP.	1,2,3,4,5,9,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				

CO2			✓			
CO3		✓				
CO4			✓			
CO5				✓		
CO6				✓		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1								1	2	2
CO2	3	2	1	1	1								2	3	2
CO3	3	3	2	2	1							2	1	2	3
CO4	3	3	3	2	2				2			2	3	2	3
CO5	3	3	3	2	2				2			2	3	3	3
CO6	3	2	2	1	1				3			3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit 1

Problems and Search: What is AI? The AI Problems; The Underlying Assumptions; What is an AI Technique? Problems, **Problem Spaces and Search**; Defining the problem as a state space search, Production systems; Problem characteristics, Production system characteristics, Issues in the design of search programs; **Heuristic search techniques:** Generate-and-test; Hill climbing; Best-First Search; Problem reduction; Constraint satisfaction.

Unit – 2

Knowledge Representation: Knowledge representation Issues: Representations and mappings; Approaches to knowledge representation; Issues in knowledge representation; **Using Predicate logic:** Representing simple facts in logic; Representing Instance and ISA relationships; Computable functions and predicates; Resolution;

Unit – 3

Representing Knowledge using Rules: Procedural versus declarative knowledge; Logic Programming, Forward versus backward reasoning, Matching;

Statistical Reasoning: Probability and Bayes Theorem, Certainty factors and rule based systems, Bayesian networks, Dempster-Shafer Theory, Fuzzy logic.

Unit – 4

Learning: What is learning?; Rote Learning; Learning by taking Advice; Learning in Problem Solving; Learning from examples; **Expert Systems**: Representing and using Domain Knowledge; Expert system shells; Explanation; Knowledge Acquisition

Natural Language Processing: Language Models, Text classification; Information Retrieval, Information Extraction; Machine Translation, Speech Recognition; Robotics: Hardware, Perception, Planning, Moving.

TEXT BOOKS:

1. Elaine Rich, Kevin Knight: Artificial Intelligence, 3rdedition, Tata Mcgraw Hill, 2009.
2. Russell & Norvig: Artificial Intelligence: A Modern Approach, Third Edition, Prentice-Hall, 2010.

REFERENCE BOOKS:

1. Nils J. Nilsson: Principles of Artificial Intelligence, Elsevier, 1980.
2. Krishan Mehrotra, Chilkuri K. Mohan, Sanjay Ranka: Artificial Neural Networks, Penram International Publishing, 1997.
3. B.Yegana narayana: Artificial Neural Networks, PHI, 2001.
4. IEEE, IEEE transaction for computational Intelligence.

Self-Learning Components:

PEAS (Performance, Environment, Actuators and Sensors) for Agents, Genetic Algorithm, Distributed Agents, Wumpus World game (Understanding the game and applying planning and learning rules), Bioinformatics.

Course Title	System Software				Course Type		SC	
Course Code	B22EFS412	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The course deals with various system softwaresuch as assemblers, loaders, linkers and compilers which support the operation of a computer. It helps the user to focus on an application, without needing to know the details of how the machine works internally. System applications are used to translate into machine language program. The course also deals with lexical and syntactical analysis that deals with construction of parsing. This course is essential for all computer science students who are aspiring to become computer architects

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Impart the knowledge about the architecture of SIC and SIC/XE.
2. Illustrate the use of different addressing modes in generating machine code.
3. Discuss functions of different types of loaders and linkers, structure of compilers
4. Design and develop simple programs using lex and yacc.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the Architecture of SIC and SIC/XE.	1 to 5,9,10,12	1,3
CO2	Apply addressing modes of SIC/XE in developing Assembly programs.	1 to 5, 9,10,12	1,3
CO3	Implement Absolute loader and relocating loader	1 to 5, 9,10,12	2, 3
CO4	To understand the working of compilers	1 to 5, 9,10,12	2
CO5	Identify and generate of tokens using lexical analysis	1 to 5, 9,10,12	1,3
CO6	Define the rules of grammar using syntactic analysis.	1 to 5, 9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1		√				
CO2			√			
CO3		√				
CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1				3	3		2	3		3
CO2	3	3	2	2	1				3	3		2	3		3
CO3	3	3	1	1	1				3	3		2		3	3
CO4	3	3	3	1	2				3	3		2		3	
CO5	3	1	2	1	3				3	3		2	3		3
CO6	3	1	2	1	3				3	3		2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction: System software and machine architecture, The simplified instructional computer (SIC): SIC Machine Architecture, SIC/XE Machine Architecture, SIC and SIC/XE programming examples.

UNIT – 2

Assemblers: BasicAssembler functions: A Simple SIC Assembler, Assembler Algorithm and Data Structures, Machine Dependent Assembler features: Instruction formats & addressing modes, program relocation, Machine Independent Assembler features: Literals, symbol defining statements, expressions, program blocks, control sections and program linking.

UNIT – 3

Loaders: Basic Loader functions: Absolute Loaders, Bootstrap loaders, Machine Dependent loader features: Relocation, program linking, algorithms and data structures for a Linking loader.

Compilers: The structure of a compiler: Grammars, lexical analysis, syntactical analysis & code generation, code optimization, symbol table management, grouping of phases into passes, compiler construction tools, Basic Compiler functions, Applications of compiler technology.

UNIT – 4

Lex and Yacc: The Simplest Lex Program, Grammars, Parser-Lexer Communication, A YACC Parser, The Rules Section, Running LEX and YACC, LEX and Hand- Written Lexers, A Word Counting Program, Using YACC – Grammars, Recursive Rules, Shift/Reduce Parsing, What YACC Cannot Parse, A YACC Parser - The Definition Section, The Rules Section, The LEXER, Compiling and Running a Simple Parser.

TEXT BOOKS:

1. System Software by Leland. L. Beck, D Manjula, 3rd edition, 2012.
2. Doug Brown, John Levine, Tony Mason, lex&yacc, O'Reilly Media, October 2012.

REFERENCE BOOKS:

1. System programming and Compiler Design, K C Louden, Cengage Learning.
2. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman , Compilers-Principles, Techniques and Tools, Pearson, 2nd edition, 2007.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/4724385
2. https://ieeexplore.ieee.org/document/1515775
3. https://ieeexplore.ieee.org/document/537096
4. https://ieeexplore.ieee.org/document/642815
5. https://ieeexplore.ieee.org/document/5942077
6. https://ieeexplore.ieee.org/document/1183668

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2. https://onlinecourses.nptel.ac.in/noc21_cs81/preview
3. https://nptel.ac.in/courses/128106013

SELF-LEARNING EXERCISES:

1. Multi-pass assemblers
2. Macroprocessors
3. Text Editors
4. Interactive Debugging Systems
5. Operating System

<table>
<tr><td>Course Title</td><td colspan="4">Sensors and Interfacing</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22EFS413</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

In a modern development cycle, it is important for the developers to understand the sensor system, how they interact, and design the interface. In this course, students understand the basic concepts of various sensors, characteristics, and its applications. Students can examine various sensors, their interfacing components and how they are applied in interfacing the applications.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the fundamental concepts of sensors and their applications
2. Explain the various types of sensors and their characteristics
3. Select an appropriate sensor for sensing and control action.
4. Demonstrate the communication and sensor interfacing components

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate the working principle of various sensors with their characteristics of communication interfaces.	1 to 3, 9,10,12	1,2
CO2	Apply analytical skills to determine the response of sensors for change in physical parameters	1 to 3, 9,10,12	1,2
CO3	Select an appropriate sensor to design physical parameter measurement solutions for a specific application	1 to 3, 9,10,12	1,2
CO4	Apply the principles of different sensors to analyze real-time physical parameters in industry	1 to 3, 9,10,12	1,2,3
CO5	Follow ethical standards when designing circuits that measure physical parameters.	1 to 3, 8 to 10,12	1,2,3
CO6	Understand the working of various sensors and provide engineering solutions for societal use.	1 to 3, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3			✓			
CO4			✓			
CO5			✓			
CO6		✓				

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	2	2						2	2		1	3	2	
CO2	2	2	3						2	2		1	3	3	
CO3	2	2	3						2	2		1	3	2	
CO4	2	2	3						2	2		1	2	3	2
CO5	2	2	3					2	2	2		1	3	2	3
CO6	2	2	3						2	2		1	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Digital Inputs and Outputs: Introduction to Digital Sensor, Sensor Types and Selection, Advantages of Digital Sensors, Digital Outputs, Pulse-Width Modulation with analog Write, Reading Digital Inputs, Building a Controllable RGB LED Nightlight.

UNIT – 2

Reading Analog Sensors: Introduction to Analog Sensor, Sensor Types and Selection, Advantages of Analog Sensors, Analog versus Digital Sensing, Understanding Analog and Digital Signals, Reading Analog Sensors with the Arduino.

UNIT – 3

Communication Interfaces: USB and Serial Communication, I2C Bus-I2C Hardware Design, Communication Scheme, and ID Numbers, communicating with an I2C Temperature Probe SPI Bus-Hardware Configuration, Communication Scheme, Comparing SPI to I2C, Communicating with an SPI Digital Potentiometer.

UNIT – 4

Sensors Interfacing: Interfacing of Analog Sensors: Potentiometer, Temperature Sensor (LM35), LDR and Flex Sensor, Interfacing of Digital Sensors: Switch, PIR Motion Sensor, Fire Sensor, Rain Sensor, and Vibration Sensor.

TEXT BOOKS:

3. Jeremy Blum, “Exploring Arduino: Tools and Techniques for Engineering Wizardry”, Wiley Publisher, First Edition, 2013.
4. T Rajesh Singh, ku "Getting Started for Internet of Things with Launch Pad and ESP8266", River Publishers, First Edition, 2019.

REFERENCE BOOKS:

1. Sensors, Actuators, and their Interfaces a Multidisciplinary Introduction, By Nathan Ida · 2014.
2. Arduino meets MATLAB: Interfacing, Programs and Simulink, Rajesh Singh, Anita Gehlot, Bhupendra Singh · 2018
3. Piezo electric Sensors and Actuators: Fundamentals and Applications, Springer, 2018
4. Senturia S. D, Sensors and Signal Conditioning Wiley-Blackwell, 2008
5. Jacob Fraden, Handbook of modern sensors, Springer, Stefan Johann Rupitsch

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/6742595
2. https://ieeexplore.ieee.org/document/9584868
3. https://ieeexplore.ieee.org/document/9376916

4. https://dl.acm.org/doi/10.1145/3231053.3231121
5. https://dl.acm.org/doi/10.1145/2899007.2899010

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2. https://www.edx.org/course/iot-sensors-and-devices?index=product&queryID=77d5d64fc974f050698418c9a9f4ff47&position=2&linked_from=autocomplete

SELF-LEARNING EXERCISES:

1. Review of the Arduino Uno board, Arduino Ethernet Shield
2. Understand why Sensors have Standard output Range and how to choose them,

Course Title	Operation Research				Course Type		SC	
Course Code	B22EFS414	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

Operations Research is the discipline of applying analytical methods to solve complex problems and make better decisions. It uses mathematical modelling, analysis, and optimization techniques in a holistic approach, OR facilitates in transforming data into information and information into insights. Its applications range from engineering to management, and from industry to the public sector. In Computer Science OR finds its application in Algorithms, Machine learning, and Artificial intelligence.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand and apply the fundamental concepts of linear programming.
2. Understand and apply different techniques to solve transportation and assignment problems.
3. Understand and apply different dynamic programming and integer programming techniques on OR problems to achieve optimality.
4. Understand and apply game theory for decision making problems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
1	Apply simplex method to solve linear programming problems and perform sensitivity analysis.	1,2,3,4,5,6	1,2,3
2	Apply different techniques to solve transportation problems and achieve optimality.	1,2,3,4,5,6	1,2,3
3	Apply different techniques to solve assignment problems and achieve optimality.	1,2,3,4,5,6	1,2,3

4	Apply Dynamic programming to solve muti stagecoach problem and achieve optimality.	1,2,3,4,5,6	1,2,3
5	Apply Integer programming to solve linear programming problems and achieve optimality.	1,2,3,4,5,6	1,2,3
6	Apply game theory and techniques on problems to take decisions and achieve optimality.	1,2,3,4,5,6	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√	√			
CO2	√	√	√			
CO3	√	√	√			
CO4	√	√	√			
CO5	√	√	√			
CO6	√	√	√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO2	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO3	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO4	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO5	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO6	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3

Note: 1-Low, 2-Medium, 3-High

UNIT- 1

Introduction, Linear Programming – 1

Introduction: The origin, nature, and impact of OR defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation. Introduction to Linear Programming: Prototype example; The linear programming (LP) model.Assumptions of LP; Additional examples. The essence of the simplex method; Setting up the simplex method; Algebra of the simplex method; the simplex method in tabular form; Tie breaking in the simplex method, Post optimality analysis, Duality Theory.

UNIT- 2

Linear Programming - 2

Transportation Problems:

Solving Balanced Transportation problems: NWCR Rule, Minimum cost method, Vogel's Approximation method (Penalty method), Basic Feasible solution, degenerate basic feasible solutions; finding optimal solution to the transportation problem: Stepping Stone method, MODI method or u-v method, Optimum solution with degenerate basic feasible solution.

Assignment Problems:

Assignment problem, properties of the optimal solution, solving the assignment problem – Hungarian method, the optimality of the Hungarian Algorithm

UNIT- 3

Dynamic and Integer Programming

Dynamic Programming-Multistage decision process, Forward and Backward approach, Resource Allocation Problem

Integer Programming – Graphical representation, Gomory's cutting plane method-concept of a cutting plane, Gomory's method for integer programming problems, branch and bound methods.

UNIT- 3

Game Theory, Decision Analysis

Game Theory: The formulation of two persons, zero sum games; Solving simple games- a prototype example; Games with mixed strategies; Graphical solution procedure; Solving by linear programming, Extensions. Decision Analysis: A prototype example; Decision making without experimentation; Decision making with experimentation; Decision trees.

TEXT BOOKS:

1. Frederick S Hillier, Gerals J Lieberman, Bodhibrata Nag, PreetamBasu, Introduction to Operations Research, , 9th Edition, McGraw Hill Education, Special Indian Edition, 2012.
2. G Srinivasan, Operations Research Principles and Applications, 2nd Edition, PHI Learning Private Limited, 2010.

REFERENCE BOOKS

1. Hamdy A. Taha, Operations Research An Introduction, , 8th Edition, Pearson Education, 2007.
2. S D Sharma, Operations Research Theory, Methods & Applications, 10th Edition, Kedarnath Ramnath & Co.
3. J K Sharma, Operations Research Theory & Applications, 5th Edition, Macmillan

SELF-LEARNING COMPONENT

1. https://www.coursera.org/learn/operations-research-modeling#syllabus
2. https://www.udemy.com/course/optimization-with-excel-operations-research-without-coding/

SWAYAM/NPTEL/COURSERA

1. https://nptel.ac.in/courses/110106062
2. https://onlinecourses.nptel.ac.in/noc22_ma48/preview
3. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview

SAMPLE QUESTIONS/PROBLEMS

MODULE-1

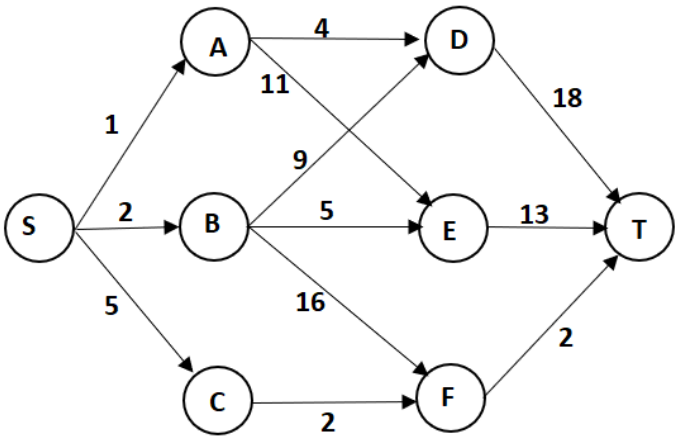
1	A man operates a pushcart. He sells hotdogs and sodas. His cart can support 210 kgs. A hotdog weighs 200 grams; a soda weighs 100 grams. He knows from experience that he must have at least 60 sodas and at least 80 hotdogs. He also knows that for every two hotdogs he sells, he needs at least one soda. Given he makes 5 rupees profit on a hotdog and 4 rupees profit on a soda. Formulate an LPP.
2	ve the given problem using simplex tabular method. (Big-M method) Min Z = 3x1+5x2 subject to 3x1+ 2x2 ≥ 36 3x1+ 5x2 ≥ 45 x1, x2 ≥ 0
)DULE-2	
1	d optimal solution for given transportation problem

					pacity
					)
					)
					)
mand	)	)	5	)	75

2	ve the given assignment problem using Hungarian Algorithm				

	P1	P2	P3	P4	P5
J1	11	7	10	17	10
J2	13	21	7	11	13
J3	13	13	15	13	14
J4	18	10	13	16	14
J5	12	8	16	19	10

)DULE-3	
1	Solve the below graph using dynamic programming.



2	Solve the given LPP using graphical method

	Max **Z = $6X + 7Y$** Subject to $4X + 5Y \leq 20$ $10X + 7Y \leq 35$ $3X + 4Y \geq 6$ **$X, Y \geq 0$ and integer**

MODULE-4

1 Solve the game using dominance principle whose payoff matrix to the player A is given below.

		B		
A		**I**	**II**	**III**
	I	1	7	2
	II	6	2	7
	III	5	2	6

2 In an election campaign, the strategies adopted by the ruling and opposition party along with payoffs (ruling party's % share in votes polled) are given below. Solve it as game theory & find the payoff:

Opposition Party's Strategies			
Ruling Party's Strategies	Campaign one day in each city	Campaign two days in large towns	Spend two days in large. rural sectors
Campaign one day in each city	55	40	35
Campaign two days in large towns	70	70	55
Spend two days in large rural sectors	75	55	65

Course Title	**Design and Analysis of Advanced Algorithms**				**Course Type**		**SC**	
Course Code	**B22EFS415**	**Credits**	**3**		**Class**		**IV Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	**3**	**3**	**3**				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

The objective of this course is to introduce the formal techniques to support the design and analysis of algorithms, focusing on both the underlying mathematical theory and practical considerations of efficiency.Topics includes asymptotic complexity bounds, techniques of analysis, Divide and conquer techniques, Dynamic programming, Greedy approach, Branch and bound techniques, NP Hard problems and algorithmic strategies.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Analyze the Asymptotic performance of algorithms and design algorithms using divide and conquer approach.
2. Design algorithms using the dynamic programming, and greedy method.

3. Develop efficient algorithm using graph methods.
4. Design the algorithms using branch and bound approach.
5. Ability to understand the Class P, NP, NP-hard and NP-complete problems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basic notation for analyzing the performance of the algorithms.	1-4,6,7	1,2
CO2	Illustrate divide-and-conquer techniques for solving suitable problems.	1-4,6,9,12	1,2
CO3	Make use ofdynamic programmingand greedy approach to solve suitable problems.	1-4,9,12	1,2
CO4	Apply the graph algorithms and their analysis.	1-4,6,7,9,12	1,2
CO5	Analyze branch and bound approach to solve an appropriate problem.	1-4,6,9,12	1,2
CO6	Evaluate the classes P, NP, and NP-Complete and be able to prove that a problem is NP-Complete.	1-4,6,7	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5				√		
CO6					√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1								3	2	
CO2	3	3	3	2	2				2			2	2	3	2
CO3	3	3	3	2	2					3		3	3	3	2
CO4	3	3	3	2	3				3	3		3	3	3	2
CO5	3	3	3	2	2				2			2	2	3	2
CO6	3	3	3	2	3				2			2	2	2	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Analysis of Algorithm: The efficient algorithm, Average, Best and worst case analysis, Amortized Analysis.

Divide and Conquer: Introduction, Recurrence and different methods to solve recurrence, Multiplying large Integers problem - Binary Search, Max-Min problem, Sorting (Merge sort, Quick Sort), Matrix Multiplication, Exponential.

UNIT – 2

Dynamic Programming: Introduction, The Principle of optimality, problem solving using Dynamic Programming-Calculating the Binomial Coefficient, Knapsack problem, Matrix chain multiplication.

Greedy Algorithm: General characteristics of greedy algorithms, Problem solving using-Activity selection problem, Fractional Knapsack Problem, Job scheduling problem.

UNIT – 3

Graph Algorithms: Representation of Undirected & Directed Graph, Traversing Graphs, Depth First search, Breadth First Search, Topological sort, strongly connected components. Single pair shortest path and minimum spanning trees (Kruskal's algorithm, Prim's algorithm) using greedy approach, All points shortest path using Dynamic programming.

UNIT – 4

Backtracking and Branch and Bound: Introduction, The Eight Queens problem, Knapsack problem, Travelling Salesman Problem, Minimax principle.

Introduction to NP-Completeness: The class P and NP, Polynomial reduction, NP-completeness problem, NP hard Problems, Travelling Salesman Problem, Hamiltonian problem.

TEXT BOOKS:

1. Anany Levitin, —Introduction to the Design and Analysis of Algorithms‖, Third Edition, Pearson Education, 2012.
2. Algorithm Design - Jon Kleinberg and Eva Tardos, Pearson, 1st Edition (2013).

REFERENCE BOOKS:

1. Introduction to the Design & Analysis of Algorithms - Anany Levitin, 2nd Edition, Pearson Education, 2007.
2. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivestand Clifford Stein, Introduction to Algorithms, 3rd Edition, PHI,2010.
3. R C T Lee, S S Tseng, R C Chang andY T Tsai, Introduction to the Design and Analysis of Algorithms A Strategic Approach, Tata McGraw Hill,2005.
4. Jon Kleinbergand E. Tardos, Algorithm Design, Pearson Addison-Wesley,2004.
5. S. Dasgupta, C. Papadimitriou and U. Vazirani Algorithms, 1st Edition, McGraw-Hill Education, 2006.
6. AV Aho, JE Hopcroft and JD Ullman, The Design and Analysis of Algorithms, Addison-Wesley Publishing Company, 1974.
7. https://www.tutorialspoint.com/parallel_algorithm/parallel_algorithm_quick_guide.htm

JOURNALS/MAGAZINES:

1. https://www.journals.elsevier.com/journal-of-algorithms
2. https://journals.sagepub.com/home/act
3. https://www.sciencedirect.com/journal/journal-of-algorithms

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106106131
2. https://onlinecourses.nptel.ac.in/noc19_cs47/preview
3. https://nptel.ac.in/courses/106101060
4. https://www.my-mooc.com/en/categorie/algorithms-and-data-structures
5. https://www.udemy.com/topic/algorithms/
6. http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html
7. http://nptel.ac.in/courses/106101060/
8. http://www.comp.nus.edu.sg/~cs5234/Links/Course-Links.htm
9. https://www.coursera.org/learn/algorithm-design-analysis
10. http://apps.topcoder.com/wiki/di...
11. http://www.geeksforgeeks.org,
12. http://www.algolist.net
13. http://www.cprogramming.com
14. http://www.codingunit.com

Self-Learning Exercises:

Design and analysis of Parallel Algorithm: Introduction-Concurrent Processing, Model of Computation, Parallel algorithm and Analysis, Parallel Algorithm Models.

Course Title	Java Programming Lab				Course Type		HC	
Course Code	B22EF0405	Credits	1		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE OVERVIEW:

Java's unique architecture enables programmers to develop a single application that can run across multiple platforms seamlessly and reliably. In this course, students gain hands-on experience on using fundamental & advanced java concepts and also learn to use tools to execute java programs.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic data types and control structures of the Java language.
2. Illustrate the creation of classes and objects in Java.
3. Demonstrate extending a class (inheritance) and use proper program anomaly handling structures.
4. Illustrate creation of windows applications using swings and event handling.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Design and develop java programs for solving simple problems using fundamental concepts.	1 to 5,9,10,12	1,3
CO2	Use arrays and other data structures to organize and use data to solve real world problems.	1 to 5, 9,10,12	1,3
CO3	Make use of properties of one class in another using inheritance.	1 to 5, 9,10,12	2, 3
CO4	Implement Exception Handling to develop effective applications using java.	1 to 5, 9,10,12	2
CO5	Develop java windows applications using swing components.	1 to 5, 9,10,12	1,3
CO6	Develop responsive applications using event handling.	1 to 5, 9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1				3	3		2	3		3
CO2	3	3	2	2	1				3	3		2	3		3
CO3	3	3	1	1	1				3	3		2		3	3
CO4	3	3	3	1	2				3	3		2		3	
CO5	3	1	2	1	3				3	3		2	3		3
CO6	3	1	2	1	3				3	3		2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

PRACT ICAL:

No	Title of the Experiment
1.	te a java program to create a console application that allows the user to choose an arithmetic operation able to provide his choice of operands for the same. Display the appropriate output. e: Use Switch statement to perform the operations.
2.	tring is a collection of characters, a given string can be a combination of vowels and consonants. Develop a java program to count the number of vowels and consonants in a string.
3.	ıg a one dimensional array, read an array of integer elements and perform the following operations. y all elements from one array to another. ıove duplicate elements from array and print only even position of array.

4.	elop a JAVA program to write an application to create student database to input name, SRN and college name, where college name should be declared as static variable and perform the following tasks. ate a class with static variable. rt some values into the members of the class including static member and display the values of the members. nge the value of static variable and display the updated values of the members.
5.	ume of a box to be computed using different features of a box: height, width and depth. Write a generic java program that accepts the values of the features of a box during the construction of its object and calculate its volume and display the same. e: Student should identify the classes, data and function members in each class and write the program.
6.	ild inherits the features of parents and also develops its own personality as it grows up in the society, over a period of time. This situation can be represented by the concept of multilevel inheritance in java programming. Apply the same concept in the car manufacturing scenario in your own terms. e: Student should identify the classes, data and function members in each class and write the program.
7	technologies is firm that has 5 employees with 1 manager, and 4 technicians. XYZ wants to digitize its payroll system, the following requirements: Dearness Allowance is 70% of basic for all employees. House Rent Allowance is 30% of basic for all employees. Income Tax is 40% of gross salary for all employees. The annual increments to the employees are to be given of the following criteria: -Manager 10% of the basic salary, and Technicians 15% of basic. Develop the pay roll for XYZ. Implement a class hierarchy using inheritance, where Employee is an abstract class and Manager and Technician are derived from Employee. Demonstrate a polymorphic behavior for giving the annual increments.
8	ne a new Exception class named Odd Exception. Create a new class named Even Odd. Write a method called halfOf(), which takes an int as parameter and throws an Odd Exception if the int is odd or zero, otherwise returns (int / 2). Write a main method that calls halfOf() three times (once each with an even int, an odd int, and zero), with three try/catch blocks, and prints either the output of halfOf() or the caught Odd Exception.
9	ate a class Student that has instance variables as Name, Age, Address and access transmutation methods to access the instance variables along with display method to print the details of student. Next write a main () function that will create a collection of 10 students and reverse the list. Print the details before and after reversing the collection.

10	ate a Shape interface having methods area () and perimeter (). Create 2 subclasses, Circle and Rectangle that implement the Shape interface. Create a class Sample with main method and demonstrate the area and perimeters of both the shape classes. You need to handle the values of length, breath, and radius in respective classes to calculate their area and perimeter.
11	elop a java application to calculate the BMI (Body Mass Index) using swing to create an interface that accepts weight and height and displays the BMI result as Overweight or Healthy.
12	Develop a Java application using swing to create a user interface for xyz company that accepts the following data of a candidate: Name, Age, Engineering discipline, percentage of marks scored. The Application should validate the candidate for recruitment process by verifying the percentage. If the percentage is greater than or equal to 80% and age is greater than 21 but less than or equal to 23 then the candidate is eligible other he is not eligible for recruitment process. The same has to be displayed on the screen.

Course Title	Database Management System Lab				Course Type		HC	
Course Code	B22EF0406	Credits	1		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE OVERVIEW:

This course introduces the core principles and techniques required in the design and Implementation of database systems. This introductory application-oriented course covers therelational database systems RDBMS - the predominant system for business scientific and Engineering applications at present. It includes Entity-Relational model, Normalization, Relationalmodel, Relational algebra, and data access queries as well as an introduction to SQL. It also coversessential DBMS concepts such as: Transaction Processing, Concurrency Control and Recovery. Italso provides students with theoretical knowledge and practical skills in the use of databases anddatabase management systems in information technology applications.

COURSE OBJECTIVE (S):

Students will have the ability to:

1. Keep on a level with of current developments to continue their own professional Development.
2. To engage themselves in lifelong learning of Database management systems, Theories and technologies this enables them to purse higher studies.
3. To interact professionally with colleagues or clients located abroad and the ability to overcome challenges that arises from geographic distance, cultural differences, and multiple languages in the context of computing.
4. Develop team spirit, effective work habits, and professional attitude in written and oral forms, towards the development of database applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the basic concepts of Database Systems and Applications.	1 to 5,9,10,12	1,3
CO2	Use the basics of MySQL and construct queries using MySQL in database creation and interaction.	1 to 5, 9,10,12	1,3
CO3	Design a commercial relational database system (Oracle, MySQL) by writing MySQL using thesystem.	1 to 5,9,10,12	2,3

CO4	Analyze and Select storage and recovery techniques of database system.	1 to 5,9,10,12	1,2
CO5	Construct the physical and logical database designs, database modeling, relational, hierarchical, and network models.	1 to 5, 9,10,12	1,2
CO6	Relate conceptual model to relational model and formulate relational algebra queries.	1 to 5, 9,10,12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				2	3		2	3	3	
CO2	3	3	2	3	1				2	3		2	3	3	
CO3	3	3	2	3	3				2	3		2	3	3	3
CO4	3	3	2	3	1				2	3		2	3	3	
CO5	3	2	3	3	3				3	3		3	3		3
CO6	3	3	2	3	3				3	3		3		3	3

Note: 1-Low, 2-Medium, 3-High

PART-A: MySQL Programming

1. Design, develop, and implement the specified queries for the following problems using Oracle, MySQL,SQL Server, or any other DBMS under LINUX/Windows environment.
2. Create Schema and insert at least 5 records for each table.
3. Add appropriate database constraints.

PART-B: Mini Project

1. Use Java, C#, PHP, Python, or any other similar front-end tool.
2. All applications must be demonstrated on desktop/laptop as a stand-alone or web based application (Mobile apps on Android/IOS are not permitted.)

SL.NO.	Title of the Experiment
	PART-A
1	Implementation of DDL, DML, DCL and TCL commands of SQL with suitable examples.
2	Study & Implementation of different types of constraints with suitable examples.
3	Implementation of different types of function, operators, Joins with suitable examples.
4	Study and Implementation of • Group By & having clause • Order by clause • Indexing • Views • Sub queries
5	Identifying entities, attributes, keys and relationshipsbetween entities, cardinalities, generalization, specialization etc. using Conceptual Designing (Ex:- ER Diagrams).
6	**Consider the following schema for a Flight Database and draw an ER Diagram.** FLIGHT(Flight no: integer, Flight from: string, Flight to: string, distance: integer, departs: time, arrives: time, price: real) AIRCRAFT (aid: integer, aname:string, cruisingrange:integer) CERTIFIED (eid:integer, aid:integer) EMPLOYEES (eid:integer, ename:string, salary: integer) **ite SQL queries to** 1. Find the names of aircraft such that all pilots certified to operate them have salaries more than Rs 80,000. 2. For each pilot who is certified for more than three aircrafts, find the eid and the maximum cruising range of the aircraft for which he/she is certified. 3. Find the names of all pilots whose salary is less than the price of the cheapest route from Bangalore to Frankfurt. 4. For all aircrafts with cruising range over 1000 kms, find the name of the aircraft and the average salary of all pilots certified for this aircraft. 5. Find the names of pilots certified for some Boeing aircraft. 6. Find the aid's of all aircraft whose cruising range is greater than the minimum distancefrom the routes from Bangalore to Delhi**.**
7	**nsider the schema for College Database and draw and ER Diagram.** JDENT (USN, SName, Address, Phone, Gender) MSEC (SSID, Sem, Sec) ASS (USN, SSID) BJECT (Subcode, Title, Sem, Credits) MARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) **ite SQL queries to** List all the student details studying in fourth semester 'C' Section. Compute the total number of male and female students in each semester and in each section. Create a view of Test1 marks of student USN '1BI15CS101' in allsubjects. Calculate the FinalIA (average of best two test marks) and update the rresponding table for allstudents. Categorize students based on the followingcriterion:

	finalIA = 17 to 20 then CAT =‘Outstanding’ finalIA = 12 to 16 then CAT = ‘Average’ finalIA< 12 then CAT = ‘Weak’ ve these details only for 8th semester A, B, and C section students.
PART-B(Mini Project)	
	For any problem selected • Make sure that the application should have five or more tables • Indicative areas include; health care, Laboratory Outcomes: The student should be able to: • Create, Update and query on the database. • Demonstrate the working of different concepts of DBMS • Implement, analyze and evaluate the project developed for an application with the front end compatibility.

Course Title	Microcontroller and IOT Lab				Course Type		HC	
Course Code	B22EF0407	Credits	1		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE OVERVIEW:

In this course, students will learn how to program ARM based controllers by digging deep into its internals and programming aspects. Using the comprehensive tool IoT Development Kit, students will be able to accelerate learning IoT Fundamentals and apply the concepts to get a Hands-On experience by performing different experiments.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain assembly language programs for the ARM microcontroller.
2. Demonstrate Interface various environmental and human interfaces with ARM microcontrollers.
3. Illustrate the use of modern system development tools in the design of IOT-based system.
4. Discuss the development of ARM microcontroller-IoTbased systems for real-world applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of ARM processor instruction set for developing simple assembly programs.	1,2,5,9,10,12	1
CO2	Construct assembly language programs for the ARM microcontroller.	1 to 5,9,12	1,2,3
CO3	Implement and interface various environmental and human interfaces with ARM microcontrollers.	1 to 5,9,12	1,2, 3
CO4	Illustrate IoT prototyping for real world socio-economic problems.	1 to 5,9,12	1,2,3
CO5	Use modern system development tools in the design of a microcontroller-based system.	1 to 5,9,12	1,2,3
CO6	Develop IoT microcontroller-based embedded systems for real-world control applications.	1 to 6,9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			

CO2						√
CO3			√			
CO4				√		
CO5						√
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3			2				2	2		2	3		
CO2	3	3	3	2	2				2	2		2	2	1	1
CO3	3	3	3	2	2				2	2		2	2	3	1
CO4	3	3	3	2	2				3	2		2	2	3	3
CO5	3	3	3	2	2				2	2		2	2	3	3
CO6	3	3	2	2	2				2	2	2	3	2	3	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1	Write an assembly language program to realize the given expressions i)A=B+C-D ii)A=4A+B iii)X=3X+4Y+9Z ite an assembly language program to add two 64-bit numbers.	Keil software	sembly Language programming
2	ite an assembly language program to find average of N 32-bit numbers.	Keil software	sembly Language programming
3.	ite an assembly language program to find number of occurrences of a number in a given list using linear search method.	Keil software	sembly Language programming
4.	ite an assembly language program to count number of ones in a given 32-bit binary number.	Keil software	sembly Language programming
5.	ite an assembly language program to find factorial of a given 32-bit number using procedure.	Keil software	sembly Language programming
6.	sign and construct a module to drive stepper motor clockwise and anti-clockwise using Arduino board to indicate that plant need to be watered by sensing its moisture level.	IoT Development Kit	sembly Language programming&IoT fundamentals
7.	sign and construct a module to interface LCD to display the temperature and moisture values using Arduino board.	IoT Development Kit	sembly Language programming&IoT fundamentals

8.	sign and construct a module to interface ultrasonic sensor to alert the obstacle (turn ON the buzzer) using Arduino board.	IoT Development Kit	sembly Language programming&IoT fundamentals
9.	sign and construct a module to drive stepper motor clockwise and anti-clockwise using Arduino board to indicate that there is a gas leakage by sensing it.	IoT Development Kit	sembly Language programming&IoT fundamentals
10.	sign and construct a module to interface light sensor to detect the darkness and switch ON the LED.	IoT Development Kit	sembly Language programming&IoT fundamentals

Recommended Learning Resources:

1. https://www.arduino.cc
2. Peter J Knaggs, "ARM Assembly Language Programming", 2016.
3. (http://www.rigwit.co.uk/ARMBook/ARMBook.pdf)

Course Title	**Skill Development Course - 2**				**Course Type**		**SDC**	
Course Code	**B22EF0408**	Credits	**2**		**Class**		**IV Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	-	-	-				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	2	4	4				
	Total	**2**	**4**	**4**	**-**	**56**	**50%**	**50%**

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3

CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-2:

Students will be offered training and certifications on the trending technologies from the industry experts.

The students are evaluated and certified after the training programs.

2nd Year

Detailed Syllabus

III SEMESTER

					Credit Pattern		**Examination**	

Course Code	Title of the Course	HC/FC /SC/OE/MC/ SDC	L	T	P	Total Credit	Contact Hours/ Week	CIE Marks	SEE Marks	Total Marks	Course category (As per AICTE)
B22AS0301	Discrete Mathematics	FC	3	0	0	3	3	50	50	100	BSC
B22CS0301	Professional Ethics	HC	2	0	0	2	2	50	50	100	HSMC
B22ME0304	Entrepreneurship	HC	1	0	0	1	1	25	25	50	HSMC
B22AS0304	Environmental Science	MC	2	0	0	0	2				HSMC
B22EF0301	Operating systems	HC	3	0	0	3	3	50	50	100	PCC
B22EF0302	Programming with python	HC	3	0	0	3	3	50	50	100	PCC
B22EF0303	Data Structures and Algorithms	HC	3	0	0	3	3	50	50	100	PCC
B22EF0304	Analog and Digital Electronics	HC	3	0	0	3	3	50	50	100	PCC
B22EF0305	Programming with python Lab	HC	0	0	1	1	2	25	25	50	PCC
B22EF0306	Data Structures and Algorithms Lab	HC	0	0	1	1	2	25	25	50	PCC
B22EF0307	Analog and Digital Electronics Lab	HC	0	0	1	1	2	25	25	50	PCC
Total			**20**	**0**	**3**	**21**	**26**	**400**	**400**	**800**	

TOTAL SEMESTER CREDITS	**21**
TOTAL CUMULATIVE CREDITS	**65**
TOTAL CONTACT HOURS	**26**
TOTAL MARKS	**800**

Course Title	**Discrete Mathematics**				**Course Type**		**FC**	
Course Code	**B22AS0301**	**Credits**	**3**		**Class**		**III Semester**	
Course Structure	**LTP**	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

A course designed to prepare mathematics, computer science and engineering majors for a background in abstraction, notation and critical thinking for the mathematics most directly related to computer science. Topics include: logic, relations, functions, basic set theory, countability and counting arguments, proof techniques, mathematical induction, combinatorics, discrete probability, recursion, recurrence relations, elementary number theory.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Learn the logical structure of statements symbolically including the proper logical connectives and quantifiers.
6. Make familiar with the techniques of combinatorics.
7. Familiarize with various Algebraic structures and algebraic operations.
8. Understand the concepts of Lattices and boolean algebra.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Prove the logical statements using the laws of logic.	1,2,3	1
CO2	Construct the truth table for compound statements and able to exemplify tautology, contradiction and contingency.	1,2,3	1
CO3	Construct a generating function and solve a recurrence relation.	1,2, 3	1
CO4	Apply the principles pigeonhole, inclusion and exclusion for solving combinatorial problems.	1,2,3	1
CO5	Apply mathematical skills to understand the fundamental concepts of algebraic structures.	1,2,3	1
CO6	Outline the concepts of Lattices and Boolean algebra.	1,2,3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2						√
CO3						√
CO4			√			
CO5			√			
CO6		√				

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	1	1										1		
CO2	3	2	2										1		
CO3	3	1	2										1		
CO4	3	2	3										1		
CO5	3	2	1										1		
CO6	3	2	3										1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

Logic and proofs: Propositional Logic – Propositional equivalences - Predicates and Quantifiers –Nested Quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy, Applications in computer science.

UNIT – II

Combinatorics: Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications, Applications in computer science.

.UNIT – III

Algebraic structures: Algebraic systems – Semi groups and monoids - Groups – Subgroups –Homomorphism's – Normal subgroup and cosets – Lagrange's theorem – Definitions and examples of Rings and Fields, Applications in computer science.

UNIT – IV

Lattices and Boolean algebra: Partial ordering – Posets – Lattices as posets – Properties of lattices -Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra, Applications in computer science.

TEXT BOOKS:

3. Kenneth H Rosen, Discrete mathematics and its application, McGraw Hill, Sept. 2002.
4. Englewood cliffs, Graph theory and its applications tp Engineering and computer science, Prentice Hall, 1974.

REFERENCE BOOKS:

5. V.Krishnamurthy, Combinatorics: Theory and Applications, East-West Press Pt. Ltd., Delhi, 1986.
6. J. Tremble, Manohar, Discrete Mathematical Structures with applications to computer Science McGraw Hill pub. 1975.
7. Richard Kohar, Basic Discrete Mathematics: Logic, Set Theory, and Probability, World Scientific Publishing Company, 1st Edition, 2017
8. Oscar Levin, Discrete mathematics: An Open Introduction, CreateSpace Independent Publishing Platform, 2nd edition, 2016

JOURNALS/MAGAZINES:

5. https://www.scimagojr.com/journalrank.php?category=2607
6. https://www.sciencedirect.com/journal/discrete-mathematics
7. https://www.tandfonline.com/toc/tdmc20/current
8. https://www.worldscientific.com/worldscinet/dmaa

SWAYAM/NPTEL/MOOCs:

5. https://onlinecourses.nptel.ac.in/noc20_cs37/preview
6. https://onlinecourses.nptel.ac.in/noc19_cs49/preview
7. https://www.classcentral.com/course/swayam-discrete-mathematics-5217
8. https://www.careers360.com/courses-certifications/swayam-mathematics-courses-brp-org

<table>
<tr><td>Course Title</td><td colspan="4">Professional Ethics</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22CS0301</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>2</td><td>2</td><td>28</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

To enable the students to imbibe and internalize the values and ethical behavior in the personal and professional lives

COURSE OBJECTIVE (S):

6. Understand the professional rules of conduct for Engineers.
7. Appreciate codes of conduct, professional rules of conduct.
8. Recognize the conflict of interest and develop strategies.
9. Understand the importance of communication with all stake holders.
10. Apply practical strategies for handling ethical dilemmas.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understanding basic purpose of profession, professional ethics and various moral and social issues.	1,2,6,8 to 12	
CO2	Awareness of professional rights and responsibilities of a Engineer, safety and risk benefit analysis of a Engineer.	1,2,4,6,8 to 12	

CO3	Acquiring knowledge of various roles of Engineer in applying ethical principles at various professional levels.	1,6,8,9,10, 12	
CO4	Professional Ethical values and contemporary issues.	1,6,8,12	
CO5	Apply practical strategies for handling ethical dilemmas.	1,4,6,8,10, 12	
CO6	Appreciate codes of conduct, professional rules of conduct.	1,4,8,12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4		√				
CO5			√			
CO6		√				

COURSE ARTICULATION MATRIX:

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	--	--	--	3	--	3	2	2	1	3			
CO2	2	3	--	1	--	2	--	3	2	2	1	3			
CO3	2	--	--	--	--	2	--	3	2	2	0	2			
CO4	2	--	--	--	--	1	--	3	--	--	--	2			
CO5	2	--	--	1	--	1	--	3	1	--	--	2			
CO6	2	--	--	1	--	--	--	3	--	--	--	2			

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT-II

Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT-III

Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession

UNIT-IV

Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation.

TEXT BOOKS:

3. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
4. Ethics in Engineering Practice & Research, Caroline Whitbeck,2e, Cambridge University Press 2015.

REFERENCE BOOKS:

3. Engineering Ethics, Concepts Cases: Charles E Harris Jr.,Michael S Pritchard, Michael J Rabins, 4e , Cengage learning, 2015.
4. Business Ethics concepts & Cases: Manuel G Velasquez, 6e,PHI, 2008.

Course Title	Environmental Science	Course Type	MC

Course Code	B22AS0304	Credits	-		Class	III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Lecture	-	2	2			
	Tutorial	-	-	-	Theory	CIE	SEE
	Practical	-	-	-			
	Total	-	2	2	28	-	-

COURSE OVERVIEW:

Environmental Science is focussed on a holistic understanding of earth systems in order to learn from the past, comprehend the present and influence the future. It is the study of how physical, chemical and biological processes maintain and interact with life, and includes the study of how humans affect nature. As environmental science is at the cross-roads of the natural sciences, it provides an enriching alternative to a single-subject honours degree, and can open the door to an exciting range of career options. This approach enables us to tackle necessary problems, such as ensuring that human needs are met in a sustainable way, so that everyone has access to clean water and air, and the resources required for agriculture and industrial activity.

COURSE OBJECTIVE (S):

The objectives of this course are to:

7. Familiar with current and emerging environmental engineering and global issues and have an understanding of ethical and societal responsibilities.
8. Recognize the need for engaging in life-long learning.
9. Study various types of energy (conventional & non-conventional) resources and natural resources.
10. Acquire knowledge with respect to biodiversity, threats, conservation and appreciate the concept of ecosystem.
11. Know about sources, effects and control measures of environmental pollution, degradation, and waste management.
12. Explore the ways for protecting the environment.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand, analyse and execute favourable environmental conditions and the role of individual, government and NGO in environmental protection.	1,2,3,7	1
CO2	List the causes, effects & remedial measures of environmental pollution, degradation & find ways to overcome them by suggesting the pollution controlled products.	1,2,3,7	1
CO3	Get motivation to find new renewable energy resources with high efficiency through active research and innovation.	1,2,3,7	1
CO4	Critically analyse the ecological imbalances and provide recommendations to protect the environment.	1,2,3,7	1
CO5	Explore the condition of environmental degradation and waste management techniques and take promising measures to make our environment ecofriendly.	1,2,3,7	1

CO6	Identify new methodologies for conservation of our natural resources and ecosystem.	1,2,3,7	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		✓				
CO2		✓				
CO3		✓				
CO4		✓				
CO5		✓				
CO6		✓				

COURSE ARTICULATION MATRIX

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	3	1				2						1		
CO 2	3	2	2				2						1		
CO 3	2	2	2				3						1		
CO 4	2	2	1				3						1		
CO 5	3	2	2				2						1		
CO 6	2	1	1				3						1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

ENVIRONMENT & ENVIRONMENTAL PROTECTION:

Basics of environment: Introduction & definition to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment.

Environmental protection: Role of Government - Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Environmental Legislations, Initiative and Role of Non-government organizations in India and world.

UNIT – 2

Environmental pollution, degradation & Waste management:

Environmental Pollution: Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Automobile Pollution-Causes, Effects & control measures.

Environmental degradation: Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect, Montreal and Kyoto protocols, The Chemical Weapons Convention (CWC).

Waste management: Municipal solid waste, Bio-medical waste and Electronic waste (E-Waste).

UNIT – 3

Energy & Natural resources:

Energy: Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, Non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy.

Natural resources:

Water resource - Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance

Mineral resources - Types of minerals, Methods of mining & impacts of mining activities

Forest wealth - Importances, Deforestation-Causes, effects and controlling measures

UNIT – 4

Ecology, ecosystem & field work:

Ecology - Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Components of ecosystem-abiotic and biotic

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots.

India as a mega-biodiversity nation; Endangered and endemic species of India

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity.

Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids

Field work:

Visit to waste water/sewage treatment plant (STP) and biogas plant at REVA university campus, and/or Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.

REFERENCE BOOKS:

9. R.J. Ranjit Daniels and Jagadish Krishnaswamy, “Environmental Studies”, Wiley India Private Ltd., New Delhi, Co-authored & Customised by Dr.MS Reddy & Chandrashekar, REVA University, 1st Edition, 2017.
10. R.J. Ranjit Daniels and Jagadish Krishnaswamy, “Environmental Studies”, Wiley India Private Ltd., New Delhi, 2nd Edition, 2014.
11. Benny Joseph, “Environmental Studies”, Tata McGraw – Hill Publishing Company Limited, 2nd Edition, 2008.
12. Dr.S.M.Prakash, “Environmental Studies”, Elite Publishers, Mangalore, 2nd Edition, 2009.
13. Rajagopalan R, “Environmental Studies – from Crisis to cure”, Oxford University Press, 3rd Edition, 2016.
14. Anil Kumar Dey and Arnab Kumar Dey, “Environmental Studies”, New age international private limited publishers, 2nd Edition, 2007.

15. Michael Allaby, “Basics of environmental Science”, Routledge-Tayler & Francis E-Library, 2nd Edition, 2002.
16. Dr.Y.K Singh, “Environmental Science”, New age international private limited publishers, 1st Edition, 2006.

Online Resources/Links:

5. http://library.envirolink.org/
6. https://www.youtube.com/watch?v=5QxxaVfgQ3k
7. https://www.springer.com/journal/11356
8. Learn Environmental Science with Online Courses, Classes, & Lessons | edX

Course Title	Operating Systems				Course Type		HC	
Course Code	B22EF0301	Credits	3		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course starts with a brief historical perspective of the evolution of operating system and then covers the major components of most of the operating systems. The operating system provides a well-known, convenient, and efficient interface between user programs and the bare hardware of the computer on which they run. The operating system is responsible for allowing resources (e.g., disks, networks, and processors) to be shared, providing common services needed by many different programs (e.g., file service, the ability to start or stop processes, and access to the printer) and protecting individual programs from one another. Emphasis is given to three major OS subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging, swapping) and file systems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Explain the major components and different services of Operating system.
6. Implement process management and scheduling schemes.
7. Discuss synchronization and deadlock techniques in real time applications.
8. Demonstrate memory management techniques for machine architecture.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the major components and services of Operating System.	1 to 5,12	1
CO2	Summarize process scheduling, scheduling algorithm and multithreading of Operating System.	1 to 5,12	1,2
CO3	Assess the Performance of different CPU Scheduling algorithm for the given real-world applications.	1 to 5,12	1,2
CO4	Apply the concept of synchronization and deadlock process.	1 to 5,12	1,2
CO5	Build method sto overcome synchronization problems and to avoid deadlocks.	1 to 5, 9,12	1,2
CO6	Compare and contrast the physical and virtual memory management techniques.	1 to 5,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					

CO2		✓				
CO3						✓
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	1							1	2		
CO2	2	2	2	2	1							1	3	1	
CO3	2	1	2	3	1							1	3	1	
CO4	2	1	2	2	1							1	2	1	
CO5	1	2	1		1							1	2	2	
CO6	1	2	2	1	1							1	1	1	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Operating System Principles: Evolution of Operating Systems, Structural overview, Types of Operating System and operations, Computing environments, Operating System Services, User - Operating System interface, System calls and system programs, Operating System structure.

UNIT – 2

Process Management: Process concept, process scheduling, Operations on processes, Inter process communication; Multi-Threaded Programming, Overview, Multithreading models, Thread Libraries, threading issues. Process scheduling: Basic concepts, scheduling criteria, scheduling algorithms.

UNIT – 3

Synchronization and Deadlock: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization: The Bounded-Buffer Problem, The Readers–Writers Problem.Deadlock definition, Deadlock characteristics, Deadlock Prevention, Deadlock Avoidance: banker's algorithm, Deadlock detection and Recovery.

UNIT – 4

Memory Management: Memory Management Strategies, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Allocation methods, Thrashing.

Self-learning components:

Virtual machines and Introduction to Linux Operating System, Introduction to Distributed computing, Parallel computing, grid computing, cloud computing,File System.

TEXT BOOKS:

4. Abraham Silberschatz, Peter Bear Galvin, Greg Gagne, Operating System Principles, Wiley Asia Student Edition, 2009.
5. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India, seventh edition, 2011.
6. D. M. Dhamdhere; Operating Systems: A Concept-Based Approach; Tata McGraw-Hill, Third edition 2012.

REFERENCE BOOKS:

3. Frederic Magoules, Jie Pan, Kiat-An Tan, Abhinit Kumar, Introduction to Grid Computing, CRC Press, Second Edition, 2014
4. Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation. Prentice-Hall, Third edition, 2014.

JOURNALS/MAGAZINES:

10. https://ieeexplore.ieee.org/document/1658969
11. https://ieeexplore.ieee.org/document/1646682
12. https://ieeexplore.ieee.org/abstract/document/402081

SWAYAM/NPTEL/MOOCs:

4. https://onlinecourses.nptel.ac.in/noc20_cs04/preview
5. https://www.coursera.org/lecture/os-power-user/introduction-r0c5h
6. https://onlinecourses.swayam2.ac.in/cec20_cs06/preview

<table>
<tr><td>Course Title</td><td colspan="4">Programming with Python</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0302</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

This course provides an introduction to programming and the Python language. Students are introduced to core programming concepts like data structures, conditionals, loops, variables, and functions. This course includes an overview of the various tools available for writing and running Python, and gets students coding quickly. In the course we will also discuss Numpy and Pandas along with visualization tools.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Explain the fundamentals of python programming language constructs and their applications.
6. Inculcate knowledge of parsing of regular expressions and their usage in various application domains.
7. Gain expertise in Object oriented programming and NumPy package.
8. Discuss the files, Pandas and Data Virtualization concepts.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Write simple computational programs using functions.	1,2,3,4,5,12	1, 2, 3
CO2	Write programs to compute mathematical functions (sin x, e^x and others) using if statements, loops and functions.	1,2,3,4,5,12	1, 2, 3
CO3	Write data processing scripts using string, tuples, sets, dictionaries with appropriate error handling using exceptions.	1,2,3,4,5,12	1, 2, 3
CO4	Write classes to implement given functionality using object-oriented features of python including operator overloading, inheritance, iteration protocol, context management protocol, decorators, and descriptors.	1,2,3,4,5,12	1, 2, 3
CO5	Apply features of object oriented and NumPy package to develop computationally intensive programming to analyze and interpret the data.	1,2,3,4,5,12	1, 2, 3
CO6	Write data processing and visualization scripts using numpy, pandas and matplotlib.	1,2,3,4,5,12	1, 2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4				√		
CO5				√		
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3							3	3	3	3
CO2	3	3	2	3	3							3	3	3	3
CO3	3	2	2	3	3							3	3	3	3
CO4	3	3	3	2	3							3	3	3	3
CO5	3	2	3	3	3							3	3	3	3

CO6	3	3	3	2	3							3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Python Fundamentals: Introduction to Python: History, Applications Your First Python Program, Constants, Variables, Naming conventions, simple data types, Type casting, Assignment statements, expressions, Boolean data type, Trigonometry functions, operators, precedence of operators, libraries, keywords, Python Collections, I/O statements, conditional statements, loops, functions, user defined functions.

UNIT – 2

Exception handling in Python, **Strings:** Unicode, Diving In, Formatting Strings, Format Specifiers, Other Common String Methods, Slicing a String.

Regular Expressions: Case Study: Street Addresses, Case Study: Roman Numerals, Checking for Thousands, Checking for Hundreds, Using the {n,m} Syntax, Checking for Tens and Ones.

UNIT – 3

Object Oriented Programming: Defining Classes, The init_() Method, Instantiating Classes, OOP features: Abstraction. Encapsulation, Single Inheritance, Polymorphism

Files: Reading from Text Files, Writing to text files, Reading and Writing the Binary Files.

UNIT – 4

Numpy: Introduction to numpy, Creating arrays, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output

Pandas and Data Visualization: Introduction, Series and Data Frames in pandas, Data Visualization

TEXT BOOKS:

3. Mark Pilgrim, “Dive into Python 3”, Apress special edition, second edition, 20l5.
4. Travis E. Oliphant, “Guide to NumPy”, Trelgol publishers, 2006.

REFERENCE BOOKS:

8. A B Choudhary, “Flowchart and Algorithms Basics” Mercury Learning and Information, 2020.
9. Mark Lutz, “Learning Python”, Oreilly. 2003.
10. John M. Zelle, “PYTHON Programming: An Introduction to Computer Science”, Franklin, Beedle & Associates. 2004.
11. Michael Dawson, “Python Programming for the Absolute Beginners”, 3rd Edition, CENAGE Learning.
12. Wesley J. Chun, “Core Python Programming”, 2nd Edition, Prentice Hall.
13. Steve Holden and David Beazley, “Python Web Programming”, New Riders, 2002. Springer, Kent D. Lee, “Python Programming Fundamentals”, 2nd Edition.
14. John V. Guttag, “Introduction to Computation and Programming using Python”, MIT Press, 2016.

JOURNALS/MAGAZINES:

6. IEEE Transactions on Artificial Intelligence
7. Journal of Machine Learning Research
8. Foundations and Trends in Machine Learning
9. Synthesis Lectures on Artificial Intelligence and Machine Learning
10. ACM Transactions on Intelligent Systems and Technology

SWAYAM/NPTEL/MOOCs:

3. Python for Everybody, Dr. Chuck Online MOOCs, Open Standards, Open Source and OERs
4. Programming, Data Structures and Algorithms using Python, Prof. MadhavanMukund, IIT Madras,

SELF-LEARNING EXERCISES:

3. Data Visualization
4. Basics of Deep Learning

Course Title	**Data Structures and Algorithms**				**Course Type**		**HC**	
Course Code	**B22EF0303**	**Credits**	**3**		**Class**		**III Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	3	3	3				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50%**

COURSE OVERVIEW:

The objective of this course is to provide the solid foundation in the basic concepts of data structures and algorithms. The knowledge of fundamentals of data structures and algorithms is a key to any type of software development: Application Software, System Software, Operating Systems, and Network Simulator. Apart from introducing the basic knowledge of data structures, this course, also introduces many algorithms that are designed using the fundamental algorithm design techniques such as brute force.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Introduce the insights of basic concepts of data structures andalgorithms.
6. Understand the fundamental data structures: arrays, stacks, queues, linked lists and trees.
7. Illustrate the mathematical foundation for the design and analysis of algorithms.
8. Demonstrate the concept of data structures to solve real world applications

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	**Course Outcomes**	**POs**	**PSOs**

CO1	Classify the various types of data structures.	1 to 4, 8	1,2,3
CO2	Understand the data structures like arrays, stacks, queues and linked lists.	1 to 4, 8	1,2,3
CO3	Exemplify the knowledge of data structures to solve real world problems.	1 to 5, 8 to 11	1,2,3
CO4	Demonstratethe algorithms to solve real world problems using the Algorithm Analysis Framework.	1 to 6, 8 to 12	1,2,3
CO5	Apply the knowledge of mathematical foundation of algorithm design and analysis to design a new algorithm and analyze its performance.	1 to 5, 8 to 11	1,2,3
CO6	Employ the foundation for any real world software using existing or creating new algorithm design technique.	1 to 6, 8 to 12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3		√				
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1				1					3	3	3
CO2	3	3	1	1				1					3	3	3
CO3	3	3	3	2	3			3	3	3	3		3	3	3
CO4	3	3	3	3	3	3		3	3	3	3	3	3	3	3
CO5	3	3	3	3	3			3	3	3	3		3	3	3
CO6	3	3	3	3	3	3		3	3	3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Algorithms and Data Structures: Introduction to data structures, types of data structures, data structure operations;

Arrays: Types of arrays, Representation of 1D array, Array Traversal, Insertion and Deletion, Representation of multi-D Array in memory, Matrix Operations

UNIT – 2

Linked Lists: Basic concept, linked list implementation, types, Circular Linked List;

Stacks: Introduction, Stacks- basic concept, Stack operations, Stack implementation and application.

UNIT – 3

Queues: Introduction**,** basic concept, queue operations, implementation, circular queue, Double Ended Queues;

Trees: Introduction, Basic Concept, Binary Tree, Binary Tree Representation, Binary Tree Traversal, Binary Search Tree, Tree Variants.

UNIT – 4

Introduction to Algorithms: Fundamentals of the Analysis of Algorithm Efficiency- The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes;

Brute Force: Bubble Sort, Selection Sort, Sequential Search and Brute-Force String Matching.

TEXT BOOKS:

3. E. Balaguruswamy ," Data Structures using C", Revised edition, 2011
4. Anany Levitin, " Introduction to Design and Analysis of Algorithms", 3rd edition

REFERENCE BOOKS:

4. Coreman, "Introduction to Algorithms", MIT, 3rd edition.
5. G. A. V. Pai, "Data Structures and Algorithms", TMH, 2008.
6. A. M. Padma Reddy, "Data Structures using C", Nandi Publications.

JOURNALS/MAGAZINES:

5. Random Structures and Algorithms, Wiley
6. Journals of Algorithms, Elsevier
7. Journal of Computing Sciences in Colleges, ACM
8. Journal of Discrete Algorithms

SWAYAM/NPTEL/MOOCs:

5. https://nptel.ac.in/courses/106102064
6. https://onlinecourses.nptel.ac.in/noc22_cs92/preview
7. https://onlinecourses.nptel.ac.in/noc22_cs26/preview
8. https://nptel.ac.in/courses/106106133

SELF-LEARNING EXERCISES:

3. Balanced Search Trees

4. Parallel Algorithms

Course Title	Analog and Digital Electronics				Course Type		HC	
Course Code	B22EF0304	Credits	3		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course takes from simple transistor circuits through the analysis of variety of its applications. It also includes knowledge of operational amplifiers in building specific engineering applications. It provides simplification of Boolean expressions using K-map and Quine-Mcluskey methods. Various data processing circuits along with flip flops are discussed in detail.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Discuss the applications of transistorsin oscillatorsand amplifiers.
6. Develop an understanding of the operational amplifier and its applications
7. Become familiarized with simplifying the functions in Sum of Products as well as Product of Sums, using K-Maps and Quine McClusky methods.
8. Discuss the working of different data processing circuits and flip-flops.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the different constituents of an analog electronic circuit using discrete components.	PO1-PO5, PO12	1
CO2	Analyze the applications of transistors in oscillators and amplifiers.	PO1-PO5, PO12	1
CO3	Apply the knowledge of operational amplifiers in building specific engineering applications.	PO1-PO5, PO12	1,3
CO4	Design the digital signal circuit using various methods.	PO1-PO5, PO12	1,3
CO5	Construct the schematics and different data processing circuits to interpret its working	PO1-PO5, PO12	1,3
CO6	Understand the working of sequential circuits build using flipflops.	PO1-PO5, PO12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2				✓		
CO3			✓			
CO4					✓	
CO5			✓			
CO6		✓				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1							1	1		
CO2	2	2	2	3	1							1	2		
CO3	2	2	3	2	2							1	1		3
CO4	1	2	3	2	2							1	1		1
CO5	1	2	3	2	1							1	1		1
CO6	2	2	3	2	3							1	1		2

Note: 1-Low,2-Medium,3-High

COURSE CONTENT

UNIT – 1

Sinusoidal Oscillators and amplifiers: Classification,conditions,types,RC phase shift oscillator,Wein bridge oscillator,Hartley oscillator,Colpitts oscillator,Crystal oscillator, CE amplifier, RC coupled amplifier**.**

UNIT – 2

Operational Amplifiers: Ideal Opamp versus Practical Opamp, Performance parameters, Some Applications: Peak Detector Circuit, Comparator, Active filters-First order LPF and HPF, Phase shifters, Instrumentation Amplifier, Non-Linear Amplifier, Relaxation oscillator**.**

UNIT – 3

Principles and Minimization Techniques of Combinational Circuits: SOP, POS, truth table of K-map, pair, quad, octet. K-map simplification (3 and 4 variables), don't care condition, QuineMcClusky method.

UNIT – 4

Data Processing Circuits: Half/Full adder, Half/Full Subtractor, Multiplexers, DE multiplexers, Encoders, Decoders.

Introduction to Sequential circuits: Flip Flops- SR, JK, D and T. Characteristic table and equations. Application of shift registers (Ring and Johnson counters)

SELF LEARNING COMPONENT:

Biasing circuits, Binary adder/Subtractor, Applications of flip flops, Shift register types

TEXTBOOKS:

4. Anil K Maini, VarshaAgarwal,"Electronic Devices and Circuits", 2nd Edition, Wiley, 2009.
5. Jacob Millman, Christos Halkias, Chetan D Parikh,"Millman's Integrated Electronics – Analog and DigitalCircuits and Systems", 2nd Edition, Tata McGraw Hill, 2010.
6. Donald P Leach, Albert Paul Malvino & Goutam Saha ,"Digital Principles and Applications", 7th Edition, Tata McGraw Hill, 2010.

REFERENCE BOOKS

8. Stephen Brown, Zvonko Vranesic," Fundamentals of Digital Logic Design with VHDL", 2nd Edition, Tata McGrawHill, 2005.
9. RD Sudhaker Samuel, "Illustrative Approach to Logic Design", Sanguine-Pearson, 2010.
10. Charles H.Roth,"Fundamentals of Logic Design",Jr., 5th Edition, Cengage Learning, 2004.
11. Ronald J.Tocci, NealS.Widmer, Gregory L.Moss,"Digital Systems Principles and Applications", 10thEdition, Pearson Education, 2007.
12. M Morris Mano,"Digital Logic and Computer Design", 10th Edition, Pearson Education, 2008.
13. Jacob Millman, Christos Halkias, "Analog and Digital Circuits and Systems", 2nd Edition,Tata McGrawHill, 2010.
14. R.D.Sudhaker Samuel,"Electronic Circuits", Sanguine-Pearson, 2010.

JOURNALS/MAGAZINES:

4. https://ieeexplore.ieee.org/document/1085417
5. https://www.academia.edu/Documents/in/Digital_Electronics
6. https://www.mdpi.com/journal/electronics/special_issues/circuit_machine_learning

SWAYAM/NPTEL/MOOCs:

4. https://technobyte.org/digital-electronics-logic-design-course-engineering/
5. https://www.udemy.com/course/digital-electronics-logic-design/
6. https://www.javatpoint.com/digital-electronics/

<table>
<tr><td>Course Title</td><td colspan="4">Programming with python Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0305</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>-</td><td>28</td><td>25%</td><td>15%</td></tr>
</table>

COURSE OVERVIEW:

Python is a Programming Language that can be treated in a procedural way, an object-orientated way or a functional way. It can be used on a server to create web applications, create workflows, connect to database systems, read and modify files, handle big data and perform complex mathematics. It can implement object oriented features and exception handling, It can parse the strings using regular expressions. It can be used for implementing the machine learning algorithms to develop solutions for interdisciplinary problems apart from any general problems leading to automation.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Explain the fundamentals of python programming language constructs and their applications.
6. Inculcate knowledge of parsing of regular expressions and their usage in various application domains.
7. Gain expertise in Object oriented programming and NumPy package.
8. Discuss the files, Pandas and Data Virtualization concepts.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply basic language constructs of python to solve logic-based problems.	1,2,3,4,5,9, 10,11,12	1,2,3
CO2	Solve problems using Object Oriented Programming concept like class and object.	1,2,3,4,5,9, 10,11,12	1,2,3
CO3	Apply features of NumPy package to develop program to analyze and interpret the data.	1,2,3,4,5,9, 10,11,12	1,2,3
CO4	Develop data science solutions with the help of files, Pandas, and Data Visualization.	1,2,3,4,5,9, 10,11,12	1,2,3
CO5	Develop sustainable solutions/projects for the needs of society, organizations, and other sectors.	1,2,3,4,5,9, 10,11,12	1,2,3
CO6	Recognize the need and engage in learning new libraries and tools in python.	1,2,3,4,5,9, 10,11,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			√			
CO2			√			
CO3			√	√		
CO4			√	√	√	
CO5						√
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	2	3	2	2				2	2	2	2	2	2	2
CO2	3	2	3	2	2				2	2	2	2	2	2	2
CO3	3	3	3	3	3				2	2	2	2	2	2	2
CO4	3	3	3	3	3				2	2	2	2	3	2	2
CO5	3	3	3	3	3				3	3	3	3	3	2	2
CO6	3	3	2	2	3				2	2	2	3	3	2	2

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	a). "LIST1" is a list that contains "N" different SRN of students read using a user defined function with the help of input () function. It is required to add SRN of "M" more students that are to be appended or inserted into "LIST1" at the appropriate place. The program must return the index of the SRN entered by user.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on list.
	b). "TUPLE1" and "TUPLE2" are two tuples that contain "N" values of different data types read using the user defined function "READ" with the help of input() function. Elements of "TUPLE1" and "TUPLE2" are to be read one at a time and the "larger" value among them should be placed into "TUPLE3". Display all tuples.		Create and perform operations on Tuples.
2.	a).SET1 and SET2 are two sets that contain unique integers. SET3 is to be created by taking the union or intersection of SET1 and SET2 using the user defined function Operation(). Perform either union or intersection by reading choice from user. Do not use built in functions union() and intersection() and also the operators "|" and "&".	Windows/Linux OS, IDE, Jupyter	Create and perform Union and Intersection, Operations on Sets.
	b).The Dictionary "DICT1" contains N Elements and each element in dictionary has the operator as the KEY and operand's as VALUES. Perform the operations on operands using operators stored as keys. Display the results of all operations.		Create dictionary and perform operation using user defined function.
3.	A substring "Substr" between index1 and index2 is to be extracted from the given input string "Str1", which is read using input (). Display the substring "Substr" using a user defined function if available in string "Str1", otherwise display NULL.	Windows/Linux OS, IDE, Jupyter	String operations.
	b) A string containing multiple words is to be read from the user one at a time, after reading perform following operations. i) Convert all the strings to uppercase and display ii) Split the words of a string using space as the separation character and display.		String operations.

4.	Consider the text file, “Std.txt”, with the details of students like SRN, NAME, SEMESTER, SECTION AND AVG_MARKS. Read the file, “Std.txt” and display the details of all the students of 4th Semester “ A” Section who have scored more than 75%.	Windows/Linux OS, IDE, Jupyter	File Handling.
	Consider the text file “Emp.txt”, with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NET_SALARY, LIC, PF and TOTALDEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input () and compute the following: OTAL_DEDUCTIONS= (LIC+PF) ROSS_SALARY= BASIC_SALARY+ DA NET_SALARY= GROSS_SALARY – TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of “Emp.txt” and display the details of each employee.		File Handling.
5.	A “CAR” has the attributes COMPANY_NAME, MODEL, COLOR, MANUFACUTING_YEAR and PRICE. A Class is required to be created for “CAR” to store the above attributes and perform the following operations: i) Get the details of “CAR” object from user and store into Array of objects ii) Display the details of “CAR” object based on “COMPANY”, “MODEL” and “PRICE”.	Windows/Linux OS, IDE, Jupyter	sses and objects usage.
	Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for “Airlilne” with the above attributes and perform the following operations: et the details of “Airline” object from user and store into Array of objects List details of all the passengers who travelled From “Bengaluru to London”. ist details of all the passengers who travelled From “Chicago to Beijing” on 10th of Feb, 2020.		sses and objects usage.
6.	‘Arr_1” is an integer array of size M x N. Size and content of the array is to be read using input() by using the user defined function READ_DATA(). It is required to display the i) Diagonal elements of ”Arr_1” lements of mth row (row no should be entered by user) iii) Elements of nth column (column no should be entered by user)	Windows/Linux OS, IDE, Jupyter	umPy arrays usability.
	he dictionary “DICT1” contains the pass percentage of each semester of B. Tech in CSE, where, ” Semester” acts as the key and “Pass Percentage” acts as the value. A Python Pandas dataframe is required to be created using the dictionary “DICT1” and display it using a user defined function.		andas Series usability.

Part-B (Mini Project: Library Management System)

ect Description

Manual process of keeping student records, book records, account details, managing employee is very difficult in library. Hence, it is required to automate the library management. The purpose of the **Library Management system** is to allow for storing details of a large number of books and allow for add, delete, search, borrow (Issue) and return facilities separately to administrator/Librarian, staff and students.

Experiments in Part B			
No	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill /Ability**
1	elop a program to create the class “USER” with the attributes USER_NAME, USER_ID, DEPARTMENT_NAME, ADDRESS, PHONE_NO, EMAIL_ID, DOB and AGE. The functions add_user(), delete_user(), edit_user(), search_user() should be part of the class. Instantiate “User” class with 10 objects. Read the attributes of each “User” object using input() and store them in the file “User_File.txt”.	ndows/Linux OS, IDE, Jupyter	eate a class user to read the attributes of user and store them in a file
2	elop a program to get the name of the “User” object whose details are to be deleted. Read the “User_File.txt” and delete the “User” object if found. Display the contents of “User_File.txt” after deletion.	ndows/Linux OS, IDE, Jupyter	eate a class user to read the attributes and delete the object.
3	elop a program to get the name of the “User” object whose details are to be edited (modified). Edit the details of the user object in the file “User”.	ndows/Linux OS, IDE, Jupyter	create a class and edit the file.
4	elop a program to create the class “BOOK” with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, DEPARTMENT_NAME and the functions add_book(), delete_book(), edit_book() and search_book(). Instantiate “Book” class with 10 objects. Read the attributes of each “BOOK” object using input () and store them in the file “Book_File.txt”.	ndows/Linux OS, IDE, Jupyter	eate a class book to read the attributes of user and store them in a file.
5	elop a program to get the name of the “BOOK” object whose details are to be deleted. Read the “Book_File.txt” and delete the “BOOK” object whose details match with the data entered. Display the contents of “Book_File.txt” after deletion.	ndows/Linux OS, IDE, Jupyter	eate a class book to read the attributes and delete the object.
6	elop a program to get the name of the “BOOK” object whose details are to be edited (modified). Edit the details of the “Book” object in the file “Book_File.txt” and display the contents after modification.	ndows/Linux OS, IDE, Jupyter	create a class and edit the file.
7	elop a program to create the class “TRANSACTION” with the attributes USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE,DUE_DATE and RETURN_DATE and the functions issue_book(), return_book() and search_book(). Instantiate “Transaction” class with 10 objects. Read the attributes of each “Transaction” object using input() and store them in the file “TransactionFile.txt”. Develop a program to issue the book as requested by the user. Update the attributes in “Transaction _File” and display the contents of file.	ndows/Linux OS, IDE, Jupyter	eate class and perform string operations.
8	elop a program to return the book. Edit the details of the user like USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE, DUE_DATE and RETURN_DATE in “TransactionFile.txt” and display the contents after modification. Compute the fine amount to be paid if return_date is not same as due_date. If both return_date and due_dateare same and put zero in fine_amount.	ndows/Linux OS, IDE, Jupyter	eate class and perform string operation.
9	elop a program to search for a book using its “author”. Display the message “available” if search is successful otherwise display the message “not available”.	ndows/Linux OS, IDE, Jupyter	eate class and object, perform file operations and regular expressions.

10	elop a program to get a list of users by referring to "User_File.txt" and "Transaction_File.txt".	ndows/Linux OS, IDE, Jupyter	eate class and object, perform file operations and regular expressions.
11	elop a program to get List of Books in stock by referring to "Book_File.txt" and "Transaction_File.txt".	ndows/Linux OS, IDE, Jupyter	eate class and object, perform file operations and regular expressions.
12	elop a program to get List of Books Issued by referring to "User_File", "Book_File" and "Transaction_File".	ndows/Linux OS, IDE, Jupyter	eate class and object, perform file operations and regular expressions.
13	elop a project by integrating User, Books, Transaction and Reports Modules.	ndows/Linux OS, IDE, Jupyter	odule integration and project development.

TEXT BOOKS:

3. Mark Pilgrim, "Dive into Python 3", 2 nd edition, Apress special edition, 2015.
4. Travis E. Oliphant, "Guide to NumPy", Trelgol publishers, 2006.

REFERENCE BOOKS:

9. A B Choudhary, "Flowchart and Algorithms Basics", Mercury Learning and Information, 2020.
10. Mark Lutz, "Learning Python", Oreilly. 2003.
11. .John M. Zelle, "PYTHON Programming: An Introduction to Computer Science", Franklin, Beedle & Associates. 2004.
12. Michael Dawson, "Python Programming for the Absolute Beginners", 3rd Edition, CENAGE Learning.
13. Wesley J. Chun, "Core Python Programming", 2nd Edition, Prentice Hall. 108
14. Steve Holden and David Beazley, "Python Web Programming", 2nd Edition New Riders, 2002. Springer".
15. John V. Guttag, "Introduction to Computation and Programming using Python", MIT Press, 2016.
16. https://www.tutorialspoint.com/computer_fundamentals/computer_fundamentals_tutorial.pdf

JOURNALS/MAGAZINES:

6. https://www.codemag.com/Magazine/ByCategory/Python
7. http://ijaerd.com/papers/special_papers/IT032.pdf
8. https://iopscience.iop.org/article/10.1088/1742-6596/423/1/012027
9. https://ieeexplore.ieee.org/document/4160250
10. Python for scientific computing

SWAYAM/NPTEL/MOOCs:

5. Coursera – Python for everybody, University of Michigan
6. Coursera – Python Basics, University of Michigan
7. https://nptel.ac.in/courses/106/106/106106182/
8. https://www.edx.org/learn/python

SELF-LEARNING EXERCISES:

5. Explore PYTHON library for IOT programming

6. More exploration on GIThub
7. Data Visualization packages
8. C modules interface

Course Title	Data Structures and Algorithms Lab				Course Type		HC	
Course Code	B22EF0306	Credits	1		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-				
	Practical	1	2	2	Theory	Practical	IA	SEE
	Total	1	2	2	-	28	25	25

COURSE OVERVIEW:

The objective of this course is to provide the solid foundation in the basic concepts of data structures and algorithm. This course helps in implementing most of the data structures such as stacks, queues, linked list, trees using C language. Some of the sorting and searching algorithms are also implemented.

COURSE OBJECTIVES:

The objectives of this lab course are to make students to:

5. Implement the concepts of matrix and palindrome.
6. Demonstrate the use of stacks, queues and lists in C.
7. Discuss and Implement the concept of trees and tree traversal.
8. Discuss the sorting and searching algorithms.

COURSE OUTCOMES:

On successful completion of this course; the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of Arrays to solve real world problems.	1,2,3,4,5,9,10, 11	1,2,3
CO2	Develop a C program for implementing the linked list and trees	1,2,3,4,5,9,10, 11	1,2,3
CO3	Build a real world application in C using stacks and queues.	1,2,3,4,5,9,10, 11	1,2,3
CO4	Apply the concepts of searching and sorting algorithms for solving real world problems.	1,2,3,4,5,9,10, 11	1,2,3
CO5	Identify the most suitable data structure for real world application.	1 to 5,9,10,12	1,2,3
CO6	Experiment with all data structures in a high-level language for problem solving.	1 to 5,9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			

CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

Course Outcomes	Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	3	2	1				3	3		3	3	2	1
CO2	3	2	3	3	1				3	3		3	3	2	1
CO3	3	1	3	3	1				3	3		3	3	2	1
CO4	3	1	3	3	1				3	3		3	3	2	1
CO5	3	3	3	3	3				3	3		3	3	3	3
CO6	3	3	3	3	3				3	3		3	3	3	3

PRACTICE:

S.N.	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill/Ability**
	PART-A		
1.	Write a C program using the “array”, a linear data structure to multiply two given matrices of same order.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
2.	Write C programs to demonstrate the operations performed on STACK ADT using an array.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
3.	Write C programs to demonstrate the operations performed on STACK ADT using a Singly Linked List.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
4.	The compilers always convert infix expression into postfix to perform further operations like parsing, lexical analysis etc. Select an appropriate data structure and develop a program to convert any fully parenthesized arithmetic infix expression into its postfix form using a stack.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
5.	Write a C program that uses both stack and queue to test whether the given string is a palindrome (Use Java Utility).	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
6.	Evaluation of postfix expressions is done by compilers during the compilation process. Design and develop a program to evaluate any valid integerexpression expressed in its postfix form, using a stack.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
7	Write a C program to demonstrate the operations performed on QUEUE ADT using an array.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
8.	Write a C program to demonstrate the operations performed on QUEUE ADT using a singly linked list.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming

9.	es are stored in memory in tree structure directory. Design and develop a program to create a directory having files with unique file-id in the hard disk, and display the files in all the three tree traversal orders using Binary Search Tree (BST).	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
10.	sign a C program to search for a pattern in a given text using brute force string matching.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming
11.	sign a C program to implement bubble sort and selection sort.	Windows DEV C/C++ IDE/ Linux OS	Basic Knowledge in C programming

TEXT BOOKS:

3. E. Balaguruswamy ," Data Structures using C", Revised edition, 2011
4. Anany Levitin, " Introduction to Design and Analysis of Algorithms", 3rd edition

REFERENCE BOOKS:

4. Coreman, "Introduction to Algorithms", MIT, 3rd edition.
5. V. Pai, "Data Structures and Algorithms", TMH, 2008
6. M. Padma Reddy, "Data Structures using C", Nandi Publications

Course Title	**Analog and Digital Electronics Lab**				**Course Type**		**HC**	
Course Code	**B22EF0307**	**Credits**	**1**		**Class**		**III Semester**	
B22EF0307	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**25%**	**25%**

COURSE OVERVIEW:

The course gives an introduction to analysis of elementary analog and digital circuits. It will give a basis for understanding and constructing simple systems of analog and digital electronic circuit elements. Central themes: applications of diodes and transistors, Boolean algebra, logic gates, combinatorial and sequential digital circuits, to write VHDL code to realize simple digital circuits.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Develop an understanding of the analog/digital circuits and its applications.
6. Illustrate the behavioral characteristics of various analog/digital circuits.
7. Demonstrate the simulation of analog/digital circuits.
8. Discuss the use of modern simulation tools.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the modern simulation tools used for analog/digital circuits	1,2,3,4,5,9,10,12	1,3
CO2	Constructanalog circuits using various electronic components using simulator	1,2,3,4,5,9,10,12	1,3
CO3	Analyze the working of various analog circuits and to understand their behaviors	1,2,3,4,5,9,10,12	2
CO4	Design and develop VHDL codes for data processing/sequential circuits using simulator	1,2,3,4,5,9,10,12	2
CO5	Analyze the behavioral characteristics of different data processing circuits	1,2,3,4,5,9,10,12	1,3
CO6	Analyze and Implement digital circuits using required hardware components	1,2,3,4,5,9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3				√		
CO4				√		
CO5					√	
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3				1	2		1	3		3
CO2	3	3	2	2	3				1	2		1	3		3
CO3	3	3	2	1	3				1	2		1		3	3
CO4	3	3	2	1	3				1	2		1		3	
CO5	3	3	3	2	3				1	2		1	3		3
CO6	3	2	2	2					1	2		1	3		3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	To simulate a positive clipper, double ended clipper & positive clamper circuits using diodes	Orcad	Simulation of clipper and clamper electronic
2.	To simulate a rectangular wave form generator (Op- amp relaxation oscillator) and compare the frequency and duty cycle with the design specifications	Orcad	Simulation of rectangular waveform generator
3.	To simulate a Schmitt trigger using Op-amp and compare the UTP and LTP values with the given specification	Orcad	Simulation of Schmitt trigger
4.	To simulate a Wien bridge Oscillator	Orcad	Simulation of Wein bridge oscillator
5.	determine the working of a power supply and observe the waveforms	Orcad	Simulation of power supply
6.	To build and simulate CE amplifier (RC coupled amplifier) for its frequency response and measure the bandwidth.	Orcad	Simulation of RC coupled amplifier and determining the quency response
7	lization of Half/Full adder and Half/Full Subtractors using logic gates	ICs, Trainer kit and patch cords Create and perform the adder and subtractor cuits	ICs, Trainer kit and patch cords Create and perform the adder and btractor circuits
8	ign and develop VHDL code to realize Full adder and Full Subtractors	nx	nulation knowledge of the mentioned adders and subtractors
9	en a 4-variable logic expression, simplify it using Entered Variable Map and realize the simplified logic expression using 8:1 multiplexer IC	, Trainer kit and patch cords	alization of a multiplexer
10	Design and develop the VHDL code for an 8:1 multiplexer. Simulate and verify it's working	nx	nulation knowledge of combinational logic circuit
11	ign and implement a ring counter using 4-bit shift register and demonstrate its working	, Trainer kit and patch cords	alization of shift register and ring counter
12	ign and develop the Verilog / VHDL code for switched tail counter.	nx	nulation of ring counter

TEXT BOOKS:

3. Anil K Maini, Varsha Agarwal,"Electronic Devices and Circuits", Wiley, 2009.
4. Jacob Millman, Christos Halkias, Chetan D Parikh,"Millman's Integrated Electronics – Analog and Digital Circuits and Systems", 2nd Edition, Tata McGraw Hill, 2010.

a. Donald P Leach, Albert Paul Malvino & Goutam Saha ,"Digital Principles and Applications", 7th Edition, Tata McGraw Hill, 2010.

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22AS0401	Graph Theory and Optimization Techniques	FC	3	0	0	3	3	50	50	100	BSC
2	B22AH0302	Universal Human Values	HC	2	0	0	2	2	50	50	100	HSMC
3	B22EF0401	Technical Documentation	HC	1	0	0	1	1	25	25	50	PCC
4	B22LSM0301	Indian Constitution	MC	2	0	0	0	2				HSMC
5	B22EF0402	Object Oriented Programming with Java	HC	3	0	0	3	3	50	50	100	PCC
6	B22EF0403	Database Management System	HC	3	0	0	3	3	50	50	100	PCC
7	B22EF0404	Computer Organization and Architecture	HC	3	0	0	3	3	50	50	100	PCC
8	B22EFS41X	Professional Elective 1	SC	3	0	0	3	3	50	50	100	PEC
9	B22EF0405	Java Programming Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0406	Database Management System Lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EF0407	Microcontroller and IoT Lab	HC	0	0	1	1	2	25	25	50	PCC
12	B22EF0408	Skill Development course 2	SDC	0	0	2	2	4	50	50	100	SDC
TOTAL				**20**	**0**	**5**	**23**	**30**	**450**	**450**	**900**	
TOTAL SEMESTER CREDITS				**23**								
TOTAL CUMULATIVE CREDITS				**88**								
TOTAL CONTACT HOURS				**30**								
TOTAL MARKS				**900**								

Course Title	Graph Theory and Optimization Techniques				Course Type		FC	
Course Code	B22AS0401	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course will cover the fundamental concepts of Graph Theory: simple graphs, digraphs, Eulerian and Hamiltonian graphs, matchings, paths and cycles, graph coloring, and planar graphs. There is an emphasis on applications to real world problems and on network flows.Optimization techniques are a powerful set of tools for solving complex real-world problems such as transportation and assignment problems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Achieve command of the fundamental definitions and concepts of graph theory.
6. Identify the trail, path, circuit and cycle in the connected graph
7. IdentifyEuler trail, path, Hamilton circuit and cycle.
8. Formulation of LPP and solving using some standard methods.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain basic concepts and analyse the significance of graph theory in different engineering disciplines.	1,2,3	1
CO2	Illustrate the concept of isomorphic graphs and coloring of the graph. Determine the maximum flow between the vertices for the given network.	1,2,3	1
CO3	Find chromatic number, chromatic polynomials for graphs and the planarity of the graph.	1,2, 3	1
CO4	Explain simplex method and two phase method for solving linear programming problem.	1,2,3	1
CO5	Find a basic feasible solution to the transportation problem by North- West Corner Method, MODI method and Vogel's Approximation Method (VAM).	1,2,3	1
CO6	Find initial basic feasible and optimal solution of the Transportation problems.	1 ,2,3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1		√				
CO2		√				
CO3	√					
CO4		√				
CO5	√					
CO6	√					

COURSE ARTICULATION MATRIX:

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1										1		
CO2	3	2	3										1		
CO3	3	2	2										1		
CO4	3	2	2										1		
CO5	3	2	1										1		
CO6	3	2	2										1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

Introduction to graph theory: Konigsberg's bridge problems, Utilities problem, Seating Problem, Graphs, Representation of Graphs. Directed graphs, Incidence, Adjacency, Degree, In degree, Out degree, Regular graphs, Complete graphs, Null Graph, Bipartite Graphs, Isomorphism, Directed Graphs, Sub graphs, Walk, Trail, Path, Circuit, Cycle, Connected and disconnected graphs, Components, Weakley connected and Strongly connected Components, Complement of graphs, Partition and Decompositions.

UNIT – II

Euler and Hamiltonian graphs and Graph coloring: Operation on graphs, Definition of Euler Trail, Euler Graphs, Hamiltonian path, Hamiltonian Cycle, Hamiltonian Graphs, Standard Theorems on Euler and Hamiltonian graphs, planar graph, detection of Planarity, Dual of planar graphs, Euler formula for planar graph, Graph coloring, Chromatic polynomial, Map coloring, Four Color Theorem, Five Color Theorem, Matching, Network flow, and its applications, Cut set, Cut vertex, Chord, Properties of Cut Sets, Max Flow Min Cut Theorem.

.UNIT – III

Linear Programming: Introduction, Canonical and Standard Form of LPP-Simplex Method-Big M Method- Two Phase Method-Principle of duality-Dual Simplex Method.

UNIT – IV

Transportation Problems-North- West Corner Method, Minimum-Cost Method, MODI method and Vogel's Approximation Method (VAM), Assignment problems: Hungarian Method,and unbalanced Assignment Problems.

TEXT BOOKS:

5. NasinghDeo, “Graph Theory with Applications to Engineering Computer Science”, Prentice-Hall, 2014.
6. KanthiSwarup, P.K. Gupta, ManMohan, “Operations research”, Sultan Chand & Sons. (module II), 5th edition.
7. Sharma J. K., “Operations Research: Theory and Applications”, Macmillan India Ltd.
8. Taha H. A., “Operations Research – An Introduction”, 9th ed., Prentice Hall India.

REFERENCE BOOKS:

4. Frank Harary, “Graph Theory”, Norosa, 2013.
5. J. A. Bondy and V. S. R. Murthy, “Graph Theory with Applications”, Macmillan, London, 2013.
6. S.S Rao, “Optimization Theory and Applications”, Wiley Eastern

JOURNALS/MAGAZINES:

6. https://onlinelibrary.wiley.com/journal/10970118
7. https://www.scimagojr.com/journalsearch.php?q=23898&tip=sid
8. https://en.wikipedia.org/wiki/Journal_of_Graph_Theory
9. https://www.springer.com/journal/10878
10. https://www.springer.com/journal/10957

SWAYAM/NPTEL/MOOCs:

7. https://onlinecourses.nptel.ac.in/noc22_ma10/preview#:~:text=Graph%20theory%20began%20in%201736,science%20and%20network%20information%20science.
8. https://onlinecourses.nptel.ac.in/noc22_cs17/preview
9. https://nptel.ac.in/courses/128106008
10. https://onlinecourses.swayam2.ac.in/cec20_ma03/preview
11. https://nptel.ac.in/courses/111105039
12. https://onlinecourses.nptel.ac.in/noc22_ma48/preview

Course Title	**Universal Human Values**				**Course Type**		**HC**	
Course Code	**B22AH0302**	**Credits**	**2**		**Class**		**IV Semester**	
Course Structure	**LTP**	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**2**	**2**	**2**	**28**	**-**	**50%**	**50%**

COURSE OVERVIEW:

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
6. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
7. Strengthening of self-reflection.
8. Development of commitment and courage to act.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	derstand the significance of value inputs in a classroom and start applying them in their life and profession.		
CO2	tinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.		
CO3	derstand the role of a human being in ensuring harmony in society and nature.		
CO4	Demonstrate the role of human being in the abetment of pollution.		
CO5	scribe appropriate technologies for the safety and security of the society as responsible human being.		
CO6	tinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.		

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

COURSE ARTICULATION MATRIX:

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

CO6															

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

Introduction and Value Education – Value Education, process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT – II

Understanding Harmony in the Human Being - **Harmony in Myself** - Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT – III

Understanding Harmony in the Family, Society and nature - Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in societyUndivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family!. Understanding Harmony in the Nature and Existence - Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT – IV

Implications of the above Holistic Understanding of Harmony on Professional Ethics - Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

TEXT BOOKS

4. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010.
5. A.N Tripathy, Human Values, New Age Intl. Publishers, New Delhi, 2004.
6. Bertrand Russell, Human Society in Ethics & Politics, Routledge Publishers, London, 1992.

REFERENCE BOOKS

6. Corliss Lamont, Philosophy of Humanism, Humanist Press, London, 1997.
7. I.C. Sharma, Ethical Philosophy of India, Nagin & co, Jalandhar, 1970.
8. Mohandas Karamchand Gandhi, The Story of My Experiments with Truth, NavajivanMudranalaya, Ahmadabad, 1993.
9. E G Seebauer& Robert L. Berry, Fundamentals of Ethics for Scientists &Engineers , Oxford University Press, 2010.
10. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd., 2011.

Course Title	Technical Documentation				Course Type		HC	
Course Code	B22EF0401	Credits	1		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	1	1	1	14	0	25%	25%

COURSE OVERVIEW:

Writing is a strength that all should improve on. This course creates specialized composing abilities important to impart data acquired through a cycle of specialized or test work. The course covers a wide range of topics to introduce Technical Writing and presents technical writing as an alternate career path.The course features the components that decide the level of detail of the language and ideas included. You will figure out how to compose distinctive specialized reports, e.g., lab reports, research reports, plan and plausibility reports, progress reports, counseling reports, and so forth.

COURSE OBJECTIVE (S):

Technical Writing prepares students to design effective technical documents for both written and digital media, with particular emphasis upon technical memos, problem-solving and decision-making reports, and organizational, product-support, and technical-information webs. Every type of writing has an objective.

The objectives of this course are to:

4. Provide with the confidence to use written communication in your work and personal experience beyond college,
5. Acquaint with the concept of a writer-reader relationship and identify the need for active participation from both writer and reader,
6. Teach the skills needed to successfully communicate in a modern world through written materials.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Interpret the stages of the writing process and apply them to technical and workplace writing tasks.	5, 9 10	3
CO2	Demonstrate rhetorical knowledge to create effective technical writing documents for end users.	1, 2, 4, 5, 6, 7, 11	1,3
CO3	Apply and adapt flexible writing process strategies to produce clear, high-quality deliverables in a multitude of technical writing genres.	1, 2, 3, 9, 10	1, 3
CO4	Use professional technical writing conventions of clean and clear design, style, and layout of written materials.	1, 2, 3, 5, 10	
CO5	Apply researched information that is appropriate to your field, as demonstrated by reading and analyzing documents, and citing sources correctly.	2, 10	
CO6	Write clearly, correctly, and concisely.	10	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					1				3	3					1
CO2	2	2		1	1	2	1				2		1		1
CO3	2	2	1						3	3			1		1
CO4	1	1	2		2					2					
CO5		2								3					
CO6										3					

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Techniques I - Introduction, Before You Start Writing, Understanding the Writing Process, Using the Computer to Improve Your Writing, Improving the Coherence of Your Writing

UNIT – 2

Techniques II -Writing Better Paragraphs, Writing Better Sentences, Choosing the Right Word, Creating and Integrating Graphics, Improving Page Design

UNIT – 3

Applications I – Letters, Memos, Minutes, Procedures and Manuals

UNIT – 4

Applications II – Formal Elements of Reports, Proposals, Progress Reports, Completion Reports introduce the Report Clearly.

TEXT BOOKS:

2. Mike Markel, "Writing In the Technical Fields: A step-by-Step Guide for Engineers, Scientists, and Technicians", John Wiley& Sons

REFERENCE BOOKS:

4. Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, "Handbook of Technical Writing", Bedford/St. Martin's, Ninth Edition, 2009
5. David Lindsay, "Scientific Writing = Thinking in Words",Clayton SouthVIC:CSIRO Publishing,Second Edition,2020
6. Carme Bombardó Solés, Clàudia Barahona Fuentes, Marta Aguilar Pérez, "Technical Writing: A Guide for Effective Communication", Edicions UPC, Second Edition, Barcelona, January 2008.

JOURNALS/MAGAZINES:

6. https://ieeexplore.ieee.org/document/6594223
7. https://ieeexplore.ieee.org/document/9219
8. https://www.tcworld.info/e-magazine/technical-writing/
9. https://journals.sagepub.com/doi/pdf/10.1177/1050651997011001003
10. https://journals.sagepub.com/doi/full/10.1177/1050651912458921

SWAYAM/NPTEL/MOOCs:

5. https://www.udemy.com/course/business-writing-immersion/
6. https://www.udemy.com/course/technical-writing/
7. https://www.coursera.org/learn/engineering-writing
8. https://www.coursera.org/specializations/leadership-communication-engineers

SELF-LEARNING EXERCISES:

Checklists, Handbook, Commonly Misused Words and Phrases, Guidelines for Speakers of English as a Second Language, Guidelines for Writing to Speakers of English as a Second Language.

<table>
<tr><td>Course Title</td><td colspan="4">Object Oriented Programming with Java</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0402</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>42</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

In this course the students shall learn Java's unique architecture which enables them to develop a single application that can run across multiple platforms seamlessly and reliably. The students shall also gain extensive experience with Java, object-oriented features and gui programming skills which helps them to provide solutions to solve real world problems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Impart elementary and the basic object oriented programming concepts and apply them in problem solving.
6. Illustrate the concept of inheritance and Polymorphism to reuse code and the implementation of packages and interfaces.
7. Introduce the concepts of exception handling and Collection.
8. Demonstrate the concept of event handling used in GUI developed using swing.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify object oriented programming features and concepts in solving the given problem.	1 to 5,9,10,12	1,2,3
CO2	Make use of concepts of inheritance and polymorphism to improve the code reusability.	1 to 5, 9,10,12	1,2,3
CO3	Develop application usingpackages and interfaces in solving complex problems.	1 to 5, 9,10,12	1,2,3
CO4	Apply the knowledge of Collections to process collective information.	1 to 5, 9 to 12	1,2,3
CO5	Implement exception handling to develop effective application	1 to 5, 9 to 12	1,2,3
CO6	Develop java-based applications using swings and event handlers	1 to 5, 9 to 12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3				3	1		3	3	3	3
CO2	3	2	3	1	3				3	1		3	3	3	3
CO3	3	2	3	2	3				3	2		3	3	3	3
CO4	3	2	3	2	3				3	2	2	3	3	3	3
CO5	3	2	3	2	3				3	2	2	3	3	3	3
CO6	3	2	3	2	3				3	3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

OOP CONCEPTS& JAVA FUNDAMENTALS: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, procedural and object oriented programming paradigm. Java programming: History of java, Java Programming environment, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions,control flow statements, simple java stand alone programs, arrays, console input and output,Introducing classes, Methods and Constructors.

Unit-2

INHERITANCE, POLYMORPHISM, PACKAGES AND INTERFACES: Basic concepts, Types of inheritance, Member access rules, Usage of this and Super key word, Method Overloading, Method overriding, Abstract classes, Dynamic method dispatch, Usage of final keyword. **Packages and interfaces:** Defining package, Access protection, importing packages, Defining and Implementing interfaces, and Extending interfaces.

Unit-3

Exception handling and The Collections Framework: Fundamentals of exception handling, Exception types, Termination or resumptive models, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception sub classes. **Collections:** Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque, Accessing a Collection via an Iterator, Using an Iterator.

Unit-4

GUI Programming with Swing and Event Handling: Introduction to Swings, Hierarchy of swing components. Containers, Top level containers - JFrame, JWindow, JDialog, JPanel, JButton, JToggleButton, JCheckBox, JRadioButton, JLabel, JTextField, JTextArea, JList, JComboBox, JScrollPane. **Event Handling-** The Delegation event model- Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes.

TEXT BOOKS:

5. HerbertSchildt, “Java™: TheComplete Reference”, McGraw-Hill,Twelfth Edition,2021.
6. Understanding OOP with Java, up dated edition, T.Budd, Pearson education.

REFERENCE BOOKS:

8. Kathy Sierra and Bert Bates Head First Java, O reilly, 2nd Edition, 2020.
9. Cay S. Horstmann, “Core Java™ Volume I—Fundamentals”, Prentice Hall, Tenth Edition, 2015.
10. Joshua Bloch, “Effective Java”, Addison-WesleyProfessional,ThirdEdition, 2017.
11. David Gallardo, Ed Burnette, Robert Mcgovern,“Eclipse in Action a guide for java developers”, Manning Publications, 2003.
12. Ed Burnette, “Eclipse IDE Pocket Guide: Using the Full-Featured IDE”, O'Reilly Media, Inc, USA, 2005.
13. Ken Kousen, “Modern Java Recipes”, O'Reilly Media, Inc.,2017.
14. Oracle Java Documentation. (https://docs.oracle.com/javase/tutorial/)

JOURNALS/MAGAZINES:

7. https://www.javadevjournal.com/
8. https://blogs.oracle.com/javamagazine/
9. https://ieeexplore.ieee.org/document/5464387
10. https://files.eric.ed.gov/fulltext/EJ1075126.pdf
11. https://www.sciencedirect.com/science/article/pii/S0167642304000590
12. https://www.informingscience.org/Publications/4322?Source=%2FJournals%2FJITEIIP%2FArticles%3FVolume%3D0-0

SWAYAM/NPTEL/MOOCs:

4. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
5. https://www.classcentral.com/course/swayam-programming-in-java-12930
6. https://swayam.gov.in/explorer?searchText=java

SELF-LEARNING EXERCISES:

6. The Eclipse-IDE
7. Streams
8. Multithreading
9. JavaFX
10. Networking- JDBC

Course Title	Database Management System				Course Type	HC	
Course Code	B22EF0403	Credits	3		Class	IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Lecture	3	3	3			
	Tutorial	-	-	-	Theory	CIE	SEE
	Practical	-	-	-			
	Total	3	3	3	42	50%	50%

COURSE OVERVIEW:

This course is intended to provide an understanding of the current theory and practice of database management systems. The course provides a solid technical overview of database management systems, using a current database product as a case study. In addition to technical concerns, more issues that are general are emphasized. These include data independence, integrity, security, recovery, performance, database design principles, and database administration. This course is designed to investigate how database management system techniques are used to design, develop, implement, and maintain modern database applications in organizations.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Understand the basic concepts about the conceptual data models and ER diagrams.
6. Make use of basic concepts to build the relational models and relational algebra.
7. Apply SQL commands to create and manipulate database.
8. Analyze database design concepts using normalization techniques.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Construct the conceptual entity relationship diagrams for the real - world applications.	1 to 5, 9,10,12	1,2,3
CO2	Make use of the concepts of relational algebra to solve queries over database.	1 to 5,9,10,12	1,2
CO3	Relate conceptual model to relational model and formulate relational algebra queries	1 to 5, 9,10,12	1,2
CO4	Create the database for given real world application and solve queries over it using SQL commands.	1 to 5, 9,10,12	1,2,3
CO5	Organize database using design guidelines and normalization technique.	1 to 5, 9,10,12	1,2
CO6	Design the database model for real-world applications	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1			√			
CO2			√			
CO3			√			
CO4						√
CO5					√	
CO6						√

COURSE ARTICULATION MATRIX

Note: 1-Low, 2-Medium, 3-High

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	3				3	3		3	3	3	
CO 2	3	3	2	2	1				3	3		3	3	3	
CO 3	3	3	2	2	1				3	3		3	3	3	3
CO 4	3	3	3	3	3				3	3		3	3	3	
CO 5	3	3	1	3	1				3	3		3	3		3
CO 6	3	3	3	3	3				3	3		3		3	3

COURSE CONTENT

UNIT – 1

Introduction to databases and Conceptual Modelling: Introduction, characteristics of the database approach, data models, schemas, instances, database languages and interfaces, Using high-level conceptual data models for database design, a sample database application, entity types, attributes, keys, relationship types, weak entity types, ER diagrams, naming conventions, design issues.

UNIT – 2

Relational Data Model and Relational algebra: Relational model concepts, relational model constraints and relational database schemas, update operations, transactions, dealing with constraint violations, unary relational operations, select and project, relational algebra operations from set theory, binary relational operations, join and division, additional relational operations, examples of queries in relational algebra.

.

UNIT – 3

SQL: SQL data definition and data types, specifying constraints in SQL, basic retrieval queries in SQL, insert, delete, update statements in SQL, additional features of SQL, schema change statements in SQL, retrieving data using the SQL Select Statement, Restricting and sorting data, Using Single row functions, Joins, More complex SQL retrieval queries, views in SQL.

UNIT – 4

Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, Normal forms based on primary keys, General definitions of second and third normal forms, Other Normal forms.

TEXT BOOKS:

5. Elmasri and Navathe, “Fundamentals of Database Systems”, 5th Edition, Pearson Education, 2007.
6. Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, 3rd Edition, McGraw Hill, 2003.
7. Phill Pratt, “Concepts of Database Management, Cengage Learning”, 8th Edition, 2014.
8. Jeffrey A Hoffer, “Modern Database Management, Pearson”, 12th Edition, 2015.

REFERENCE BOOKS:

7. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: “Database System Concepts”, 6th Edition, McGraw Hill, 2010.
8. C J Date, “Database Design and Relational Theory: Normal Forms and All that Jazz”, O ‘Reilly, April 2012.
9. James Martin, “Principles of Database Management Systems”, 1985, Prentice Hall of India, New Delhi.
10. IEEE Transactions on Knowledge and Data Engineering.
11. Elsevier Data and Knowledge Engineering.
12. ACM Transactions on Database Systems.

JOURNALS/MAGAZINES:

13. https://ieeexplore.ieee.org/document/5464387
14. https://blogs.oracle.com/javamagazine/
15. https://airccse.org/journal/ijdms/index.html
16. https://www.imedpub.com/scholarly/database-management-journals-articles-ppts-list.php
17. http://www.odbms.org/odmg-standard/reading-room/magazines/
18. https://www.igi-global.com/journal/journal-database-management/1072

SWAYAM NPTEL/MOOCs:

5. https://onlinecourses.nptel.ac.in/noc22_cs51/preview
6. https://www.mooc-list.com/tags/database-management
7. https://onlinecourses.swayam2.ac.in/cec21_cs11/preview
8. https://www.udemy.com/topic/database-management/

Practice

Design and draw the ER Diagram for any of the two following database application with minimum 4/ 5 entities and specify the proper key and structural constraints:

6. Design a college library management project that manages and stores books information electronically according to students needs. The system helps both students and library manager to keep a constant track of all the books available in the library. It allows both the admin and the student to search for the desired book.
7. Develop a Hostel Management system for the computerization of the Hostel. The common transaction of the hostel includes the maintenance of mess bills, information about students in the hostel, enrolling of new students and their payments and dues etc are stored into the databases and reports are generated according to the user requirements
8. Develop a Hospital Management system that includes registration of patients, storing their details into the system, and computerized billing in the pharmacy, and labs. The software should have the facility to give a unique id for every patient and stores the details of every patient and the staff automatically.

9. Bank Managementcreation of a secure Internet banking system. This will be accessible to all customers who have a valid User Id and Password. This is an approach to provide an opportunity to the customers to have some important transactions to be done from where they are at present without moving to bank.
10. Super Market Information Management automation. This software should help salespersons in managing the various types of Records pertaining to his/her customer. The product should help the user to work in a highly effective and efficient environment.

Example Questions to relational Algebraic expression and SQL.

Assume the following relations:

BOOKS (DocId, Title, Publisher, Year)

STUDENTS (StId, StName, Major, Age)

AUTHORS (AName, Address)

Borrows (DocId, StId, Date)

Has-written (DocId, AName)

Describes (DocId, Keyword)

11. List the year and title of each book.
12. List all information about students whose major is CS.
13. List all books published by McGraw-Hill before 1990.
14. List the name of those authors who are living in Davis.
15. List the name of students who are older than 30 and who are not studying CS
16. Rename AName in the relation AUTHORS to Name.
17. List the names of all students who have borrowed a book and who are CS majors.
18. List the authors of the books the student 'Smith' has borrowed.
19. Which books have both keywords 'database' and 'programming'?
20. List the title of books written by the author 'Ullman'.

SELF-LEARNING EXERCISES:

Transactions and Recovery: The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions. Introduction to recovery, Recovery Concepts, Shadow Paging, The Aries Recovery Algorithm

Course Title	Computer Organization and Architecture				Course Type		HC	
Course Code	B22EF0404	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	0	50%	50%

COURSE OVERVIEW:

The course is designed to make the students capable of comprehending the fundamental design of a digital computer. Understanding the hardware that powers the code and how it interacts with the existing memory and I/O structure during execution at the physical level requires study of computer organisation and architecture. It aids students in grasping the principles of computer system design so they may expand on the capabilities of computer organisation to identify and address issues with computer architecture.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Understand the basics of computer organisation & architecture.
6. Learn the mechanism of computer arithmetic.
7. Recognize the different memory hierarchy.
8. Study the different I/O mechanism.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Recognize and explain the significance of a digital computer's fundamental parts, I/O organisation, and memory architecture.	1,2,3,9,12	1
CO2	Describe how arithmetic algorithms are implemented in a digital computer.	1,2,3.9,12	1
CO3	Explain the types of memory systems and mapping functions used in memory systems	1,2,39,12	1
CO4	Understand the different input output mechanism and interfacing circuits.	1,2,3,9,12	1
CO5	Discuss different communication techniques used in computer architecture.	1,2,3,9,12	1
CO6	Demonstrate the control signals required for the execution of a given instruction	1,2,3,9,12	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			

CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2						3			2	3		
CO2	3	3	2						3			2	3		
CO3	3	3	2						3			2	3		
CO4	3	3	3						3			2	3		
CO5	3	2	2						3			2	3		
CO6	3	2	2						3			2	3		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Basic Structure of Computers & Basic Processing: Computer Types, Functional Units, Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Basic Operational Concepts.

Some Fundamental Concepts, Instruction Execution, Load Instructions, Arithmetic and Logic Instructions, Store Instructions.

UNIT – 2

Computer Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Carry-Lookahead Addition, Multiplication of Unsigned Numbers, Array Multiplier, Sequential Circuit Multiplier, Multiplication of Signed Numbers, The Booth Algorithm, Fast Multiplication, Bit-Pair Recoding of Multipliers, Carry-Save Addition of Summands, Integer Division, Floating-Point Numbers and Operations Arithmetic Operations on Floating-Point Numbers.

UNIT – 3

Memory: Basic Concepts, Semiconductor RAM Memories, Internal Organization of Memory Chips, Static Memories, Dynamic RAMs, Synchronous DRAMs, Structure of Larger Memories, Read-only Memories, ROM, PROM, EPROM, EEPROM, Flash Memory, Direct Memory Access, Memory Hierarchy, Cache Memories, Mapping Functions, Replacement Algorithms, Virtual Memory, Address Translation.

UNIT – 4

I/O : Accessing I/O Devices, I/O Device Interface, Program-Controlled I/O, Interrupts, Bus Structure, Bus Operation, Synchronous Bus, Asynchronous Bus, Arbitration, Interface Circuits, Parallel Interface, Serial Interface, Interconnection Standards Universal Serial Bus (USB), PCI Bus, PCI Express.

Self Learning Components: Pipelining: Basic Concept—The Ideal Case, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays.

Basic introduction to multi core processors

Text Book:

2. Carl Hamacher, Computer Organization and Embedded Systems, Sixth Edition, Tata MC Graw Hill.

REFERENCE BOOKS:

4. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier.
5. William Stallings: Computer Organization & Architecture, 7th Edition, PHI.
6. Vincent P. Heuring& Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education.

JOURNALS/MAGAZINES:

5. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=40
6. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=2
7. https://dl.acm.org/journal/tocs
8. https://www.sciencedirect.com/journal/future-generation-computer-systems

SWAYAM/NPTEL/MOOCs:

3. https://onlinecourses.nptel.ac.in/noc20_cs25/preview
4. https://onlinecourses.nptel.ac.in/noc20_cs64/preview

Professional Elective -1

Course Title	Artificial Intelligence				Course Type		SC	
Course Code	B22EFS411	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course introduces the basics of Artificial Intelligence (AI), AI problems and search strategies. The students can explore knowledge representation issues and methods. This course provides algorithms for, problem solving and controlling the knowledge and also demonstrates various learning methods for constructing knowledge and taking decisions.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Learn the different search strategies and its applications in AI.
6. Illustrate the representation of knowledge in solving AI problems.
7. Implement the concepts involved in the knowledge of reasoning.
8. Demonstrate the techniques of learning, expert systems and various applications of AI.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the role of search algorithms in any AI problem solving.	1,2,3,4,5	1,2,3
CO2	Apply basic principles of AI in solutions that require problem solving, knowledge representation and learning.	1,2,3,4,5	1,2,3
CO3	Represent problems using first order and predicate logic	1,2,3,4,5,12	1,2,3
CO4	Demonstrate knowledge of reasoning and representation for solving real world problems.	1,2,3,4,5,9,12	1,2,3
CO5	Illustrate the understanding of various applications of AI techniques in learning, expert systems.	1,2,3,4,5,9,12	1,2,3
CO6	Apply and analyze the concepts of Artificial Intelligence in developing applications for NLP.	1,2,3,4,5,9,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				

CO2			✓			
CO3		✓				
CO4			✓			
CO5				✓		
CO6				✓		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1								1	2	2
CO2	3	2	1	1	1								2	3	2
CO3	3	3	2	2	1							2	1	2	3
CO4	3	3	3	2	2				2			2	3	2	3
CO5	3	3	3	2	2				2			2	3	3	3
CO6	3	2	2	1	1				3			3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit 1

Problems and Search: What is AI? The AI Problems; The Underlying Assumptions; What is an AI Technique? Problems, **Problem Spaces and Search**; Defining the problem as a state space search, Production systems; Problem characteristics, Production system characteristics, Issues in the design of search programs; **Heuristic search techniques:** Generate-and-test; Hill climbing; Best-First Search; Problem reduction; Constraint satisfaction.

Unit – 2

Knowledge Representation: Knowledge representation Issues: Representations and mappings; Approaches to knowledge representation; Issues in knowledge representation; **Using Predicate logic:** Representing simple facts in logic; Representing Instance and ISA relationships; Computable functions and predicates; Resolution;

Unit – 3

Representing Knowledge using Rules: Procedural versus declarative knowledge; Logic Programming, Forward versus backward reasoning, Matching;

Statistical Reasoning: Probability and Bayes Theorem, Certainty factors and rule based systems, Bayesian networks, Dempster-Shafer Theory, Fuzzy logic.

Unit – 4

Learning: What is learning?; Rote Learning; Learning by taking Advice; Learning in Problem Solving; Learning from examples; **Expert Systems**: Representing and using Domain Knowledge; Expert system shells; Explanation; Knowledge Acquisition

Natural Language Processing: Language Models, Text classification; Information Retrieval, Information Extraction; Machine Translation, Speech Recognition; Robotics: Hardware, Perception, Planning, Moving.

TEXT BOOKS:

3. Elaine Rich, Kevin Knight: Artificial Intelligence, 3rdedition, Tata Mcgraw Hill, 2009.
4. Russell & Norvig: Artificial Intelligence: A Modern Approach, Third Edition, Prentice-Hall, 2010.

REFERENCE BOOKS:

5. Nils J. Nilsson: Principles of Artificial Intelligence, Elsevier, 1980.
6. Krishan Mehrotra, Chilkuri K. Mohan, Sanjay Ranka: Artificial Neural Networks, Penram International Publishing, 1997.
7. B.Yegana narayana: Artificial Neural Networks, PHI, 2001.
8. IEEE, IEEE transaction for computational Intelligence.

Self-Learning Components:

PEAS (Performance, Environment, Actuators and Sensors) for Agents, Genetic Algorithm, Distributed Agents, Wumpus World game (Understanding the game and applying planning and learning rules), Bioinformatics.

Course Title	System Software				Course Type		SC	
Course Code	B22EFS412	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The course deals with various system softwaresuch as assemblers, loaders, linkers and compilers which support the operation of a computer. It helps the user to focus on an application, without needing to know the details of how the machine works internally. System applications are used to translate into machine language program. The course also deals with lexical and syntactical analysis that deals with construction of parsing. This course is essential for all computer science students who are aspiring to become computer architects

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Impart the knowledge about the architecture of SIC and SIC/XE.
6. Illustrate the use of different addressing modes in generating machine code.
7. Discuss functions of different types of loaders and linkers, structure of compilers
8. Design and develop simple programs using lex and yacc.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the Architecture of SIC and SIC/XE.	1 to 5,9,10,12	1,3
CO2	Apply addressing modes of SIC/XE in developing Assembly programs.	1 to 5, 9,10,12	1,3
CO3	Implement Absolute loader and relocating loader	1 to 5, 9,10,12	2, 3
CO4	To understand the working of compilers	1 to 5, 9,10,12	2
CO5	Identify and generate of tokens using lexical analysis	1 to 5, 9,10,12	1,3
CO6	Define the rules of grammar using syntactic analysis.	1 to 5, 9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1		√				
CO2			√			
CO3		√				
CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1				3	3		2	3		3
CO2	3	3	2	2	1				3	3		2	3		3
CO3	3	3	1	1	1				3	3		2		3	3
CO4	3	3	3	1	2				3	3		2		3	
CO5	3	1	2	1	3				3	3		2	3		3
CO6	3	1	2	1	3				3	3		2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction: System software and machine architecture, The simplified instructional computer (SIC): SIC Machine Architecture, SIC/XE Machine Architecture, SIC and SIC/XE programming examples.

UNIT – 2

Assemblers: BasicAssembler functions: A Simple SIC Assembler, Assembler Algorithm and Data Structures, Machine Dependent Assembler features: Instruction formats & addressing modes, program relocation, Machine Independent Assembler features: Literals, symbol defining statements, expressions, program blocks, control sections and program linking.

UNIT – 3

Loaders: Basic Loader functions: Absolute Loaders, Bootstrap loaders, Machine Dependent loader features: Relocation, program linking, algorithms and data structures for a Linking loader.

Compilers: The structure of a compiler: Grammars, lexical analysis, syntactical analysis & code generation, code optimization, symbol table management, grouping of phases into passes, compiler construction tools, Basic Compiler functions, Applications of compiler technology.

UNIT – 4

Lex and Yacc: The Simplest Lex Program, Grammars, Parser-Lexer Communication, A YACC Parser, The Rules Section, Running LEX and YACC, LEX and Hand- Written Lexers, A Word Counting Program, Using YACC – Grammars, Recursive Rules, Shift/Reduce Parsing, What YACC Cannot Parse, A YACC Parser - The Definition Section, The Rules Section, The LEXER, Compiling and Running a Simple Parser.

TEXT BOOKS:

3. System Software by Leland. L. Beck, D Manjula, 3rd edition, 2012.
4. Doug Brown, John Levine, Tony Mason, lex&yacc, O'Reilly Media, October 2012.

REFERENCE BOOKS:

3. System programming and Compiler Design, K C Louden, Cengage Learning.
4. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman , Compilers-Principles, Techniques and Tools, Pearson, 2nd edition, 2007.

JOURNALS/MAGAZINES:

7. https://ieeexplore.ieee.org/document/4724385
8. https://ieeexplore.ieee.org/document/1515775
9. https://ieeexplore.ieee.org/document/537096
10. https://ieeexplore.ieee.org/document/642815
11. https://ieeexplore.ieee.org/document/5942077
12. https://ieeexplore.ieee.org/document/1183668

SWAYAM/NPTEL/MOOCs:

4. https://onlinecourses.nptel.ac.in/noc21_cs07/preview
5. https://onlinecourses.nptel.ac.in/noc21_cs81/preview
6. https://nptel.ac.in/courses/128106013

SELF-LEARNING EXERCISES:

6. Multi-pass assemblers
7. Macroprocessors
8. Text Editors
9. Interactive Debugging Systems
10. Operating System

<table>
<tr><td>Course Title</td><td colspan="4">Sensors and Interfacing</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22EFS413</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

In a modern development cycle, it is important for the developers to understand the sensor system, how they interact, and design the interface. In this course, students understand the basic concepts of various sensors, characteristics, and its applications. Students can examine various sensors, their interfacing components and how they are applied in interfacing the applications.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Understand the fundamental concepts of sensors and their applications
6. Explain the various types of sensors and their characteristics
7. Select an appropriate sensor for sensing and control action.
8. Demonstrate the communication and sensor interfacing components

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate the working principle of various sensors with their characteristics of communication interfaces.	1 to 3, 9,10,12	1,2
CO2	Apply analytical skills to determine the response of sensors for change in physical parameters	1 to 3, 9,10,12	1,2
CO3	Select an appropriate sensor to design physical parameter measurement solutions for a specific application	1 to 3, 9,10,12	1,2
CO4	Apply the principles of different sensors to analyze real-time physical parameters in industry	1 to 3, 9,10,12	1,2,3
CO5	Follow ethical standards when designing circuits that measure physical parameters.	1 to 3, 8 to 10,12	1,2,3
CO6	Understand the working of various sensors and provide engineering solutions for societal use.	1 to 3, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3			✓			
CO4			✓			
CO5			✓			
CO6		✓				

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	2	2						2	2		1	3	2	
CO2	2	2	3						2	2		1	3	3	
CO3	2	2	3						2	2		1	3	2	
CO4	2	2	3						2	2		1	2	3	2
CO5	2	2	3					2	2	2		1	3	2	3
CO6	2	2	3						2	2		1	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Digital Inputs and Outputs: Introduction to Digital Sensor, Sensor Types and Selection, Advantages of Digital Sensors, Digital Outputs, Pulse-Width Modulation with analog Write, Reading Digital Inputs, Building a Controllable RGB LED Nightlight.

UNIT – 2

Reading Analog Sensors: Introduction to Analog Sensor, Sensor Types and Selection, Advantages of Analog Sensors, Analog versus Digital Sensing, Understanding Analog and Digital Signals, Reading Analog Sensors with the Arduino.

UNIT – 3

Communication Interfaces: USB and Serial Communication, I2C Bus-I2C Hardware Design, Communication Scheme, and ID Numbers, communicating with an I2C Temperature Probe SPI Bus-Hardware Configuration, Communication Scheme, Comparing SPI to I2C, Communicating with an SPI Digital Potentiometer.

UNIT – 4

Sensors Interfacing: Interfacing of Analog Sensors: Potentiometer, Temperature Sensor (LM35), LDR and Flex Sensor, Interfacing of Digital Sensors: Switch, PIR Motion Sensor, Fire Sensor, Rain Sensor, and Vibration Sensor.

TEXT BOOKS:

7. Jeremy Blum, “Exploring Arduino: Tools and Techniques for Engineering Wizardry”, Wiley Publisher, First Edition, 2013.
8. T Rajesh Singh, ku "Getting Started for Internet of Things with Launch Pad and ESP8266", River Publishers, First Edition, 2019.

REFERENCE BOOKS:

6. Sensors, Actuators, and their Interfaces a Multidisciplinary Introduction, By Nathan Ida · 2014.
7. Arduino meets MATLAB: Interfacing, Programs and Simulink, Rajesh Singh, Anita Gehlot, Bhupendra Singh · 2018
8. Piezo electric Sensors and Actuators: Fundamentals and Applications, Springer, 2018
9. Senturia S. D, Sensors and Signal Conditioning Wiley-Blackwell, 2008
10. Jacob Fraden, Handbook of modern sensors, Springer, Stefan Johann Rupitsch

JOURNALS/MAGAZINES:

6. https://ieeexplore.ieee.org/document/6742595
7. https://ieeexplore.ieee.org/document/9584868
8. https://ieeexplore.ieee.org/document/9376916

9. https://dl.acm.org/doi/10.1145/3231053.3231121
10. https://dl.acm.org/doi/10.1145/2899007.2899010

SWAYAM/NPTEL/MOOCs:

3. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
4. https://www.edx.org/course/iot-sensors-and-devices?index=product&queryID=77d5d64fc974f050698418c9a9f4ff47&position=2&linked_from=autocomplete

SELF-LEARNING EXERCISES:

3. Review of the Arduino Uno board, Arduino Ethernet Shield
4. Understand why Sensors have Standard output Range and how to choose them,

Course Title	Operation Research				Course Type		SC	
Course Code	B22EFS414	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

Operations Research is the discipline of applying analytical methods to solve complex problems and make better decisions. It uses mathematical modelling, analysis, and optimization techniques in a holistic approach, OR facilitates in transforming data into information and information into insights. Its applications range from engineering to management, and from industry to the public sector. In Computer Science OR finds its application in Algorithms, Machine learning, and Artificial intelligence.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Understand and apply the fundamental concepts of linear programming.
6. Understand and apply different techniques to solve transportation and assignment problems.
7. Understand and apply different dynamic programming and integer programming techniques on OR problems to achieve optimality.
8. Understand and apply game theory for decision making problems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
1	Apply simplex method to solve linear programming problems and perform sensitivity analysis.	1,2,3,4,5,6	1,2,3
2	Apply different techniques to solve transportation problems and achieve optimality.	1,2,3,4,5,6	1,2,3
3	Apply different techniques to solve assignment problems and achieve optimality.	1,2,3,4,5,6	1,2,3

4	Apply Dynamic programming to solve muti stagecoach problem and achieve optimality.	1,2,3,4,5,6	1,2,3
5	Apply Integer programming to solve linear programming problems and achieve optimality.	1,2,3,4,5,6	1,2,3
6	Apply game theory and techniques on problems to take decisions and achieve optimality.	1,2,3,4,5,6	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√	√			
CO2	√	√	√			
CO3	√	√	√			
CO4	√	√	√			
CO5	√	√	√			
CO6	√	√	√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO2	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO3	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO4	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO5	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO6	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3

Note: 1-Low, 2-Medium, 3-High

UNIT- 1

Introduction, Linear Programming – 1

Introduction: The origin, nature, and impact of OR defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation. Introduction to Linear Programming: Prototype example; The linear programming (LP) model.Assumptions of LP; Additional examples. The essence of the simplex method; Setting up the simplex method; Algebra of the simplex method; the simplex method in tabular form; Tie breaking in the simplex method, Post optimality analysis, Duality Theory.

UNIT- 2

Linear Programming - 2

Transportation Problems:

Solving Balanced Transportation problems: NWCR Rule, Minimum cost method, Vogel's Approximation method (Penalty method), Basic Feasible solution, degenerate basic feasible solutions; finding optimal solution to the transportation problem: Stepping Stone method, MODI method or u-v method, Optimum solution with degenerate basic feasible solution.

Assignment Problems:

Assignment problem, properties of the optimal solution, solving the assignment problem – Hungarian method, the optimality of the Hungarian Algorithm

UNIT- 3

Dynamic and Integer Programming

Dynamic Programming-Multistage decision process, Forward and Backward approach, Resource Allocation Problem

Integer Programming – Graphical representation, Gomory's cutting plane method-concept of a cutting plane, Gomory's method for integer programming problems, branch and bound methods.

UNIT- 3

Game Theory, Decision Analysis

Game Theory: The formulation of two persons, zero sum games; Solving simple games- a prototype example; Games with mixed strategies; Graphical solution procedure; Solving by linear programming, Extensions. Decision Analysis: A prototype example; Decision making without experimentation; Decision making with experimentation; Decision trees.

TEXT BOOKS:

3. Frederick S Hillier, Gerals J Lieberman, Bodhibrata Nag, PreetamBasu, Introduction to Operations Research, , 9th Edition, McGraw Hill Education, Special Indian Edition, 2012.
4. G Srinivasan, Operations Research Principles and Applications, 2nd Edition, PHI Learning Private Limited, 2010.

REFERENCE BOOKS

4. Hamdy A. Taha, Operations Research An Introduction, , 8th Edition, Pearson Education, 2007.
5. S D Sharma, Operations Research Theory, Methods & Applications, 10th Edition, Kedarnath Ramnath & Co.
6. J K Sharma, Operations Research Theory & Applications, 5th Edition, Macmillan

SELF-LEARNING COMPONENT

3. https://www.coursera.org/learn/operations-research-modeling#syllabus

4. https://www.udemy.com/course/optimization-with-excel-operations-research-without-coding/

SWAYAM/NPTEL/COURSERA

4. https://nptel.ac.in/courses/110106062

5. https://onlinecourses.nptel.ac.in/noc22_ma48/preview

6. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview

SAMPLE QUESTIONS/PROBLEMS

MODULE-1

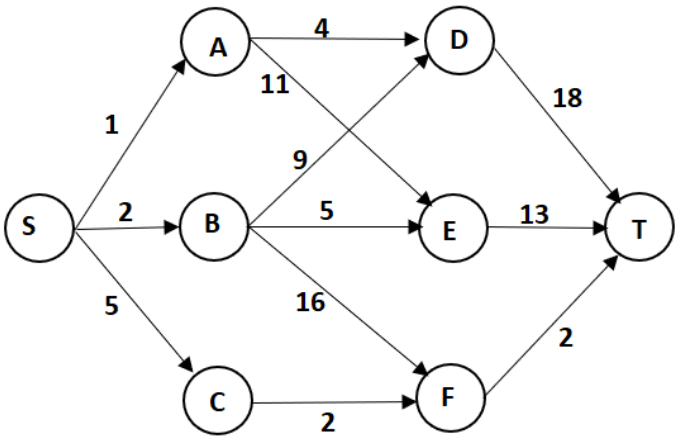
1	A man operates a pushcart. He sells hotdogs and sodas. His cart can support 210 kgs. A hotdog weighs 200 grams; a soda weighs 100 grams. He knows from experience that he must have at least 60 sodas and at least 80 hotdogs. He also knows that for every two hotdogs he sells, he needs at least one soda. Given he makes 5 rupees profit on a hotdog and 4 rupees profit on a soda. Formulate an LPP.
2	ve the given problem using simplex tabular method. (Big-M method) Min Z = 3x1+5x2 subject to 3x1+ 2x2 ≥ 36 3x1+ 5x2 ≥ 45 x1, x2 ≥ 0
)DULE-2	
1	d optimal solution for given transportation problem

					pacity
					)
					)
					)
mand	)	)	5	)	75

2	ve the given assignment problem using Hungarian Algorithm				

	P1	P2	P3	P4	P5
J1	11	7	10	17	10
J2	13	21	7	11	13
J3	13	13	15	13	14
J4	18	10	13	16	14
J5	12	8	16	19	10

)DULE-3	
1	Solve the below graph using dynamic programming.



2	Solve the given LPP using graphical method

	Max **Z = $6X + 7Y$** Subject to $4X + 5Y \leq 20$ $10X + 7Y \leq 35$ $3X + 4Y \geq 6$ **$X, Y \geq 0$ and integer**
MODULE-4	
1	Solve the game using dominance principle whose payoff matrix to the player A is given below.

		B		
A		**I**	**II**	**III**
	I	1	7	2
	II	6	2	7
	III	5	2	6

2	In an election campaign, the strategies adopted by the ruling and opposition party along with payoffs (ruling party's % share in votes polled) are given below. Solve it as game theory & find the payoff:

Opposition Party's Strategies			
Ruling Party's Strategies	Campaign one day in each city	Campaign two days in large towns	Spend two days in large. rural sectors
Campaign one day in each city	55	40	35
Campaign two days in large towns	70	70	55
Spend two days in large rural sectors	75	55	65

Course Title	**Design and Analysis of Advanced Algorithms**				**Course Type**		**SC**	
Course Code	**B22EFS415**	**Credits**	**3**		**Class**		**IV Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	**3**	**3**	**3**				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

The objective of this course is to introduce the formal techniques to support the design and analysis of algorithms, focusing on both the underlying mathematical theory and practical considerations of efficiency.Topics includes asymptotic complexity bounds, techniques of analysis, Divide and conquer techniques, Dynamic programming, Greedy approach, Branch and bound techniques, NP Hard problems and algorithmic strategies.

COURSE OBJECTIVE (S):

The objectives of this course are to:

6. Analyze the Asymptotic performance of algorithms and design algorithms using divide and conquer approach.
7. Design algorithms using the dynamic programming, and greedy method.

8. Develop efficient algorithm using graph methods.
9. Design the algorithms using branch and bound approach.
10. Ability to understand the Class P, NP, NP-hard and NP-complete problems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basic notation for analyzing the performance of the algorithms.	1-4,6,7	1,2
CO2	Illustrate divide-and-conquer techniques for solving suitable problems.	1-4,6,9,12	1,2
CO3	Make use ofdynamic programmingand greedy approach to solve suitable problems.	1-4,9,12	1,2
CO4	Apply the graph algorithms and their analysis.	1-4,6,7,9,12	1,2
CO5	Analyze branch and bound approach to solve an appropriate problem.	1-4,6,9,12	1,2
CO6	Evaluate the classes P, NP, and NP-Complete and be able to prove that a problem is NP-Complete.	1-4,6,7	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5				√		
CO6					√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1								3	2	
CO2	3	3	3	2	2				2			2	2	3	2
CO3	3	3	3	2	2					3		3	3	3	2
CO4	3	3	3	2	3				3	3		3	3	3	2
CO5	3	3	3	2	2				2			2	2	3	2
CO6	3	3	3	2	3				2			2	2	2	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Analysis of Algorithm: The efficient algorithm, Average, Best and worst case analysis, Amortized Analysis.

Divide and Conquer: Introduction, Recurrence and different methods to solve recurrence, Multiplying large Integers problem - Binary Search, Max-Min problem, Sorting (Merge sort, Quick Sort), Matrix Multiplication, Exponential.

UNIT – 2

Dynamic Programming: Introduction, The Principle of optimality, problem solving using Dynamic Programming-Calculating the Binomial Coefficient, Knapsack problem, Matrix chain multiplication.

Greedy Algorithm: General characteristics of greedy algorithms, Problem solving using-Activity selection problem, Fractional Knapsack Problem, Job scheduling problem.

UNIT – 3

Graph Algorithms: Representation of Undirected & Directed Graph, Traversing Graphs, Depth First search, Breadth First Search, Topological sort, strongly connected components. Single pair shortest path and minimum spanning trees (Kruskal's algorithm, Prim's algorithm) using greedy approach, All points shortest path using Dynamic programming.

UNIT – 4

Backtracking and Branch and Bound: Introduction, The Eight Queens problem, Knapsack problem, Travelling Salesman Problem, Minimax principle.

Introduction to NP-Completeness: The class P and NP, Polynomial reduction, NP-completeness problem, NP hard Problems, Travelling Salesman Problem, Hamiltonian problem.

TEXT BOOKS:

3. Anany Levitin, —Introduction to the Design and Analysis of Algorithms‖, Third Edition, Pearson Education, 2012.
4. Algorithm Design - Jon Kleinberg and Eva Tardos, Pearson, 1st Edition (2013).

REFERENCE BOOKS:

8. Introduction to the Design & Analysis of Algorithms - Anany Levitin, 2nd Edition, Pearson Education, 2007.
9. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivestand Clifford Stein, Introduction to Algorithms, 3rd Edition, PHI,2010.
10. R C T Lee, S S Tseng, R C Chang andY T Tsai, Introduction to the Design and Analysis of Algorithms A Strategic Approach, Tata McGraw Hill,2005.
11. Jon Kleinbergand E. Tardos, Algorithm Design, Pearson Addison-Wesley,2004.
12. S. Dasgupta, C. Papadimitriou and U. Vazirani Algorithms, 1st Edition, McGraw-Hill Education, 2006.
13. AV Aho, JE Hopcroft and JD Ullman, The Design and Analysis of Algorithms, Addison-Wesley Publishing Company, 1974.
14. https://www.tutorialspoint.com/parallel_algorithm/parallel_algorithm_quick_guide.htm

JOURNALS/MAGAZINES:

4. https://www.journals.elsevier.com/journal-of-algorithms
5. https://journals.sagepub.com/home/act
6. https://www.sciencedirect.com/journal/journal-of-algorithms

SWAYAM/NPTEL/MOOCs:

15. https://nptel.ac.in/courses/106106131
16. https://onlinecourses.nptel.ac.in/noc19_cs47/preview
17. https://nptel.ac.in/courses/106101060
18. https://www.my-mooc.com/en/categorie/algorithms-and-data-structures
19. https://www.udemy.com/topic/algorithms/
20. http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html
21. http://nptel.ac.in/courses/106101060/
22. http://www.comp.nus.edu.sg/~cs5234/Links/Course-Links.htm
23. https://www.coursera.org/learn/algorithm-design-analysis
24. http://apps.topcoder.com/wiki/di...
25. http://www.geeksforgeeks.org,
26. http://www.algolist.net
27. http://www.cprogramming.com
28. http://www.codingunit.com

Self-Learning Exercises:

Design and analysis of Parallel Algorithm: Introduction-Concurrent Processing, Model of Computation, Parallel algorithm and Analysis, Parallel Algorithm Models.

Course Title	Java Programming Lab				Course Type		HC	
Course Code	B22EF0405	Credits	1		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE OVERVIEW:

Java's unique architecture enables programmers to develop a single application that can run across multiple platforms seamlessly and reliably. In this course, students gain hands-on experience on using fundamental & advanced java concepts and also learn to use tools to execute java programs.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Explain the basic data types and control structures of the Java language.
6. Illustrate the creation of classes and objects in Java.
7. Demonstrate extending a class (inheritance) and use proper program anomaly handling structures.
8. Illustrate creation of windows applications using swings and event handling.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Design and develop java programs for solving simple problems using fundamental concepts.	1 to 5,9,10,12	1,3
CO2	Use arrays and other data structures to organize and use data to solve real world problems.	1 to 5, 9,10,12	1,3
CO3	Make use of properties of one class in another using inheritance.	1 to 5, 9,10,12	2, 3
CO4	Implement Exception Handling to develop effective applications using java.	1 to 5, 9,10,12	2
CO5	Develop java windows applications using swing components.	1 to 5, 9,10,12	1,3
CO6	Develop responsive applications using event handling.	1 to 5, 9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1				3	3		2	3		3
CO2	3	3	2	2	1				3	3		2	3		3
CO3	3	3	1	1	1				3	3		2		3	3
CO4	3	3	3	1	2				3	3		2		3	
CO5	3	1	2	1	3				3	3		2	3		3
CO6	3	1	2	1	3				3	3		2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

PRACT ICAL:

No	Title of the Experiment
1.	te a java program to create a console application that allows the user to choose an arithmetic operation able to provide his choice of operands for the same. Display the appropriate output. e: Use Switch statement to perform the operations.
2.	tring is a collection of characters, a given string can be a combination of vowels and consonants. Develop a java program to count the number of vowels and consonants in a string.
3.	ıg a one dimensional array, read an array of integer elements and perform the following operations. y all elements from one array to another. ıove duplicate elements from array and print only even position of array.

4.	elop a JAVA program to write an application to create student database to input name, SRN and college name, where college name should be declared as static variable and perform the following tasks. ate a class with static variable. rt some values into the members of the class including static member and display the values of the members. nge the value of static variable and display the updated values of the members.
5.	ume of a box to be computed using different features of a box: height, width and depth. Write a generic java program that accepts the values of the features of a box during the construction of its object and calculate its volume and display the same. e: Student should identify the classes, data and function members in each class and write the program.
6.	ild inherits the features of parents and also develops its own personality as it grows up in the society, over a period of time. This situation can be represented by the concept of multilevel inheritance in java programming. Apply the same concept in the car manufacturing scenario in your own terms. e: Student should identify the classes, data and function members in each class and write the program.
7	technologies is firm that has 5 employees with 1 manager, and 4 technicians. XYZ wants to digitize its payroll system, the following requirements: Dearness Allowance is 70% of basic for all employees. House Rent Allowance is 30% of basic for all employees. Income Tax is 40% of gross salary for all employees. The annual increments to the employees are to be given of the following criteria: -Manager 10% of the basic salary, and Technicians 15% of basic. Develop the pay roll for XYZ. Implement a class hierarchy using inheritance, where Employee is an abstract class and Manager and Technician are derived from Employee. Demonstrate a polymorphic behavior for giving the annual increments.
8	ne a new Exception class named Odd Exception. Create a new class named Even Odd. Write a method called halfOf(), which takes an int as parameter and throws an Odd Exception if the int is odd or zero, otherwise returns (int / 2). Write a main method that calls halfOf() three times (once each with an even int, an odd int, and zero), with three try/catch blocks, and prints either the output of halfOf() or the caught Odd Exception.
9	ate a class Student that has instance variables as Name, Age, Address and access transmutation methods to access the instance variables along with display method to print the details of student. Next write a main () function that will create a collection of 10 students and reverse the list. Print the details before and after reversing the collection.

10	ate a Shape interface having methods area () and perimeter (). Create 2 subclasses, Circle and Rectangle that implement the Shape interface. Create a class Sample with main method and demonstrate the area and perimeters of both the shape classes. You need to handle the values of length, breath, and radius in respective classes to calculate their area and perimeter.
11	elop a java application to calculate the BMI (Body Mass Index) using swing to create an interface that accepts weight and height and displays the BMI result as Overweight or Healthy.
12	Develop a Java application using swing to create a user interface for xyz company that accepts the following data of a candidate: Name, Age, Engineering discipline, percentage of marks scored. The Application should validate the candidate for recruitment process by verifying the percentage. If the percentage is greater than or equal to 80% and age is greater than 21 but less than or equal to 23 then the candidate is eligible other he is not eligible for recruitment process. The same has to be displayed on the screen.

Course Title	Database Management System Lab				Course Type		HC	
Course Code	B22EF0406	Credits	1		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE OVERVIEW:

This course introduces the core principles and techniques required in the design and Implementation of database systems. This introductory application-oriented course covers therelational database systems RDBMS - the predominant system for business scientific and Engineering applications at present. It includes Entity-Relational model, Normalization, Relationalmodel, Relational algebra, and data access queries as well as an introduction to SQL. It also coversessential DBMS concepts such as: Transaction Processing, Concurrency Control and Recovery. Italso provides students with theoretical knowledge and practical skills in the use of databases anddatabase management systems in information technology applications.

COURSE OBJECTIVE (S):

Students will have the ability to:

5. Keep on a level with of current developments to continue their own professional Development.
6. To engage themselves in lifelong learning of Database management systems, Theories and technologies this enables them to purse higher studies.
7. To interact professionally with colleagues or clients located abroad and the ability to overcome challenges that arises from geographic distance, cultural differences, and multiple languages in the context of computing.
8. Develop team spirit, effective work habits, and professional attitude in written and oral forms, towards the development of database applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the basic concepts of Database Systems and Applications.	1 to 5,9,10,12	1,3
CO2	Use the basics of MySQL and construct queries using MySQL in database creation and interaction.	1 to 5, 9,10,12	1,3
CO3	Design a commercial relational database system (Oracle, MySQL) by writing MySQL using thesystem.	1 to 5,9,10,12	2,3

CO4	Analyze and Select storage and recovery techniques of database system.	1 to 5,9,10,12	1,2
CO5	Construct the physical and logical database designs, database modeling, relational, hierarchical, and network models.	1 to 5, 9,10,12	1,2
CO6	Relate conceptual model to relational model and formulate relational algebra queries.	1 to 5, 9,10,12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				2	3		2	3	3	
CO2	3	3	2	3	1				2	3		2	3	3	
CO3	3	3	2	3	3				2	3		2	3	3	3
CO4	3	3	2	3	1				2	3		2	3	3	
CO5	3	2	3	3	3				3	3		3	3		3
CO6	3	3	2	3	3				3	3		3		3	3

Note: 1-Low, 2-Medium, 3-High

PART-A: MySQL Programming

4. Design, develop, and implement the specified queries for the following problems using Oracle, MySQL,SQL Server, or any other DBMS under LINUX/Windows environment.
5. Create Schema and insert at least 5 records for each table.
6. Add appropriate database constraints.

PART-B: Mini Project

3. Use Java, C#, PHP, Python, or any other similar front-end tool.
4. All applications must be demonstrated on desktop/laptop as a stand-alone or web based application (Mobile apps on Android/IOS are not permitted.)

SL.NO.	Title of the Experiment
	PART-A
1	Implementation of DDL, DML, DCL and TCL commands of SQL with suitable examples.
2	Study & Implementation of different types of constraints with suitable examples.
3	Implementation of different types of function, operators, Joins with suitable examples.
4	Study and Implementation of • Group By & having clause • Order by clause • Indexing • Views • Sub queries
5	Identifying entities, attributes, keys and relationshipsbetween entities, cardinalities, generalization, specialization etc. using Conceptual Designing (Ex:- ER Diagrams).
6	**Consider the following schema for a Flight Database and draw an ER Diagram.** FLIGHT(Flight no: integer, Flight from: string, Flight to: string, distance: integer, departs: time, arrives: time, price: real) AIRCRAFT (aid: integer, aname:string, cruisingrange:integer) CERTIFIED (eid:integer, aid:integer) EMPLOYEES (eid:integer, ename:string, salary: integer) **ite SQL queries to** 1. Find the names of aircraft such that all pilots certified to operate them have salaries more than Rs 80,000. 2. For each pilot who is certified for more than three aircrafts, find the eid and the maximum cruising range of the aircraft for which he/she is certified. 3. Find the names of all pilots whose salary is less than the price of the cheapest route from Bangalore to Frankfurt. 4. For all aircrafts with cruising range over 1000 kms, find the name of the aircraft and the average salary of all pilots certified for this aircraft. 5. Find the names of pilots certified for some Boeing aircraft. 6. Find the aid's of all aircraft whose cruising range is greater than the minimum distancefrom the routes from Bangalore to Delhi**.**
7	**nsider the schema for College Database and draw and ER Diagram.** JDENT (USN, SName, Address, Phone, Gender) MSEC (SSID, Sem, Sec) ASS (USN, SSID) BJECT (Subcode, Title, Sem, Credits) MARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) **ite SQL queries to** List all the student details studying in fourth semester 'C' Section. Compute the total number of male and female students in each semester and in each section. Create a view of Test1 marks of student USN '1BI15CS101' in allsubjects. Calculate the FinalIA (average of best two test marks) and update the rresponding table for allstudents. Categorize students based on the followingcriterion:

	finalIA = 17 to 20 then CAT =‘Outstanding’ finalIA = 12 to 16 then CAT = ‘Average’ finalIA< 12 then CAT = ‘Weak’ ve these details only for 8th semester A, B, and C section students.
PART-B(Mini Project)	
	For any problem selected • Make sure that the application should have five or more tables • Indicative areas include; health care, Laboratory Outcomes: The student should be able to: • Create, Update and query on the database. • Demonstrate the working of different concepts of DBMS • Implement, analyze and evaluate the project developed for an application with the front end compatibility.

Course Title	Microcontroller and IOT Lab				Course Type		HC	
Course Code	B22EF0407	Credits	1		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE OVERVIEW:

In this course, students will learn how to program ARM based controllers by digging deep into its internals and programming aspects. Using the comprehensive tool IoT Development Kit, students will be able to accelerate learning IoT Fundamentals and apply the concepts to get a Hands-On experience by performing different experiments.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Explain assembly language programs for the ARM microcontroller.
6. Demonstrate Interface various environmental and human interfaces with ARM microcontrollers.
7. Illustrate the use of modern system development tools in the design of IOT-based system.
8. Discuss the development of ARM microcontroller-IoTbased systems for real-world applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of ARM processor instruction set for developing simple assembly programs.	1,2,5,9,10,12	1
CO2	Construct assembly language programs for the ARM microcontroller.	1 to 5,9,12	1,2,3
CO3	Implement and interface various environmental and human interfaces with ARM microcontrollers.	1 to 5,9,12	1,2, 3
CO4	Illustrate IoT prototyping for real world socio-economic problems.	1 to 5,9,12	1,2,3
CO5	Use modern system development tools in the design of a microcontroller-based system.	1 to 5,9,12	1,2,3
CO6	Develop IoT microcontroller-based embedded systems for real-world control applications.	1 to 6,9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			

CO2						√
CO3			√			
CO4				√		
CO5						√
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3			2				2	2		2	3		
CO2	3	3	3	2	2				2	2		2	2	1	1
CO3	3	3	3	2	2				2	2		2	2	3	1
CO4	3	3	3	2	2				3	2		2	2	3	3
CO5	3	3	3	2	2				2	2		2	2	3	3
CO6	3	3	2	2	2				2	2	2	3	2	3	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1	Write an assembly language program to realize the given expressions i)A=B+C-D ii)A=4A+B iii)X=3X+4Y+9Z ite an assembly language program to add two 64-bit numbers.	Keil software	sembly Language programming
2	ite an assembly language program to find average of N 32-bit numbers.	Keil software	sembly Language programming
3.	ite an assembly language program to find number of occurrences of a number in a given list using linear search method.	Keil software	sembly Language programming
4.	ite an assembly language program to count number of ones in a given 32-bit binary number.	Keil software	sembly Language programming
5.	ite an assembly language program to find factorial of a given 32-bit number using procedure.	Keil software	sembly Language programming
6.	sign and construct a module to drive stepper motor clockwise and anti-clockwise using Arduino board to indicate that plant need to be watered by sensing its moisture level.	IoT Development Kit	sembly Language programming&IoT fundamentals
7.	sign and construct a module to interface LCD to display the temperature and moisture values using Arduino board.	IoT Development Kit	sembly Language programming&IoT fundamentals

8.	sign and construct a module to interface ultrasonic sensor to alert the obstacle (turn ON the buzzer) using Arduino board.	IoT Development Kit	sembly Language programming&IoT fundamentals
9.	sign and construct a module to drive stepper motor clockwise and anti-clockwise using Arduino board to indicate that there is a gas leakage by sensing it.	IoT Development Kit	sembly Language programming&IoT fundamentals
10.	sign and construct a module to interface light sensor to detect the darkness and switch ON the LED.	IoT Development Kit	sembly Language programming&IoT fundamentals

Recommended Learning Resources:

4. https://www.arduino.cc
5. Peter J Knaggs, "ARM Assembly Language Programming", 2016.
6. (http://www.rigwit.co.uk/ARMBook/ARMBook.pdf)

Course Title	**Skill Development Course - 2**				**Course Type**		**SDC**	
Course Code	**B22EF0408**	Credits	**2**		**Class**		**IV Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	-	-	-				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	2	4	4				
	Total	**2**	**4**	**4**	**-**	**56**	**50%**	**50%**

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3

CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-2:

Students will be offered training and certifications on the trending technologies from the industry experts.

The students are evaluated and certified after the training programs.

V SEMESTER

	Course Code	Title of the Course	HC/FC /SC/OE /MC/SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
	B22XXO51X	Open Elective – 1 (multidisciplinary)	OE	3	0	0	3	3	50	50	100	POE
	B22PAM501	Indian Heritage and Culture (MC)	MC	2	0	0	0	2				HSMC

	B22EF0501	Theory of Computation	HC	3	0	0	3	3	50	50	100	PCC
	B22EF0502	Big Data Analytics	HC	3	0	0	3	3	50	50	100	PCC
	B22EF0503	Computer Networks	HC	3	0	0	3	3	50	50	100	PCC
	B22EF0504	Machine Learning and Applications	HC	3	0	0	3	3	50	50	100	PCC
	B22EFS51X	Professional Elective - 2	SC	3	0	0	3	3	50	50	100	PEC
	B22EFS52X	Professional Elective - 3	SC	3	0	0	3	3	50	50	100	PEC
	B22EF0505	Big Data Analytics Lab	HC	0	0	1	1	2	25	25	50	PCC
	B22EF0506	Computer Networks Lab	HC	0	0	1	1	2	25	25	50	PCC
	B22EF0507	Machine Learning Applications Lab	HC	0	0	1	1	2	25	25	50	PCC
	B22EF0508	Skill Development course 3	SDC	0	0	2	2	4	50	50	100	SDC
TOTAL				**23**	**0**	**5**	**26**	**33**	**475**	**475**	**950**	

TOTAL SEMESTER CREDITS	**26**
TOTAL CUMULATIVE CREDITS	**114**
TOTAL CONTACT HOURS	**33**
TOTAL MARKS	**950**

Open Elective – I

Course Title	**Data Structures and Algorithms**				**Course Type**		**POE**	
Course Code	**B22EFO511**	**Credits**	**3**		**Class**		**V Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

The objective of this course is to provide the solid foundation in the basic concepts of data structures and algorithms. The knowledge of fundamentals of data structures and algorithms is a key to any type of software development: Application Software, System Software, Operating Systems, and Network Simulator. Apart from introducing the basic knowledge of data structures, this course, also introduces many algorithms that are designed using the fundamental algorithm design techniques: Brute force, Divide and Conquer, Decrease and Conquer, Greedy Technique.

COURSE OBJECTIVES:

The objectives of this course are:

1. Introduce the insights of basic concepts of data structures andalgorithms.
2. Demonstrate the fundamental data structures: arrays, stacks, queues and linkedlists.
3. Explain the mathematical foundation for the design and analysis of algorithms.
4. Demonstrate the algorithms using brute force and divide and conquer design technique.

COURSE OUTCOMES (COs):

On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify and classify various types of data structures.	1,2,3,5	1,2,3
CO2	Design and implement programsusing data structures like arrays, stacks, queues and linked lists.	1,2,3,5	1,2,3
CO3	Apply the knowledge of data structures tosolve real world problems.	1,2,3,5	1,2,3
CO4	Identify and design new algorithms to solve real world problems.	1 to 5	1,2,3
CO5	Apply the knowledge of mathematical foundation of algorithm design and analysis to design a new algorithm and analyze its performance.	1 to 5	1,2,3
CO6	Design the foundation for any real world software development using existing or creating new algorithm design technique.	1 to 5	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

Bloom's Level						
CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3			✓			
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1										3	3	3
CO2	3	2	2										3	3	3
CO3	3	2	2										3	3	3
CO4	3	2	2										3	3	3
CO5	3	3	3										3	3	3
CO6	3	3	3										3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT:

Unit - 1

Introduction to Arrays and Data Structures: Introduction to data structures, types of data structures, data structure operations;

Arrays: Types of arrays, operations on arrays;

LinkedLists: Basic concept, linked list implementation, types.

Unit – 2

Stacks: Introduction, Stacks- basic concept, Stack operations, Stack implementation;

Queues: Introduction, Queues-basic concept, queue operations, implementation, circular queue.

Unit – 3

Introductionto Algorithms: Fundamentals of the Analysis of Algorithm Efficiency: The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes.

Brute Force: Bubble Sort, Selection Sort, Sequential Search and Brute-Force String Matching

Unit – 4

Divide-and-Conquer: Merge sort, Quick sort, Introduction to Graphs.

Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm.

TEXT BOOKS:

1. E.Balaguruswamy,"Data Structures using C", Revised edition, 2011.
2. M. Padma Reddy, "Data Structures using C", Nandi Publications.
3. Anany Levitin, "Introduction to Design and Analysis of Algorithms", 3rd edition.

REFERENCE BOOKS:

1. Coreman, "Introduction to Algorithms", MIT, 3rd edition.
2. A. V. Pai, "Data Structures and Algorithms", TMH, 2008.

Course Title	Unix Shell Programming				Course Type		POE	
Course Code	B22EFO512	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course provides the basics of Unix operating system with which the student gets familiarized with the Unix environment and shall be able to use Unix platform through command execution. They shall also understand the fundamental aspects of shell programming language and provide solutions for the problems using the scripting language.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals and structure of UNIX Operating System.
2. Describe UNIX file types and permissions.
3. Illustrate the use of powerful vi editor and process features.
4. Impart UNIX basic shell scripting concepts with suitable examples.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the fundamentals of Operating System and UNIX environment.	1 ,2,5,9,10,12	1,2,3
CO2	Execute basic Unix commands and explore the system.	1,2,4, 5,9,10,12	1,2,3
CO3	Make use of UNIX file types, file structure and file system implementation.	1,4,5,9,10,12	1,2,3
CO4	Analyze the behavior of process using various features.	1,4,5,9,10,12	1,2,3
CO5	Demonstrate the application of vi editor through commands	1,4,5,9,10,12	1,2,3
CO6	Implement basic scripts in shell to solve given problems	1,2,4,5,9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1		√				
CO2			√			
CO3			√			
CO4				√		
CO5		√				
CO6			√			

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			3				3	3		3	3	1	3
CO2	3	2		2	3				3	3		3	3	3	3
CO3	3			3	3				3	3		3	3	2	3
CO4	3			3	2				3	3		3	3	1	3
CO5	3			2	3				3	3		3	3	2	3
CO6	3	2		3	3				3	3		3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Unix: What is an operating system? UNIX operating system and its architecture, features of the UNIX Operating System. UNIX Command structure and the difference between Internal and external commands.The flexibility of usage of UNIX commands and man command with its options.Organization of files. Hidden files, Fundamental Concept for Scheduler and Scheduling Algorithm.

UNIT – 2

Unix File system: The ls command with options. Changing file permissions: the relative and absolute permissions changing methods. Recursively changing file permissions. Directory permissions, Wild cards. Removing the special meanings of wild cards. Three standard files and redirection. Pipe. Basic and Extended regular expressions. The grepcommand, Typical examples involving different regular expressions.

UNIT – 3

Basics of vi editor: The .exrc file, and different ways of invoking and quitting vi.Different modes of vi editor, Input mode commands, Command mode commands, and the ex-mode commands.Illustrative examples of Navigation commands, the repeat command, Pattern searching command.

The Process: Process basics, Process status, Process states and zombies, Running jobs in background.

UNIT – 4

Shell Programming:A basic structure of Shell Script, Reading input from standard input that is the keyboard.The special variable in shell programming and reading variables from command line arguments.Exit status, conditional statements, and looping

statements in a shell programming language.Evaluating expressions using expr command and using test command, Simple shell programs.

TEXT BOOKS:

1. Sumitabha Das, Your Unix: Ultimate Guide, McGraw Hill Education; 3rdedition, 2013.
2. Yukun Liu, Yong Yue, Liwei Guo, "UNIX Operating System: The Development Tutorial via UNIX Kernel Services", Springer, Higher Education Press, 2011.
3. Sumitabha Das, "Unix concepts and applications", 4th Edition, MC Graw Hill.

REFERENCE BOOKS:

1. William Stallings," Operating Systems: Internals and Design Principles", Prentice Hall of India, seventh edition 2011.
2. M. Dhamdhere," Operating Systems: A Concept-Based Approach",Tata McGraw-Hill,2002.
3. Gary J. Nutt,"Operating Systems: A Modern Perspective", Addison-Wesley, 2011.

JOURNALS/MAGAZINES:

1. https://www.linuxjournal.com/tag/unix
2. Journal of Advances in Shell Programming (JoASP)
3. https://fedoramagazine.org/bash-shell-scripting-for-beginners-part-1/

SWAYAM/NPTEL/MOOCs:

1. Coursera – The UNIX Workbench
2. Coursera – Practical Introduction to the Command line
3. https://www.edx.org/course/linux-basics-the-command-line-interface
4. https://www.edx.org/course/introduction-to-linux

SELF-LEARNING EXERCISES:

1. UNIX I/O system
2. C modules interface

<table>
<tr><td>Course Title</td><td colspan="4">Indian Heritage and Culture</td><td colspan="2">Course Type</td><td colspan="2">MC</td></tr>
<tr><td>Course Code</td><td>B22PAM501</td><td>Credits</td><td colspan="2">-</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>2</td><td>2</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>-</td><td>2</td><td>2</td><td>28</td><td>-</td><td>-</td><td>-</td></tr>
</table>

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. To provide conceptual knowledge of Indian culture and traditions.
2. To introduce students to the science and technological advancements related to Indian culture.

3. To help students understand the Indian spiritual aspects of Indian culture.
4. To help learners understand the factors which unite the diverse cultures of India.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Gain conceptual understanding of Indian heritage and culture.		
CO2	Understand various forms dance and music in ancient India.		
CO3	ppreciate the science and technological advancements in ancient India.		
CO4	mprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana.		
CO5	monstrate the theory behind celebrating Hindu festivals and concept of making varieties of food		
CO6	Understand India as a land united by cultural diversity.		

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															
CO6															

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Indian Tradition

Culture – Indus Valley Civilization and early cultural practices, The Vedic culture, Influence of Buddhism and Jainism on Indian Culture, Influence of Islam and Christianity.

Religion – Pre-vedic and Vedic religion, Jainism, Buddhism, Hinduism, Religious Reform Movements, Advent of Christianity.

Art –Introduction to Natyashastra,classical and contemporary art forms (dance and music), regional art forms (dance and music), Folk art, Rise of modern theatre and Indian cinema.

Architecture – Engineering and Architecture in Ancient India; Evolution of Hindu Temple Structures, Sculptures, Coins and Pottery from Ancient India

Literature- Vedas, Upanishads, Ramayana, Mahabharata &Bhagavat Gita

UNIT – 2

Contribution of ancient India to Science and Maths

Development of Science in Ancient India- Astronomy, Mathematics, Medicine, Metallurgy

Scientists of Ancient India:

Mathematics and Astronomy- Baudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya

Science- Kanad, Varahamihira, Nagarjuna

Medical Sciences (Ayurveda and Yoga)- Susruta, Charaka, Yoga and Patanjali

Science and Scientists in Medieval India - Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture

Scientists in Modern India- Srinivas Ramanujan, Chandrasekhara V Raman, Jagadish Chandra Bose, Homi Jehangir Bhabha, Dr, Vikram Ambalal Sarabhai, ,Dr. APJ Abdul Kalam

UNIT – 3

Indian Spiritual Aspects

Hindu Spirituality based on shruti and smriti- Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

Hata Yoga and Pranayama- Main Features,Basics of Yoga –Different kinds of Yoga; Raja Yoga (Ashtanga yoga); Karma yoga; Bhakti Yoga – yoga of Loving Devotion; Jnana yoga – Yoga of Knowledge; Hatha Yoga (Asana/ Pranayamas); Kundalini Yoga; Nada Yoga; Sannyasa Yoga

Buddhist, Jaina Spiritualities- Main Doctrines of Buddhism: Four Noble Truths (AryaSatya), Concept of Nirvana -AshtangaMarga

UNIT – 4

Unity in Diversity

Commensality and the Significance of Food– Eating Together as Family and as a Society, Food at Rituals; annaprasan, marriage and funeral, Kitchen as Shared Space for Women, Food and Nationalist Response of Indian Community, Visibility of Indian Cuisine in the World

Celebrating Diverse Festivals – FestivalTypes: Religious and Seasonal, Religious- Holi, Diwali, Ganesh Chaturthi, Janmashtami,Mahavir Jayanthi, Ramadan, Christmas, Buddha Purnima; Seasonal (harvest festivals)- Baisakhi, Pongal, Sankranti

Attire - Indus Valley Civilization, Vedic period, Modern India

Text Books

1. Sundararajan K.R., Hindu Spirituality - Vedas through Vedanta, Cross Road Publications, New York, 1997. Griffiths Bede, Yoga and the Jesus Prayer Tradition, Asian Trading Corporation, Bangalore, 1992.
2. AnshMishra, Science in Ancient India, Indian Corporation, New Delhi, 1998

3. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.
4. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018

Course Title	Theory of Computation				Course Type		HC	
Course Code	B22EF0501	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The course introduces some fundamental concepts in automata theory and formal languages which deal with concepts of automata, formal languages, grammar, pushdown automaton, Turing machine.These form basic models of computation; they are also the foundation of many branches of computer science, viz. compilers, software engineering, concurrent systems, etc. The reasons to study Automata Theory and Formal Languages are that Automata Theory provides a simple, elegant view of the complex machine that we call a computer. Automata Theory possesses a high degree of permanence and stability, in contrast with the ever-changing paradigms of computer systems technology, development, and management. Further, parts of the Automata theory have a direct bearing on practice, such as Automata on circuit design, compiler design, and search algorithms; Formal Languages and Grammars on compiler design; and Complexity on cryptography and optimization problems in manufacturing, business, and management.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the concepts of Deterministic and Non-Deterministic Finite Automata.
2. Demonstrate the use of Regular Expressions for constructing DFA and NFA.
3. Illustrate the construction of Context-Free Grammar for a given language.
4. Narrateadvanced computing Machines such as PDA and Turing Machine

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Construct the Finite State Machine by applying the concepts of DFA, NFA and Epsilon-NFA.	1 to 5,11,12	1,2,3
CO2	Express the Regular Expressions for DFA, NFA and Epsilon-NFA.	1 to 5,11,12	1,2,3
CO3	Identify ambiguity in Grammar and Construct CFG for the given language in Normal Forms.	1 to 5,11,12	1,2,3
CO4	Apply the concepts of Push down Automata and Turing machine for a given Language.	1 to 5,11,12	1,2,3
CO5	Classify a problem for different models of Computation.	1 to 5,11,12	1,2,3
CO6	Recognize skills in formal reasoning and reduction of a problem to a formal model.	1 to 5,11,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2		√				
CO3		√				
CO4			√			
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	-	-	-	2	-	3	3	1	3	3
CO2	2	2	3	3	3	-	-	-	2	-	3	3	1	3	3
CO3	2	2	3	3	3	-	-	-	2	-	3	3	1	3	3
CO4	2	2	3	3	3	-	-	-	2	-	3	3	1	3	3
CO5	2	2	3	3	3	-	-	-	2	-	3	3	3	3	3
CO6	2	2	3	3	3	-	-	-	2	-	3	3	2	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Finite Automata (FA): Introduction, Alphabets; Languages; strings; Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA) - Definition of NFA, language of an NFA, Equivalence of Deterministic and Non-deterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions.

UNIT – 2

Regular Expressions (RE): Minimization of Deterministic Finite Automata, Introduction to Regular Expression, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, Applications of Regular Expressions. Equivalence of finite automata and regular expressions; pumping lemma for regular languages;

UNIT – 3

Regular Grammars, Context Free Grammars and Normal Forms: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Context Free Grammars; Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings; Ambiguity in CFG's; Normal forms-CNF and GNF.

UNIT – 4

Push Down Automata (PDA): Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA.

Turing Machines (TM): Formal definition and behavior, Languages of a TM, Problems.

TEXTBOOKS:

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson Education, 2009.
2. Peter Linz, An Introduction to formal Languages and Automata, 4/ E, Jones and Bartlett Publishers, 2006.

REFERENCE BOOKS:

1. Kamala Krithivasan, Rama R, Introduction to Formal Languages, Automata Theory and Computation, Pearson, 2009.
2. B N Srinivasa Murthy, Formal Languages and Automata Theory, Sanguine Publishers, 2006.

JOURNALS/MAGAZINES:

1. https://theoryofcomputing.org/
2. https://www.springer.com/journal/224/
3. https://www.sciencedirect.com/journal/theoretical-computer-science
4. https://www.worldscientific.com/worldscinet/ijfcs
5. https://lmcs.episciences.org/

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_cs79/preview
2. https://nptel.ac.in/courses/106104028
3. https://www.classcentral.com/course/youtube-computer-science-theory-of-computation-47562

4. https://www.udemy.com/course/theory-of-computation-automata-theory-finite-automata/
5. https://nptel.ac.in/courses/106/103/106103070/
6. https://www.udemy.com/course/theory-of-automata/
7. https://www.edx.org/course/automata-theory
8. https://www.coursera.org/courses?query=theory%20of%20computation

Course Title	Big Data Analytics				Course Type		HC	
Course Code	B22EF0502	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course introduces the concept of big data and provides a practical foundation level exposure that enables students to participate in big data application development. The course provides grounding in basic and advanced methods to big data technology with Apache Spark fundamentals.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the concepts of Big Data and its Business Implications.
2. Illustrate the fundamentals of functional programming for Big-Data Analytics.
3. Exemplifying the features of Apache Spark for Data Analytics.
4. Implement Machine Learning in Spark to solve real business problems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the concepts of Big Data and its Business Implications.	1 to 5,9,10,12	1
CO2	Apply the concept of functional distributed programming to Big Data Analytics applications.	1 to 5, 9,10,12	1,2, 3
CO3	Understand the fundamentals of Apache Spark and Spark Core.	1 to 5, 9,10,12	1, 3
CO4	Design a Data Analytics Framework using Apache Spark with Python.	1 to 5, 9,10,12	1,2,3
CO5	Implement distributed Machine Learning Applications for big data using Spark.	1 to 5, 9,10,12	1,2,3
CO6	Develop real world big data application using Apache Spark with Python programming.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√					
CO2			√			
CO3		√				
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	3	-	-	-	-	-	-	-	3	1	3
CO2	3	3	3	3	3	-	-	-	3	-	-	2	3	3	3
CO3	3	1	3	1	3	-	-	-	3	3	3	3	3	3	3
CO4	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
CO5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
CO6	3	3	3	3	3	1	-	1	3	3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introducing Big Data, Hadoop, and Spark: Introduction to Big Data, Distributed Computing, and Hadoop, A Brief History of Big Data and Hadoop, Hadoop Explained; **Introduction to Apache Spark**: Apache SparkBackground, Uses for Spark, Programming Interfaces to Spark, Submission Types for Spark Programs, Input/Output Types for Spark Applications, The Spark RDD, Spark and Hadoop; **Functional Programming Using Python**: Data Structures Used in Functional Python Programming, Python Object Serialization, Python Functional Programming Basics;

UNIT – 2

Understanding the Spark Cluster Architecture: Anatomy of a Spark Application: Spark Driver, Spark Workers and Executors, The Spark Master and Cluster Manager; **Spark Applications Using the Standalone Scheduler:** Spark Applications Running on YARN Deployment; **Modes for Spark Applications Running on YARN:** Client Mode, Cluster Mode, Local Mode Revisited; **Learning Spark Programming Basics**: Introduction to RDDs,Loading Data into RDDs, Creating an RDD from a File or Files, Methods for Creating RDDs from a Text File or Files, Creating an RDD from an Object File, Creating an RDD from a Data Source, Creating RDDs from JSON Files, Creating an RDD Programmatically;

UNIT – 3

Operations on RDDs: Key RDD Concepts, Basic RDD Transformations, Basic RDD Actions, Transformations on PairRDDs, MapReduce and Word Count Exercise, Join Transformations, Joining Datasets in Spark, Transformations on Sets, Transformations

on Numeric RDDs; **Advanced Programming Using the Spark Core API: Shared Variables in Spark**: Broadcast Variables, Accumulators, Exercise: Using Broadcast Variables and Accumulators; **Partitioning Data in Spark**: Partitioning Overview, Controlling Partitions, Repartitioning Functions, Partition-Specific or Partition-Aware API Methods; **RDD Storage Options:** RDD Lineage Revisited, RDD Storage Options, RDD Caching, Persisting RDDs, Choosing When to Persist or Cache RDDs, Checkpointing RDDs, Exercise: Checkpointing RDDs;

UNIT – 4

Processing RDDs with External Programs: Data Sampling with Spark; **Understanding Spark Application and Cluster Configuration**: Spark Environment Variables, Spark Configuration Properties; **Optimizing Spark**: Filter Early, Filter Often, Optimizing Associative Operations, Understanding the Impact of Functionsand Closures, Considerations for Collecting Data, Configuration Parameters for Tuning and Optimizing Applications, Avoiding Inefficient Partitioning, Diagnosing Application Performance Issues; **Machine Learning with Spark:** Machine Learning Primer, Machine Learning Using Spark MLlib, Exercise: Implementing a Recommender Using Spark MLlib, Machine Learning Using Spark ML;

TEXT BOOKS:

9. Aven, Jeffrey. Data Analytics with Spark Using Python. Addison-Wesley Professional, 2018.
10. Bengfort, Benjamin, and Jenny Kim. Data analytics with Hadoop: an introduction for data scientists." O'Reilly Media, Inc.", 2016.
11. Sridhar Alla, Big Data Analytics with Hadoop 3, published by Packt Publishing Ltd, May 2018
12. SubhashiniChellappan, DharanitharanGanesan, Practical Apache Spark Using the Scala API, A Press, 2018.

REFERENCE BOOKS:

1. Michael Minelli, Michele chambers, AmbigaDhiraj: Big data, big analytics, Wiley, 2013.
2. P. Tan, M. Steinbach, V. Kumar, Introduction to Data Mining, Addison-Wesley, 2005.
3. J. Han, M. Kamber, Data Mining: Concepts and Techniques, 2nd ed. Morgan Kaufmann, 2005.

JOURNALS/MAGAZINES:

1. IEEE,Introduction to the IEEE Transactions on Big Data
2. Elsevier,Big data research journal Elsevier
3. Springer, Journal on Big Data Springer.
4. ACM DL,The Journal of Machine Learning Research-ACM

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106104189
2. https://onlinecourses.nptel.ac.in/noc20_cs92/preview
3. https://iisc.talentsprint.com/cds/?utm_source=googlesearch&utm_medium=tcpa&utm_campaign=ts-googlesearch-iisc-cds-tcpa-similar-audiences-roi&utm_content=data-science-program&utm_term=Analytics%20training%20courses&gclid=Cj0KCQjw8uOWBhDXARIsAOxKJ2HfWKGqgpZ7Gm0dBPDgkwWaj0BqSZBzuWvcqmbF5AOvYvxYSB5lvFcaAlO_EALw_wcB
4. https://www.simplilearn.com/pgp-data-engineering-certification-training-

course?utm_source=google&utm_medium=cpc&utm_term=big%20data%20analysis%20online%20course&utm_content=11233548673-137256573987-586850068745&utm_device=c&utm_campaign=Search-DataCluster-PG-BigData-CDE-Purdue-IN-Main-AllDevice-adgroup-SEMR-09Mar2022-BD-Analysis-Course-Phrase&gclid=Cj0KCQjw8uOWBhDXARIsAOxKJ2GINP8K1hXBRF4Qu6cWTaZ714GQYvQR_CL4ff9qM6whNg_Xx2vLFmcaAjMTEALw_wcB

SELF-LEARNING EXERCISES:

1. SQL and NoSQL Programming with Spark
2. Stream Processing and Messaging Using Spark

Course Title	Computer Networks				Course Type		HC	
Course Code	B22EF0503	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The main emphasis of this course is on the organization and management of local area networks (LANs). The course description include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and about Open Systems Interconnection (OSI) communication model with TCP/IP protocol; This course provides knowledge of error detection and recovery; local area networks; bridges, routers and gateways; network naming and addressing; and local and remote procedures. This course also emphasis on User Datagram Protocol, TCP Congestion Control; DNS Message Formatting and RemoteLogin Protocols.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the protocol stacks (OSIandTCP/IP) for data communication.
2. Discuss the MAC protocols, error detection & correction strategies for data transmission over the networking devices.
3. Describe the standards for data communication with routing protocols.
4. Illustrate the client server communication using TCP or UDP protocols and other application level protocols.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the physical layer concepts in computer communications and networking.	1 to 3	1
CO2	Analyze and Design the computer network with simplicity, scalability and better performance.	1 to 5	2
CO3	Appraise the working principles of Internet.	1,2,5	3
CO4	Compile the effectiveness of MAC Layer, Network Layer and Transport Layer Protocols in designing network applications.	1 to 4	2
CO5	Summarize the key components and protocols used in interconnection of the Network.	1,3,4	1,3
CO6	Demonstrate different application and transport protocols used in real world application.	1 to 5	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2				√		
CO3			√			
CO4			√			

CO5		√				
CO6		√	√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2										2		
CO2	3	3	3	2	2									2	
CO3	3	2			2										3
CO4	3	3	2	2										2	
CO5	2		2	2									3		3
CO6	3	3	3	3	2									3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Data Communication and Networking:

Internet history and Internet today, Data Communications, Networks, Network Topologies, Classification of Networks, Protocols & Standards

Layered Architectures: Tasks, The OSI model, Layers in OSI model, TCP/IP Protocol suite, Addressing

Introduction to switching: Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks, **Physical Layer:** Introduction to Transmission Media, Periodic Analog signals, Digital signals, Nyquist bit rate,shanon capacity, performance, PCM, DM, Parallel transmission, serial transmission, ASK, FSK, PSK, QAM, AM,FM,PM.

Introduction to Network Tools: WireShark, PacketTracer, NS3, etc.

UNIT – 2

Coding: Line Coding, Introduction to Multiplexing: FDM, WDM, TDM, FHSS, DSSS.

Error Detection and Correction: Introduction, cyclic Codes: CRC, Internet checksum. Framing, DataLink Protocols: Point-to-Point Protocol.

MAC Protocols: classification of MAC protocols, Random access (ALOHA, CSMA/CD, CSMA/CA), Controlled Access (Reservation, Polling, Tokenpassing), Channelization Protocols (FDMA, TDMA, CDMA)

Introduction to Networking Devices: Repeaters, Hubs, Bridges, Routers, and High layered switches, Gateways, Virtual LAN.

UNIT – 3

Standards: IEEE Standards, Standard Ethernet, Gigabit Ethernet. IEEE 802.11: Architecture, MAC Sub layer, Addressing Mechanism.

Network Layer: IPv4 addresses, IP Datagram format, ICMP Messages, Introduction to Mobile IP for mobility management, IPv6 addresses, IPv6 Packet Format, Transition from IPv4 to IPv6, Routing algorithms (DistanceVector, Link State and Path vector), Unicast Routing protocols (RIP, OSPF). Awareness on BGP, Introduction to Multicasting protocols, brief introduction to multicast protocols such DVMRP, MOSPF, PIM.

UNIT – 4

Transport Layer: Introduction to Stop and Wait, GoBack-N, Selective repeat N, Piggybacking. Services and portnumbers, User Datagram Protocol (UDP): UDP Segment, Transmission Control.Protocol (TCP): TCP Segment, TCP Connection Setup, Application of TCP and UDP.TCP flow control, TCP error control, TCP Congestion Control and options, Introduction to SCTP services and features.

Application Layer: Client server programming using UDP and TCP, DNS, SMTP. Introduction to Remote LoginProtocols: TELNET Protocol and SSH Protocol.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1	a) Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.	RJ-45 connector, IO Connector, Crimping Tool, Twisted pair Cable, Cable Tester.	Cable Crimping, Standard Cabling and Cross Cabling, IO connector crimping and testing the crimped cable using a cable tester can be done successfully.
	b) Install and Configure Wired and Wireless NIC and transfer files between systems in LAN and Wireless LAN.	NIC, Adapter	Installation and configuration of Wired and Wireless (remotely) NIC and transfer files between systems in LAN and Wireless
			LAN between two systems in a LAN can be done successfully.
	c) Install and configure Network Devices: HUB, Switch and Routers.	HUB, Switch, Router and configuration software	Gain the knowledge on configuring the different Connecting devices.
	d) Connect the computers in Local Area Network.	Computer Systems with connecting media.	Interconnection and building a simple LAN.
2	a) Establish Peer to Peer network connection using two systems using Switch and Router in a LAN.	Computer Systems with connecting media.	Configuration of peer to peer network communication
	b) Configure Internet connection and use IPCONFIG, PING/Tracer and Netstatutilities to debug the network issues.	Connected Computer Systems.	Configure Internet connection
	c) Transfer files between systems in LAN using FTP Configuration, install Printserver in a LAN and share the printer in a network.	Connected Computer Systems with printer.	File *t*ransfer between systems in LAN using FTP Configuration.
	d) Study of basic network command and Network configuration commands.	Command Prompt	Network configuration

TEXT BOOKS:

1. Behrouz A Forouzan, “Data Communications and Networking”, 5th Edition, McGraw–Hill, 2016.
2. NaderF.Mir,“Computer and Communication Networks”, Pearson Education, 2009.

REFERENCE BOOKS:

1. Alberto Leon-Garcia and Indra idjaja, “Communication Networks – Fundamental Concepts and Key Architectures”, 2nd Edition Tata McGraw–Hill, 2004.
2. Andrew S.Tanenbaum, “Computer Networks”, 4th Edition, Pearson Education, 2005.
3. Larry L. Peterson and Bruce S. Davie, “Computer Networks- A system Approach”, 5th Edition, Elsevier, 2012.
4. William Stallings, “Data and Computer Communications”, 10th Edition, Pearson Education, 2008.

3	In information theory and coding theory with applications in computer science and telecommunication, error detection and correction or error control are techniques that enable reliable delivery of digital data over unreliable communication channels. Many communication channels are subject to channel noise, and thus errors may be introduced during transmission from the source to a receiver. Error detection techniques allow detecting such errors, while error correction enables reconstruction of the original data in many cases. Write a Program for Implementation of anyone mechanism for Error Detection/Error Correction Techniques.	CRC Hamming Code	Error detection and control in data transmission.
4	A routing algorithm is a procedure that lays down the route or path to transfer data packets from source to the destination. They help indirecting Internet traffic efficiently. Routing algorithm mathematically computes the best path, i.e. "least – cost path" that the packet can be routed through. Write a Program for Implementation of any Routing algorithms.	Distance vector & Linkstate routing	Routing in networks before the communication begins.
Part B: MiniProject1: Design of Corporate Network			
1	Configuring a Switched network and Study of VLAN's and assigning a PC based on the VLAN.	Windows/LinuxOS, Packet Tracer	Switch and VLANConfiguration.
2	Implementing an IP Addressing Scheme Configuring WEP on a Wireles sRouter. Interpreting Ping and Traceroute Output	Windows/LinuxOS, Packet Tracer	Router configuration and connectivity checking.
3	Configuring Static Routing. Configuring Dynamic Routing protocols RIP, OSPF.	Windows/LinuxOS, Packet Tracer	Static and Dynamic Routing over a network
4	Examining Network Address Translation (NAT). Configuring a Cisco Router as a DHCP Server	Windows/LinuxOS, Packet Tracer	Configuration and working of NAT with setup of DHCP server.
Part C: Mini Project 2: Performance Analysis of TCP and UDP applications over the different Topologies of network			
1	Consider Six nodes and demonstrate the different ways of connecting the mintopology methods. Also specify the different transmission media with specific channel specifications.	Python, NS3, Ubuntu.	Create an interface between the devices using different topologies.
2	Configure the IP address of the nodes in the specified network. Achieve the port specifications for different applications. Apply and Demonstrate the TFTP on the specified Network using UDP. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the performance using UDP based applications
3	Apply and Demonstrate the FTP and TELNET on the specified network using TCP. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the performance using TCP based applications
4	Apply and Demonstrate the Congestion and Error Controlling mechanism in the specified	Python, NS3, Ubuntu.	Analyze the congestion and error controlling in TCP based

	networks. Observe the trace results.		Applications.

5. Douglas E.Comer, "Internetworking with TCP/IP Vol.1", 6th Edition, Pearson, 1995.

JOURNALS/MAGAZINES

1. IEEE Transactions on Networking.
2. Elsevier Journal of Computer Networks
3. Springer Journal of communications and Information networks.

SWAYAM NPTEL/MOOCs:

1. https://www.udemy.com/topic/computer-network/
2. https://www.coursera.org/courses?query=computer%20network
3. https://nptel.ac.in/courses/106/105/106105183/
4. https://www.edx.org/learn/computer-networking

SELF-LEARNING EXERCISES:

SDN, Wifi, WiMAX, 4G, 5G, Satellite Networks, MPLS, VPN, ATM, Bluetooth Architecture. World Wide Web (WWW).

Course Title	**Machine Learning and Applications**				**Course Type**		**HC**	
Course Code	**B22EF0504**	**Credits**	**3**		**Class**		**V Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

This course provides a concise introduction to the fundamental concepts in machine learning and popular machine learning algorithms. We will cover the standard and most popular supervised learning algorithms including linear regression, logistic regression, decision trees, etc. We will also cover the basic clustering algorithms. In the course we will discuss various issues related to the application of machine learning algorithms.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Study the basic theory underlying machine learning.
2. Explain machine learning algorithms to solve problems of moderate complexity for data analysis.
3. Discuss the implementation of Machine learning algorithms and modules.
4. Discuss the applications of Machine Learning

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Understand basics of Artificial Intelligence and Machine Learning.	1,2,3,4,5, 12	1, 2, 3

CO2	Apply supervised learning algorithm for regression and classification problems.	1,2,3,4,5, 12	1, 2, 3
CO3	Use unsupervised learning algorithms to identify patterns and structure in unlabelled datasets.	1,2,3,4,5, 12	1, 2, 3
CO4	Analyze real world applications using supervised and unsupervised learning algorithms.	1,2,3,4,5, 12	1, 2, 3
CO5	Analyze the performance of machine learning models using different evaluation metrics.	1,2,3,4,5, 12	1, 2, 3
CO6	Explain dimensionality reduction algorithms and its applications.	1,2,3,4,5,12	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	**Bloom's Level**					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3			√			
CO4				√		
CO5				√		
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	3							3	3	3	3
CO2	3	3	2	3	3							3	3	3	3
CO3	3	2	2	3	3							3	3	3	3
CO4	3	3	3	2	3							3	3	3	3
CO5	3	2	3	3	3							3	3	3	3
CO6	3	3	3	2	3							3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

What is Artificial Intelligence?, The AI Problem, The Underlying Assumption, What is an AI technique?, : Well-Posed Learning Problems, Designing a Learning System, Concept Learning and the General-to-Specific Ordering: A Concept Learning Task, Concept Learning as Search, FIND-S, Version Spaces and Candidate Elimination algorithm, Inductive bias

UNIT – 2

Supervised Learning algorithms - Linear regression, logistic regression, support vector machine, Decision Trees, Nearest neighbor algorithm, Naive bayes model, Evaluation metrics for regression and classification algorithms

UNIT – 3

Unsupervised Learning algorithms - Difference between supervised and unsupervised learning, What is clustering? KMeans Clustering, what is dimensionality reduction?, PCA, Probabilistic PCA, Kernel PCA.

UNIT – 4

Recommendation Systems – Model for Recommendation Systems, Utility Matrix, Content- Based Recommendations, Discovering Features of Documents, Collaborative Filtering, Application of dimensionality reduction.

TEXT BOOKS:

1. Elaine Rich, Kevin Knight, Artificial Intelligence, Tata McGraw Hill.
2. Tom Mitchell, "Machine Learning", McGraw Hill Education.
3. Anand Rajaraman, Jure Leskovec and J.D. Ullman, “Mining of Massive Data sets”, ebook,Publisher, 2014 (unit 4) - www.mmds.org.
4. John D Kelleher, Brian Mac Namee, Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics, Second Edition.

REFERENCE BOOKS:

1. Christopher M Bishop, "Pattern Recognition and Machine Learning", Springer.

JOURNALS / MAGAZINES:

11. IEEE Transactions on Pattern Analysis and Machine Learning
12. IEEE Transactions on Artificial Intelligence
13. Journal of Machine Learning Research
14. Foundations and Trends in Machine Learning
15. Synthesis Lectures on Artificial Intelligence and Machine Learning
16. ACM Transactions on Intelligent Systems and Technology

SWAYAM / NPTEL / MOOCs:

5. Introduction to Machine Learning, by Prof. Balaraman Ravindran, IIT Madras, Swayam – NPTEL.
6. Machine Learning Specialization, by Andrew Ng, Coursera.

SELF-LEARNING EXERCISES:

5. Data Visualization
6. Basics of Deep Learning

Professional Elective – 2

Course Title	Neural Networks and Deep Learning				Course Type		SC	
Course Code	B22EFS511	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

In the last decade due to availability of cheap computation, several neural network approaches had beenexplored in order to advance the performance of many state-of-the-art visual recognition problems such as image searching, understanding, medical applications, autonomous vehicles such as drones and self-driving cars etc. All these problems rely on efficient, accurate and robust solutions for basic vision tasks such like image classification, localization and detection. In this course students will be given an exposure to the details of neural networks as well as deep learning architectures and to develop end-to-end models for such tasks. Students will learn to implement, train and debug their own neural networks.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. To introduce the students with machine learning fundamentals for solving real world scenario applications and Apply suitable machine learning techniques for data handling and to gain knowledge from it.
2. Acquire theoretical knowledge on setting hypothesis for pattern recognition.
3. To design own models for the specific applications and optimize them efficiently
4. Evaluate the performance of algorithms and to provide solution for various real-world applications.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the optimization techniques for various Machine Learning models.	1 to 5,9,10,12	1,2,3
CO2	Develop methods of data representations in machine learning environment.	1 to 5, 9,10,12	1,2,3
CO3	Create probabilistic and unsupervised learning models for handling unknown pattern.	1 to 5, 9,10,12	1,2,3
CO4	Classify Machine learning models for Non-linear systems.	1 to 5, 9,10,12	1,2,3

CO5	Understand basic machine learning models and prediction techniques.	1 to 5, 9,10,12	1,2,3
CO6	Apply machine learning models in speech and image processing applications.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2						√
CO3						√
CO4		√				
CO5			√			
CO6	√					

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				3	3		2	3		3
CO2	3	3	2	2	2				3	3		2	3		3
CO3	3	3	2	2	2				3	3		2		3	3
CO4	3	3	3	2	2				3	3		2		3	
CO5	3	2	2	2	3				3	3		2	3		3
CO6	3	2	2	2	3				3	3		2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Basics of artificial neural networks (ANN): Artificial neurons, Computational models of neurons, Structure of neural networks, Functional units of ANN for pattern recognition tasks.

Feedforward neural networks: Pattern classification using perceptron, Multilayer feedforward neural networks (MLFFNNs), Backpropagation learning, Empirical risk minimization, Regularization, Autoencoders.

UNIT – 2

Deep neural networks (DNNs): Difficulty of training DNNs, Greedy layerwise training, Optimization for training DNNs, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Second order methods

Convolution neural networks (CNNs): Introduction to CNNs – convolution, pooling, Deep CNNs, Different deep CNN architectures – LeNet, AlexNet, VGG, PlacesNet, Training a CNNs: weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs training, Regularization methods (dropout, drop connect, batch normalization).

UNIT – 3

Recurrent neural networks (RNNs): Sequence modeling using RNNs, Back propagation through time, Long Short Term Memory (LSTM), Bidirectional LSTMs, Bidirectional RNNs, Gated RNN Architecture.

UNIT – 4

Generative models: Restrictive Boltzmann Machines (RBMs), Stacking RBMs, Belief nets, Learning sigmoid belief nets, Deep belief nets.

Applications: Applications in vision, speech and natural language processing

TEXT BOOKS:

1. Ian Goodfellow and YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2016.
2. S. Haykin, Neural Networks and Learning Machines , Prentice Hall of India, 2010
3. Bishop, C ,M., Pattern Recognition and Machine Learning, Springer, 2006.

REFERENCE BOOKS:

1. Satish Kumar, Neural Networks - A Class Room Approach, Second Edition, Tata McGraw-Hill, 2013.
2. Yegnanarayana, Artificial Neural Networks, Prentice- Hall of India, 1999.
3. Ravindran, K. M. Ragsdell, and G. V. Reklaitis, ENGINEERING OPTIMIZATION: Methods and Applications, John Wiley & Sons, Inc, 2016..
4. Antoniou, W. S. Lu, PRACTICAL OPTIMIZATION Algorithms and Engineering Applications, Springer, 2007.

JOURNALS/MAGAZINES:

1. IEEE Transactions on Neural Networks and Learning System
2. IEEE Transactions on Pattern Analysis and Machine Intelligence
3. Springer Journal of Deep Learning.
4. Elsevier journal on Deep learning Based Intelligent Systems
5. ACM Jounral on Machine Learning Research

SWAYAM/NPTEL/MOOCs:

1. https://www.cs.ox.ac.uk/people/nando.defreitas/machinelearning/
2. https://people.eecs.berkeley.edu/~jrs/189/
3. http://www.cse.iitm.ac.in/~ravi/courses/Introduction%20to%20Machine%20Learning.html
4. http://leap.ee.iisc.ac.in/sriram/teaching/DL20/
5. http://www.cse.iitm.ac.in/~miteshk/CS6910.html
6. https://www.cs.princeton.edu/courses/archive/spring16/cos495/
7. https://d2l.ai/
8. https://nptel.ac.in/courses/106106184
9. http://www.ai.mit.edu/courses/6.867-f03/exams.html

10. . https://ml2.inf.ethz.ch/courses/aml/
11. https://www.studocu.com/in/document/kalinga-institute-of-industrial-technology/neural-networks-and-machine-learning/ml-extra-qbank/17982037
12. . CSCI 5922: Neural Networks and Deep Learning (colorado.edu)
13. Berkeley AI Materials
14. Adit Deshpande – Engineering at Forward | UCLA CS '19 (adeshpande3.github.io)
15. Hamid Beigy (Deep Learning) (sharif.edu) 18. WTF Deep Learning!!! (wtf-deeplearning.github.io)
16. IIT Ropar – SudharIyenger – Deep Learning: NPTEL
17. CIS520 Machine Learning | Lectures / Lectures (upenn.edu)
18. Best : University of Toronto: CSC413/2516 Neural Networks and Deep Learning (Winter 2020) (csc413-2020.github.io)
19. . Best : university of Pittuserberg:CS1678: Intro to Deep Learning (pitt.edu)
20. . Best : Charles university: Deep Learning – Summer 2017/18 | ÚFAL (cuni.cz)
21. . The Best : Deep Learning | ÚFAL (cuni.cz)
22. Best : University of Chicago: CMSC 35246 Deep Learning - University of Chicago (ttic.edu)
23. IIT Bombay: CS 344 - Artificial Intelligence/ CS 386 - Artificial Intelligence Lab. Spring 2008 (iitb.ac.in)
24. University of Princeton: Introduction to Deep Learning: Home Page (princeton.edu)
25. The Best : http://www.cs.toronto.edu/~rgrosse/courses/csc421_2019/
26. http://www.cs.umd.edu/~djacobs/CMSC828DeepLearning/Syllabus18.htm
27. https://www.cs.ox.ac.uk/people/nando.defreitas/machinelearning/
28. http://www.cs.umd.edu/~djacobs/CMSC828DeepLearning/Syllabus18.htm
29. https://mriquestions.com/deep-learning-dl.html
30. https://www.deeplearning.ai/program/deep-learning-specialization/
31. http://www.cs.umd.edu/~djacobs/CMSC828DeepLearning/Syllabus18.htm
32. https://flatironschool.com/blog/deep-learning-vs-machine-learning/
33. https://nptel.ac.in/courses/117105084
34. https://www.youtube.com/watch?v=rvMVqPsXL10
35. https://stackify.com/learn-python-tutorials/
36. https://www.simplilearn.com/tutorials/deep-learning-tutorial/deep-learning-algorithm
37. https://analyticsindiamag.com/8-free-resources-tools-to-learn-pytorch-in-2021/
38. https://www.mathworks.com/videos/matlab-for-deep-learning-1530256241637.html
39. https://www.youtube.com/watch?v=bOIZ74rOik0

SELF-LEARNING EXERCISES:

11. Advanced Python Programming
12. R Programming
13. Linear Algebra
14. Probability and statistics
15. Image Processing

Course Title	System Modeling and Simulation				Course Type		SC	
Course Code	B22EFS512	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

Simulation modeling and simulation is the process of creating and able to understand the working principle of a model. In this course, students learn the different statistical techniques and simulation software model.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand and explain the different simulation techniques.
2. Define the basics of simulation modeling and simulate the real-world situations.
3. Describe the models for the purpose of optimization using simulation software.
4. Analyze the current queueing system through a simulation framework.

COURSE OUTCOMES (COs)

After the completion of the course, the students will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate the fundamentals of discrete-time and continuous-time simulations.	1,12	1,2,3
CO2	Apply the techniques to model a complex system using discrete event simulation.	1,2,5,12	1,2,3

CO3	Express proficiency in generating random numbers using different techniques.	1,2,3,12	1,2,3
CO4	Analyze the distribution of data using various statistical models.	1,2,5,12	1,2,3
CO5	Apply various simulation techniques / models for real world applications.	1,2,3,4,5,12	1,2,3
CO6	Evaluate the performance of real-world queuing systems.	1,2,3,4,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3			√			
CO4				√		
CO5			√			
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3	3	3	3
CO2	3	3			3							3	3	3	3
CO3	3	3	3		3							3	3	3	3
CO4	3	3			3							3	3	3	3
CO5	3	3	3	3	2							3	3	3	3
CO6	3	2	2	3								3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

INTRODUCTION: When simulation is the appropriate tool and when it is not appropriate; Advantages anddisadvantages of Simulation; Areas of application; Systems and system environment; Components of asystem; Discrete and continuous systems; Model of a system; Types of Models; Discrete-Event SystemSimulation, Steps in a Simulation Study.

The basics of spread sheet simulation, the random generators used in the examples, simulation example: Simulation of queuing systems in spread sheet, simulating a single service queue.

UNIT – 2

General Principles, Simulation Software : Concepts in Discrete-Event Simulation, The Event-Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling, List processing-Basic properties and Operations performed on list, Using arraysfor List processing, Using Dynamic Allocation and Linked Lists, Simulation in Java-Single server Queue simulation in java.

Random Number Generation: Properties of random numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random N for numbers.

UNIT – 3

Statistical Models in Simulation: Review of terminology and concepts, Useful statistical models, Discrete Distributions, Continuous Distributions, Poisson Process, Empirical distributions

UNIT – 4

Queuing Models: Characteristics of queuing Systems, Queuing notation, Long-run measures of performance of queuing Systems, The Conservation Equation, Server Utilization, Steady-state behavior of infinite-population Markovian models, Steady-state behavior of finite-population models, Networks of queues,Rough-cut modeling: An illustration.

Case study: AnyLogic Simulation software: Study of simple queue system, Behavior of queuing system, Bus stop simulation.

TEXT BOOKS:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, "Discrete-Event System Simulation", 5th, Pearson Education, 2007.

REFERENCE BOOKS:

1. Seila-Ceric-Tadikamalla, "Applied Simulation Modelling", Cengage Learning,2004.
2. Averill M. Law, "Simulation Modeling and Analysis", 4thEdition, Tata McGraw-Hill, 2007.ISBN: 9780070667334
3. Lawrence M. Leemis, Stephen K. Park, "Discrete – Event Simulation: A First Course",Pearson Education, 2006.ISBN: 978-0131429178

Case study Weblinks:

1. **Simple queue system:** https://cloud.anylogic.com/model/1c626205-7dfa-48ae-8f57-52cd89183afc?mode=SETTINGS
2. **Behavior of queuing system:** https://cloud.anylogic.com/model/dba4abd8-4b7b-41a6-b62a-bef250dc1754?mode=SETTINGS
3. **Bus stop simulation:** https://cloud.anylogic.com/model/2b573f5a-6397-4f40-bcff-e7b710b5b042?mode=SETTINGS

JOURNALS/MAGAZINES:

1. https://www.cs.utexas.edu/users/browne/cs380ns2003/Papers/SimpleQueuingModelspdf.pdf
2. https://www.researchgate.net/publication/303965218_Numerical_Simulation_Approaches
3. https://irh.inf.unideb.hu/~jsztrik/education/16/Queueing_Problems_Solutions_2021_Sztrik.pdf
4. https://www.sciencedirect.com/science/article/abs/pii/S1364032117307761s

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_ma17/preview
2. https://nptel.ac.in/courses/117103017

SELF-LEARNING EXERCISES:

1. Simulation games in the education system.

https://homepage.divms.uiowa.edu/~mbognar/applets/pois.html

Course Title	IOT Architecture and Protocols				Course Type		SC	
Course Code	B22EFS513	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The course covers the importance of IoT in society, the current components of typical IoT devices and trends for the future. IoT design considerations, constraints and interfacing between the physical world and your device will also be covered. This course will get to know how to make design trade-offs between hardware and software. It also covers key components of networking to ensure that students understand how to connect their device to the Internet.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain basics of Arduino programs.
2. Illustrate sample programs to interface sensors to Arduino boards to read, process and analyze data.
3. Demonstrate to read and store data from sensors, and to monitor and control IoT devices.
4. Discuss IoT programming to develop larger smart products useful for the society.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Narrating Enabling Technologies of IoT	1 to 5,9,10,12	1,3
CO2	Explaining the simplified IoT Architecture	1 to 5, 9,10,12	1,3
CO3	Applying basics of Embedded C programming in Arduino programming	1 to 5, 9,10,12	2, 3
CO4	Demonstrating Difference between sensors & actuators	1 to 5, 9,10,12	2
CO5	Analyzing the techniques to transmit the data of any sensor to cloud using a WiFi module.	1 to 5, 9,10,12	1,3
CO6	Designing Automatic Home system	1 to 5, 9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√					

CO2	√					
CO3			√			
CO4			√			
CO5				√		
CO6						√

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1				3	3		2	3		3
CO2	3	3	2	2	1				3	3		2	3		3
CO3	3	3	1	1	1				3	3		2		3	3
CO4	3	3	3	1	2				3	3		2		3	
CO5	3	1	2	1	3				3	3		2	3		3
CO6	3	1	2	1	3				3	3		2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

FUNDAMENTALS OF IoT- Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT – 2

DESIGN AND DEVELOPMENT- Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details.

UNIT – 3

BUILDING BLOCKS: Arduino Basics, Hardware Requirements, Software Requirements: Toolbar, Status Window, Serial Monitor Window; Arduino Programming Language Reference. Basics of Embedded C programming for Arduino - Interfacing LED, push button and buzzer with Arduino - Interfacing Arduino with LCD.

SENSOR & ACTUATORS WITH ARDUINO - Overview of Sensors working - Analog and Digital Sensors - Importance of Accurate Sensors - Sensor Calibration – Difference between sensors & actuators.

UNIT – 4

REAL TIME EXAMPLES OF IOT: Interfacing of Actuators with Arduino – Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino. - Interfacing of Relay Switch and Servo Motor with Arduino – Automatic Home system - Transmit the data of any sensor to cloud using a WiFi module.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	Interface LEDs and switches to a microcontroller and demonstrate the ON/OFF status of LEDs depending on switch positions.	Arduino IDE Installed	Arduino Programming Skill
2.	Design an interface to connect a stepper motor to microcontroller and rotate it clockwise and Anti-clockwise.	Arduino IDE, Temperature sensor	Arduino Programming Skill
3.	Design an interface to connect 4x4 matrix keyboard to microprocessor and identify the key pressed.	Arduino IDE, 4x4 matrix keybad	Arduino Programming Skill
4.	Develop and demonstrate a time delay program using built – in Timer / Counters.	Arduino IDE, 7-segment LED	Arduino Programming Skill
5.	te a program to display a message in a 2 line x 16 characters LCD display.	Arduino IDE, Temperature sensor	Arduino Programming Skill
6.	Design a program to transmit the data of any sensor to cloud using a WiFi module.	duino IDE, 4x4 matrix keybad	duino Programming Skill
7	ign a module for non-contact object detection using Arduino and ultrasonic sensor.	duino IDE, 7-segment LED	duino Programming Skill
8	ign an intelligent garden system with Arduino and soil moisture sensor that turn ON the motor when it is time to water a potted plant.	duino IDE, Moisture Sensor	duino Programming Skill
9	te an Arduino program to interface temperature and humidity sensor with LCD.	duino IDE, Temperature sensor	duino Programming Skill
10	te an Arduino program to interface gas sensor and stepper motor.	duino IDE, LCD & Stepper Motor	duino Programming Skill

Sl. No.	Part B Mini Project
	1. Set up Arduino Yún to connect toWiFi 2. Build a smart temperature controller for yourroom 3. Build your own decision systembased-IoT 4. Build a tracking vision system for movingobjects 5. Build a your own car robot based onGPS 6. Make your IoT boardspeak 7. Make IoT application with data science-basedcloud

Text books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madisetti, Universities, APress, 2015
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill HigherEducation
4. Programming Arduino Getting Started with Sketches – Simon Monk, McGraw-Hill, 2012.

Reference Books:

1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012
2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O"Reilly Media, 2011.
5. Agus Kurniawan, Smart Internet of Things Projects, Packt Publishing, 2016.

JOURNALS/MAGAZINES:

1. https://www.sciencedirect.com/journal/internet-of-things
2. https://www.techscience.com/journal/jiot
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6488907
4. https://www.sciencedirect.com/journal/internet-of-things
5. https://www.inderscience.com/jhome.php?jcode=ijitca

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_cs96/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs95/preview
3. https://swayam.gov.in/explorer?searchText=iot

SELF-LEARNING COMPONENTS

Explore any one of the boards like Raspberry Pi, Intel Galileo, Beagle Bone Black, Dragon Board, UDOO DUAL/QUAD, ARM Boards, DIY Development boards for IoT prototyping (C.H.I.P, MediatekLinkit One, Particle Photon, Tessel, Adafruit Flora, LightBlue Bean, Udoo Neo, Intel Edison).

Course Title	Object Oriented Modeling & Design				Course Type		SC	
Course Code	B22EFS514	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weight age	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course introduces object models and designs from system requirements. The course begins with an overview of the object-oriented analysis and design. Object-Oriented modeling & design (OOMD) promote better understanding of requirements, cleaner designs and more maintainable systems. Object-oriented modeling and design is a way of thinking about problems using models organized around real world concepts.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the object-oriented models for developing large applications.
2. Describe the classes and objects.
3. Demonstrate the use of various UML diagrams in real world applications.
4. Discuss different case studies that make use of OOMD concepts.

COURSE OUTCOMES (COs):

On successful completion of this course; the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the concepts of object-oriented and basic Object modeling.	1,2	1
CO2	Apply Static Class, Dynamic Class and object models for solving the given real-world problems.	1-4,9,10	1,2
CO3	Analyze and Design UML diagrams for the given real-world applications.	1-5,8-10	1,2,3
CO4	Design real world applications using Object oriented approach.	1-5,9,10	1,2,3
CO5	Identify suitable models for solving the given real-world problems	1-5,9,10	1,2
CO6	Apply the concepts of architectural design for deploying the code for software.	1-5,9,10	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			

CO2			√			
CO3			√	√		√
CO4				√		√
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3		
CO2	3	3	3	1					2	1			1	1	
CO3	3	3	3	3	3			1	2	1			1	1	1
CO4	3	3	3	3	3				2	1			1	2	2
CO5	3	3	3	3	3				2	1			2	1	
CO6	3	3	3	3	3				2	1			2	1	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction: What is Object Orientation? What is OO development? OO themes, Evidence for usefulness of OO development, OO modeling history; Modeling as Design Technique: Modeling, abstraction; the three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance;

Complexity: The Structure of Complex Systems, The Inherent Complexity of Software, The Five Attributes of a Complex System, Organized and Disorganized Complexity, Bringing Order to Chaos, On Designing Complex Systems, The Object Model: The Evolution of the Object Model, Foundations of the Object Model, Elements of the Object Model, Applying the Object Model.

UNIT – 2

Classes and Objects : The Nature of an Object, Relationships among Objects, The Nature of a Class, Relationships among Classes, The Interplay of Classes and Objects, On Building Quality Classes and Objects, **Classification :**The Importance of Proper Classification, Identifying Classes and Objects, Key Abstractions and Mechanisms.

UNIT – 3

The Unified Modeling Language : Package Diagrams, Component Diagrams, Deployment Diagrams, Use Case Diagrams, Activity Diagrams, Class Diagrams, Sequence Diagrams, Interaction Overview Diagrams, Composite Structure Diagrams, State Machine Diagrams, Timing Diagrams, Object Diagrams, Communication Diagrams.

UNIT – 4

Applications: Traffic Management**:** Inception, Elaboration, Construction, Post-Transition, Web Application: Vacation Tracking System, Inception, Elaboration, Construction, Post-Transition. Crypt Analysis: Inception, Elaboration, Construction, Post-Transition.

TEXT BOOKS:

1. Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen and Kelli A. Houston, "Object-Oriented Analysis and Design with Applications", Third Edition, Addison Wesley, 2009.
2. Michael Blaha, James Rumbaugh: Object-Oriented Modeling and Design with UML (2nd ed.), Pearson Education, 2005.

REFERENCE BOOKS:

1. Brett McLaughlin, Gary Pollice, David West, "Head First Object-Oriented Analysis and Design:A Brain Friendly Guide to OOA&D",OreillyMediaInc,2007.
2. Brahma Dathan, Sarnath Ramnath, "Object-Oriented Analysis, Design and Implementation: An Integrated Approach", Springer Universities Press, 2015.
3. James J. Odell, "Advanced Object-Oriented Analysis and Design Using UML", SIGS Books and Multimedia, 1998.

JOURNALS/MAGAZINES:

1. Elsevier Journal of systems and software.
2. Springer Journal of Object-Oriented Programming.

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_cs48/preview
2. https://nptel.ac.in/courses/106/105/106105153/
3. https://onlinecourses.nptel.ac.in/noc20_cs59/preview

SELF-LEARNING EXERCISES:

1. https://objectdiscovery.com/training/course/analysis/uml/outline.html
2. https://www.classcentral.com/course/object-oriented-design-9216

Course Title	Computer Graphics with OpenGL				Course Type		SC	
Course Code	B22EFS515	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course introduces techniques, algorithms and principles of interactive computer graphics and animation, thiscourse also prepares for study in real-time rendering, realistic image synthesis, and computer animation. The course has major topics related to graphics system and graphics programming using OpenGL. The transformation of objects once created in homogenous and general coordinate system. It introduce with different kind of viewing the objects in parallel and perspective modes. It also introduces the animation using a flash tool.

COURSE OBJECTIVE (S):

Objectives of this course are to:

1. Explain the basic principles of 3-dimensional computer graphics using Software and Hardware.
2. Describe the basics of Geometric transformation systems.
3. Demonstrate the use of two- and three-dimensional viewing pipeline.

4. Illustrate the use of Animation and Flash overview

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Develop interactive computer graphics programs using OpenGL	1 to 5	1
CO2	Apply three dimensional transformations for a real-world application	1 to 5	2
CO3	Identify requirements and constraints of two and three-dimensional viewing pipeline.	1 to 5	2,3
CO4	Design Animations using ADOBE Flash for the given real-world application.	1 to 5	2,3
CO5	Understand the concepts of clipping and visible surface detection in 2D and 3D viewing, and Illumination Models	1 to 5	1,2
CO6	Develop real-world graphics applications using OpenGL and also animate using flash.	1 to 5	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1						√
CO2			√			
CO3		√				
CO4						√
CO5		√				
CO6						√

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3								3		
CO2	3	2	3	2	3									3	
CO3	3	3	2	2	3								3	3	
CO4	2	1	2	2	3								2		
CO5	3	2	3	2	1								3	3	
CO6	2	1	2	2	2									3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Applications of computer graphics, A graphics system, Images: Physical and synthetic, Imaging Systems, The synthetic camera model, The programmer's interface, Graphics architectures, Graphics Programming: The Sierpinski gasket, Programming Two Dimensional Applications, The OpenGL API, Primitives and attributes, Color, Viewing, Control functions, The Gasket program, Polygons and recursion, The three dimensional gasket.

UNIT – 2

Interaction, Input devices, Display Lists, Programming Event Driven Input, Menus, Building Interactive Models, Animating Interactive Programs, Three-dimensional Primitives, Coordinate Systems, Rotation, Translation and Scaling, Transformation in Homogeneous Coordinates, Concatenation of Transformations, OpenGL Transformation Matrices, Modeling a Colored Cube (Program).

UNIT – 3

Classical and computer viewing, Positioning of the camera, Simple projections, Projections in OpenGL, Hidden surface removal, Parallel-projection matrices, Perspective-projection matrices, Projections and Shadows.
Clipping; Line-segment clipping – Cohen Sutherland Clipping and Liang-Barsky Clipping;
Polygon clipping, Clipping in three dimensions, Rasterization, Bresenham's algorithm.

UNIT – 4

Animation and Flash overview: Development of animation, Non Computer and computer based animation, Flash basics, Flash Work Environment, drawing overview, creating text boxes, creating animation

Text Books:

1. Edward Angel, Interactive Computer Graphics A Top Down Approach with OpenGL, Addison- Wesley, 5th Edition, 2008
2. Malay K. Pakhira, Computer Graphics and Animation, PHI Learning Pvt. Ltd., First edition, 2010

Reference Books:

1. Foley, Van Damn, Feiner and Hughes, Computer Graphics: Principles and Practice. Addison Wesley.
2. Modeling in Computer Graphics: Proceedings of the IFIP WG 5.10 Working Conference Tokyo, Japan, April 8-12, 1991 (IFIP Series on Computer Graphics) by Tosiyasu L Kunii

Self-learning Components: Lighting and shading models, Tools for graphics and animation, VFX.

Professional Elective – 3

Course Title	Natural Language Processing and Applications				Course Type		SC	
Course Code	B22EFS521	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The intent of the course is to give introduction to Natural Language Processing (NLP, a.k.a. computational linguistics), the study of computing systems that can process, understand, or communicate in human language. The primary focus of the course will be on understanding various NLP tasks as listed in the course syllabus, algorithms for effectively solving these problems, and methods for evaluating their performance. There will be a focus on statistical algorithms to acquire the knowledge needed to perform language processing.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of natural language processing and python
2. Discuss how to access the text corpora and Lexical Resources
3. Demonstrate the writing the structured programs to process the raw text
4. Describe role of Classifiers in Text processing.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the fundamentals of natural language processing.	1 to 5,9,10,12	1,2,3
CO2	Appraise how to access the text corpora and Lexical Resources	1 to 5, 9,10,12	1,2,3
CO3	Analyze large volume text data generated from a range of real-world applications.	1 to 5, 9,10,12	1,2,3
CO4	Demonstrate semantics and pragmatics of English language for text processing.	1 to 5, 9,10,12	1,2,3
CO5	Estimate the skills for writing the structured programs to process the raw text.	1 to 5, 9,10,12	1,2,3

CO6	Apply different classifiers for Text processing.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2					√	
CO3				√		
CO4		√				
CO5					√	
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			1					3				3	3	3	
CO2					2						1	3	3	3	
CO3			1					3			1	3	3	3	
CO4			3					3			1	3	3	3	
CO5			3		3			2				3	3	3	3
CO6								2			1	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Language Processing and python, Accessing Text corpora and Lexical Analysis: Computing with language: Texts and words, a closer look at python: texts as list of words, computing with language: simple statistics, Automatic natural language understanding; Accessing Text Corpora, Conditional Frequency Distributions, Lexical Resources, WordNet, Introduction to NLTK Tool.

UNIT – 2

Processing Raw Text: Accessing Text from the Web and from Disk, Strings: Text Processing at theLowest Level, Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text, Regular Expressions for Tokenizing Text, Segmentation, Formatting: From Lists to Strings,

Object-Oriented Programming: Working with Objects; Implementing Classes; Object Construction; Static Variables and Methods, Packages; Nested Classes; Documentation Comments; Interfaces; Static, Default and Private Methods in interface; Lambda Expressions; Method and Constructor References; Local and Anonymous Classes.

UNIT – 3

Categorizing and Tagging words: Using a Tagger, Using a Tagger, Mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging, How to Determine the Category of a Word.

UNIT – 4

Classifying Text: Supervised Classification: Examples, Evaluation; Decision Trees, Naive Bayes Classifiers, Maximum Entropy Classifiers, Modelling Linguistic Patterns.

TEXT BOOKS:

1. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", OReilly Media, 2009.
2. Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packt publisher, 2017.

REFERENCE BOOKS:

1. James Allen, "Natural Language Understanding", Benjamin-Cummings Publishing Co, Inc., 1995.
2. Christopher D. Manning and HinrichSchutze, "Foundations of Statistical Natural Language Processing", The MIT Press, 1999.
3. Randolf Quirk, Sidney Greenbaum, Geoffrey Leech, Jan Svartvik, "A Comprehensive Grammar of English Language", Cambridge University Press, 1987.

JOURNALS/MAGAZINES:

1. Springer Journal on Natural Language Process
2. Springer Journal on Natural Language Process
3. Elsevier Journal on Natural Language Process
4. ACM Transactions on Language Processing
5. Elsevier Journal of cognitive systems research

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/ Natural Language Process
2. https://www.classcentral.com/course/ Natural Language Process
3. https://nptel.ac.in/courses/476/876/3323106156/

SELF-LEARNING COMPONENT:

Extracting information from Text, Exploring the 20 Newsgroups with Text Analysis Algorithms, Stock Price prediction with Regression Algorithms, Best Practices: i) Data preparation stage ii)Training sets generation stage iii) Model training, evaluation and selection stage.

PRACTICE:

Sl. No.	List of Programs
1	NLTK is a leading platform for building Python programs to work with human language data. It provides easy-to-use interfaces to over 50 corpora and lexical resources such as WordNet, along with a suite of text processing libraries for classification, tokenization, stemming, tagging, parsing, and semantic reasoning, wrappers for industrial-strength NLP libraries, and an active discussion forum. Write a python program to extract tokens from the input sentence of English language using python NLTK toolkit.

Course Title	Embedded and Real Time Systems			Course Type	SC
Course Code	B22EFS522	Credits	3	Class	V Semester

2	An incredible amount of unstructured text data is generated every day by social media, web pages, and a variety of other sources. But without the ability to tame and harness that data, you'll be unable to glean any value from it. In this course, learn how to translate messy text data into powerful insights using Python. Instructor Derek Jedamski begins with a quick review of foundational NLP concepts, including how to clean text data and build a model on top of vectorized text. He then jumps into more complex topics such as word2vec, doc2vec, and recurrent neural networks.Develop a python program to create social network structure of LinkedIn profile using python NLTK toolkit.
3	Analyzing movie reviews data and try to predict whether the review is positive or negative. Familiarity with some machine learning concepts will help to understand the code and algorithms used. Develop a program to analyze the review comments of a movie trailer to provide rating using Python NLTK Toolkit.
4	Cluster is a process of grouping similar items together. Ecah group, also called as a cluster, contains items that are similar to each other. Clustering algorithms are unsupervised learning algorithms Develop a program to cluster similar text documents using Python NLP Toolkit.
5	A popular NLP application called Machine Translation. In Machine Translation, you take in a bunch of words from a language and convert these words into another language. Develop a NLP program to convert simple sentences from one language to another.
6	Sentiment Analysis is the process of 'computationally' determining whether a piece of writing is positive, negative or neutral. It's also known as opinion mining, deriving the opinion or attitude of a speaker. Analyse twitter sentimental data set to predict the sentiments.
7	While the voice of an individual is unique, secure authentication through voice recognition can be a challenge in some cases – for instance, if the user has a sore throat or cold. It is therefore important to prevent unauthorized users from hacking into the database by mimicking someone else's voice.Develop program to recognize speech for authentication.
8	Text summarization is the process of creating a short, accurate, and fluent summary of a longer text document. It is the process of distilling the most important information from a source text. Automatic text summarization is a common problem in machine learning and natural language processing (NLP). Automatic text summarization methods are greatly needed to address the ever-growing amount of text data available online to both better help discover relevant information and to consume relevant information faster. Perform document summarization using NLP toolkit.
9	An IVR system's effectiveness is rated by the percentage of callers who ask to speak to a live operator. The lower the percentage, the more successful the system. Of course there are some IVR systems that never give you the option of speaking to a live operator. Develop an IVR system for REVA University.
10	Again, for services and email clients not mentioned here, you can almost always prevent emails from getting sent to spam simply by adding the sender to your address book or contacts. If it has an option to mark as "Not Spam", "Remove From Spam", or something similar, you can always click that too. However, it's generally better to add a sender Develop a program to classify mails to spam.

	LTP	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
Course Structure	**Lecture**	3	3	3	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

This course provides an overview of the unique concepts and techniques needed to design and implement computer systems having real-time response requirements in an embedded environment. It contrasts the concepts and techniques of real time and embedded systems with those of more traditional computer systems. Topics include: Basic concepts of real time and embedded systems, real time operating systems, synchronization techniques, performance optimization and current trends in real time and embedded systems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Educate how to systematically design real-time and embedded systems.
2. Show programming techniques for the problem at hand.
3. Familiarize with the formal specification and verification of timing constraints and properties.
4. Teach how to program real-time and embedded systems while meeting temporal and resource constraints.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the role of embedded processors, memory, sensors, actuators, and their interfacing with the I/O subsystems ofan embedded system	1 to 5	1
CO2	Invent different approaches for embedded firmware design anddevelopment, the merits and limitations of each	1 to 5	1, 2, 3
CO3	Experiment different ways of mixing assembly language with high level language forembedded application development	1 to 5	1, 2, 3
CO4	Infer on real time operating system executives.	1, 2, 4, 5	1, 3
CO5	Hypothesize formally tasks and their constraints and dependencies.	1 to 5	1, 2, 3
CO6	Analyze memory management techniques for embedded systems with RTOS tasks and executive.	1 to 5	1, 2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1				√		
CO2						√
CO3			√			
CO4				√		
CO5						√
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	3								3		
CO2	3	3	1	3	3								3	3	3
CO3	3	3	2	3	3								3	3	3
CO4	3	3		3	3								3		3
CO5	3	3	3	3	3								3	3	3
CO6	3	3	2	3	3								3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Embedded Systems - What is an Embedded System, Classification of Embedded Systems, Purpose of Embedded Systems.

The Typical Embedded System - Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components, PCB and Passive Components.

UNIT – 2

Embedded Firmware Design and Development - Embedded Firmware Design Approaches, Embedded Firmware Development Languages, Programming in Embedded C.

UNIT – 3

Fundamentals of Real-Time Systems - Concepts and Misconceptions, Multidisciplinary Design Challenges, Birth and Evolution of Real-Time Systems

Hardware for Real-Time Systems - Basic Processor Architecture, Memory Technologies, Architectural Advancements, Peripheral Interfacing, Microprocessor versus Microcontroller, Distributed Real-Time Architectures.

UNIT – 4

Real-Time Operating Systems - From Pseudokernels to Operating Systems, Theoretical Foundations of Scheduling, System Services for Application Programs, Memory Management Issues, Selecting Real-Time Operating Systems

TEXT BOOKS:

1. ShibuKizhakkeVallathai, “Introduction to Embedded Systems”, McGraw Hill, Second Edition, 2017.
2. Phillip A. Laplante, Seppo J. Ovaska,“Real-Time Systems Design and Analysis: Tools for the Practitioner”, Wiley, Fourth Edition,2013.

REFERENCE BOOKS:

1. Tammy Noergaard, “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”, Elsevier, 2005.
2. Qing Li, Carolyn Yao, “Real-Time Concepts for Embedded Systems”, CMP Books, 2003.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/courses/details/EDP009
2. https://ieeexplore.ieee.org/document/1183109/
3. https://ieeexplore.ieee.org/document/4720620/
4. https://www.sciencedirect.com/science/article/pii/B9780128015070000018
5. https://www.sciencedirect.com/science/article/pii/016412129290047N
6. https://ieeexplore.ieee.org/courses/details/EDP001
7. https://ieeexplore.ieee.org/document/557830/

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_cs93/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs94/preview
3. https://onlinecourses.nptel.ac.in/noc22_cs104/preview
4. https://onlinecourses.swayam2.ac.in/aic20_sp04/preview

SELF-LEARNING EXERCISES:

1. An Introduction to Embedded System Design with VxWorks and MicroC/OS-II RTOS
2. Programming Languages for Real-Time Systems
3. Requirements Engineering Methodologies
4. Software Design Approaches
5. Performance Analysis Techniques

<table>
<tr><td>Course Title</td><td colspan="4">Robotics and Operating System</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22EFS523</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Robotics and Operating System enables studentsto have a good understanding of Linux, especially Ubuntu, Linux shell commands, C++, and Python programming knowledge. Students also have the knowledge of Robot Operating System (ROS).

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic concepts in Ubuntu Linux and fundamentals of C++ for Robotics programming.
2. Illustrate the fundamentals of Python for Robotics programming.
3. Explore the concepts of Robot Operating System (ROS), its architecture, Command and GUI tools.
4. Demonstrate the use of programming with ROS using rospy and embedded boards.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the concepts in Ubuntu Linux.	1 to 5,9,10,12	1,3
CO2	Explain the fundamentals of C++ for Robotics Programming.	1 to 5, 9,10,12	1,2,3
CO3	Illustratethe fundamentals of Python for Robotics Programming.	1 to 5, 9,10,12	1,2, 3
CO4	Explorethe concepts of Robot Operating System (ROS).	1 to 5, 9,10,12	1,3

CO5	Apply the concepts of ROS Command tools and GUI tools	1 to 5, 9,10,12	1,3
CO6	Demonstratethe use of programming with ROS using rospy and embedded boards.	1 to 5, 9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2				3	3		2	3		3
CO2	3	3	3	2	1				3	3		2	3	3	3
CO3	3	3	3	2	1				3	3		2	3	3	3
CO4	3	3	3	2	2				3	3		2	3		3
CO5	3	2	2	2	3				3	3		2	3		3
CO6	3	2	2	2	3				3	3		2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Getting Started with Ubuntu Linux for Robotics: What is Ubuntu, Why Ubuntu for Robotics, Installing Ubuntu, Playing with Ubuntu GUI, Getting Started with Shell Commands.

Fundamentals of C++ for Robotics Programming: C++ in Ubuntu Linux, Learning OOP Concepts from Examples, Building a C++ Project

UNIT – 2

Fundamentals of Python for Robotics Programming: Python in Ubuntu Linux, Introduction to Python Interpreter, Installing Python on Ubuntu 16.04 LTS, Understanding Python Basics.

UNIT – 3

Kick-Starting Robot Programming using ROS: What is Robot Programming, Getting Started with ROS, Robot Programming Before and After ROS, The History of ROS, Why use ROS, Installing ROS, Robots and Sensors supporting ROS, ROS Architecture and Concepts, ROS Command Tools, ROS GUI Tools.

UNIT – 4

Programming with ROS: Creating a ROS Workspace and Package, Using ROS Client Libraries, The Hello World Example using ROS, Programming TurtleSim using rospy, Programming TurtleBot Simulation using rospy, Programming Embedded Boards using ROS, Interfacing Arduino with ROS, Installing ROS on a Raspberry Pi

PRACTICE:

Sl. No.	Mini Project
1.	**e Following Robot using ROS with Raspberry Pi** e following robots is used in warehouses and industries to carry components from one place to another. The movement of Line following robots completely depends on the track or line drawn on the floor. In this ROS project, you will learn to develop a Line following robot using Raspberry Pi Lidar positioned in front of the robot to detect the path. To communicate with the ROS installed in the Raspberry pi you will use MATLAB's Robotics Operating System Software package.
2.	**stacle Avoidance Robot** lision avoidance or obstacle avoidance systems play an important role in robots to avoid accidents and damages by detecting the obstacles in their way. This ROS project helps you to develop one such system with the help of 360-degree lidar to map the obstacles in the environment. You will learn to create the program to reach the desired destination by avoiding the obstacle.
3.	**AM Robot using Raspberry Pi and ROS** AM (Simultaneous Localization and Mapping) is a commonly used method to help robots to create a map of the environment by scanning the area with Lidar. This ROS project helps you to develop one such robot with the SLAM Algorithm. You will use components like Arduino, Raspberry pi, HC-05 Bluetooth module, etc. to develop this project. You will establish the communication with ROS in Raspberry pi using ROS Network configurations.
4.	**h Planning Robot using Raspberry and ROS** u will use Raspberry pi installed with ROS to develop this project and MATLAB to plan the path. Lidar and compass are used by the robot to plan the path. The objective of this ROS project is to develop a fully autonomous robot that is capable of planning and navigating through obstacles on its own.
5.	**velopment of Self-Driving Car using ROS and MATLAB** his ROS project, you will develop a self-driving car with sensor fusion. A Camera is used to track vehicles and pedestrians, Lidar is used to detect the obstacles. As part of this project, you will also learn to develop a lane detection algorithm to detect lanes.

6.	**botic Arm simulation using ROS** botic Arms play a major role in the automation and manufacturing industries. In this ROS project, you will create a robotic arm model and perform simulation in Gazebo. You will give various commands to make the robotic arm to perform various tasks.
7.	**one simulation using Gazebo and ROS** e usage of drones is increasing day by day and it is used for various purposes such as drone delivery, surveillance, mapping, and so on. To avoid unnecessary accidents, you can make use of Gazebo and ROS to simulate the created code and later you can deploy in real-time. As part of this ROS project, you will learn to plan an autonomous mission with the help of ROS and Gazebo.
8.	**adruped Robot** his ROS project, you will create a Quadruped robot model in the Gazebo environment and simulate it in the rugged environment. You will also make the robot perform various acrobatic activities.
9.	**tonomous Mobile Robot** part of this ROS robotics project, you will develop an autonomous robot that can be controlled using a mobile. You will use a DTMF module, Arduino board, and actuators to control the robot.
10.	**sture controlled Robot using ROS** sture controlled robots can be controlled easily with just the hand movements. In this ROS robotics project, you will develop a gesture-controlled robot using Arduino, Accelerometer sensor, and actuators.

TEXT BOOKS:

1. Lentin Joseph, “Robot Operating System for Absolute Beginners”, Apress, First Edition, 2018.

REFERENCE BOOKS:

1. Morgan Quigley, Brian Gerkey & William D. Smart, “Programming Robots with ROS: A Practical Introduction to the Robot Operating System”, O’Reilly, First Edition,2015.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/8384644
2. https://ieeexplore.ieee.org/document/6195127
3. https://www.roboticstomorrow.com/tag/ros
4. https://www.computer.org/csdl/magazine/co/2013/12/mco2013120016/13rRUypp53G
5. https://link.springer.com/book/10.1007/978-3-030-75472-3

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/specializations/robotics
2. https://nptel.ac.in/courses/112105249
3. https://www.edx.org/course/hello-real-world-with-ros-robot-operating-system
4. https://www.classcentral.com/course/edx-hello-real-world-with-ros-robot-operating-system-11555
5. https://www.udemy.com/topic/robot-operating-system/

6. https://www.skyfilabs.com/blog/10-simple-ros-projects-for-beginners

SELF-LEARNING EXERCISES:

1. Official tutorials: ROS Wiki
2. ROS Video Tutorials
3. Integrated ROS learning platform – Robot Ignite Academy
4. Face-to-face ROS training
5. ROS Books

Course Title	Multimedia Systems				Course Type		SC	
Course Code	B22EFS524	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course provides the knowledge of basic concepts of Multimedia and Hypermedia, World Wide Web, overview of Multimedia Software Tools, multimedia applications, graphics, image data representation, color in image and video, types of video signals and basics of digital audio multimedia operating Systems. It also provides knowledge of Quality of Service, compression standards, Network Protocols for multimedia communication and multimedia over wireless networks.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic concepts of Multimedia and Hypermedia, World Wide Web, and Overview of Multimedia Software Tools and exploring multimedia applications.
2. Demonstrate graphics and image data representation, color in image and video and types of video signals and basics of digital audio.
3. Discuss and describe the current and future issues related to multimedia technology.
4. Illustrate practical aspects in designing multimedia systems surrounding the emergence of multimedia technologies using contemporary hardware and software technologies.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply different compression techniques depending on the multimedia object streams, interpret the various standards for multimedia communications and their features.	1to4, 9,12	1
CO2	Demonstrate multimedia and its applications to potential clients.	1to3,5,9,12	2
CO3	Identify requirements and constraints for a good Quality of service in multimedia environment.	1to3,5,9,12	3
CO4	Design and develop applications and exercise proper design choices and meet Quality of Service requirements.	1to5, 9,12	2,3
CO5	Illustrate different Synchronization techniques used by Operating system for process management.	1to 5	1,2
CO6	Apply Digitization and Quantization method in the real-time multimedia network applications.	1to 5	2.3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2		√				

CO3			√			
CO4			√			
CO5		√				
CO6			√			

COURSE ARTICULATION MATRIX

CO# / PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2									2		
CO2	3	2	2		2									3	
CO3	3	1	1		2										3
CO4	3	2	2	2	2									3	
CO5	2	3	3	3	2								3	2	
CO6	3	3	2	3	3										3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Multimedia: What is Multimedia? Multimedia and Hypermedia, World Wide Web, Overview of Multimedia Software Tools

Graphics and Image Data Representation: Graphic/Image Data Types, Popular File Formats.

Color in Image and Video: Colo rScience, Color Models in Images, Color Models in Video.

UNIT – 2

Fundamental Concepts in Video: Types of Video Signals, Analog Video, Digital Video.

Basics of Digital Audio: Digitization of Sound, MIDI: Musical Instruments Digital Interface, Quantization and Transmission of Audio.

UNIT – 3

Multimedia Data Compression: Lossless Compression Algorithms: Basics of Information Theory, Shannon–Fano Algorithm, Huffman Coding, Adaptive Huffman Coding.

Image Compression Standards: The JPEG Standard: Main Steps in JPEG Image Compression, JPEG Modes.

Digital Watermarking and Steganography: Digital watermarking, Digital steganography, Differences between watermarking and steganography, a brief history.

UNIT – 4

Multimedia Operating Systems: Process Management, Interprocess Communication and Synchronization, Memory Management, Device Management, System Architecture.

TEXT BOOKS:

1. Li, Ze-Nian, Drew, Mark S., Liu, Jiangchuan, "Fundamentals of Multimedia", Springer, First edition, 2014.
2. Steinmetz, Ralf, Nahrstedt, Klara, "Multimedia Systems" Springer, Second edition, 2004.
3. Frank Y. Shih,"Digital watermarking and steganography: fundamentals and techniques", Taylor & Francis, Second edition,

2017.

REFERENCE BOOKS:

1. Fred Halshall, “Multimedia communication- Applications, Networks, Protocols and Standards”, Pearson education, Second Edition, 2007
2. R.Steimnetz, K.Nahrstedt, “Multimedia Computing, Communications and Applications”, Pearson Education, Sixth edition, 2008
3. K.R. Rao, Zoran S. Bojkovic, Dragovard A. Milovanovic, “Introduction to Multimedia Communications”, Wiley Publication.

JOURNALS/MAGAZINES:

1. https://www.guide2research.com/journals/web-mobile-multimedia
2. https://dl.acm.org/journal/tomm
3. ACM, ACM Transactions on Multimedia Computing, Communications, and Applications.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/lecture/internet-of-things-multimedia/multimedia-computing-and-classification- KRa30

2. https://www.aonlinetraining.com/multimedia_courses_elearning_training_school.html

SELF-LEARNING EXERCISES:

1. Social Media Sharing-Representative Social Media Services More exploration on GitHub.
2. Multimedia Cloud Computing.

<table>
<tr><td>Course Title</td><td colspan="4">C# & .Net Programming</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22EFS525</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The course is provides students a comprehensive foundation in the C# programming language and the framework it lives in. With the help of Pro C# 9 with .NET students will gain the confidence to put C# into practice, and explore the .NET universe and its vast potential on your own terms. C# is the core language of the Microsoft .NET framework, designed specifically to take advantage of CLI (Common Language Interface) features. The course focuses on C# program structure, language syntax, and implementation details. It is a simple, object-oriented, and type-safe programming language that is based on the C and C++ family of languages.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss Building Blocks of the .NET Platform.

2. Explain Core C# Programming Constructs.
3. Demonstrate the use of the Object Oriented Programming features and Interfaces
4. Illustrate the use of Structured exceptions, interfaces and object lifetime in real world application.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Familiarize with a number of .NET Corecentric building blocks.	1 to 5,12	1,2,3
CO2	Make use of the fundamental data types of .NET 5, work with text manipulation, and learn the role of various C# parameter modifiers.	1 to 5,11,12	1,2,3
CO3	Understand the core constructs of the C# language.	1 to 5,11,12	1,2,3
CO4	Apply various runtime exceptions, interfaces for real world applications.	1 to 5,11,12	1,2,3
CO5	Discriminate the various concepts of C# language.	1 to 5,11,12	1,2,3
CO6	Develop C# applications on .NET platform.	1 to 5,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2				√		
CO3			√			
CO4				√		
CO5					√	
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2							2	3	3	3
CO2	3	3	2	3	3						2	2	3	3	3
CO3	3	3	3	2	2						2	2	3	3	3
CO4	3	3	3	2	2						2	2	3	3	3
CO5	3	2	2	3	3						2	3	3	3	3
CO6	3	3	2	2	3							3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Introducing C# and .NET (Core) 5: Exploring Some Key Benefits of the .NET Core Platform, Understanding the .NET Core Support Lifecycle, Previewing the Building Blocks of the .NET Core Platform (.NET Runtime, CTS,and CLS), Using Additional .NET Core–Aware Programming Languages, Getting an Overview of .NET Assemblies, Understanding the Common Type System, Understanding the Common Language Specification, Understanding the .NET Core Runtime, Distinguishing Between Assembly, Namespace, and Type,Exploring an Assembly Using ildasm.exe

Building C# Applications: Installing .NET 5, Building .NET Core Applications with Visual Studio, Building .NET Core Applications with Visual Studio Code, Finding the .NET Core and C# Documentation

UNIT – 2

Core C# Programming Constructs, Part 1: Breaking Down a Simple C# Program, Using the System.Console Class, Working with System Data Types and Corresponding C# Keywords, Working with String Data, Narrowing and Widening Data Type Conversions, Understanding Implicitly Typed Local Variables, Working with C# Iteration Constructs

Core C# Programming Constructs, Part 2: Understanding C# Arrays, Understanding Methods, Understanding Method Parameters, Understanding the enum Type, Understanding the Structure (aka Value Type), Understanding Value Types and Reference Types, Understanding C# Nullable Types, Understanding Tuples.

UNIT – 3

Object Oriented Programming with C#:

Understanding Encapsulation: Introducing the C# Class Type, Understanding Constructors, Understanding the Role of the this Keyword, Understanding the static Keyword, Defining the Pillars of OOP, Understanding C# Access Modifiers (Updated 7.2), Understanding the First Pillar: C#'s Encapsulation Services, Understanding Automatic Properties, Understanding Object Initialization, Working with Constant and Read-Only Field Data, Understanding Partial Classes, Using Records (New 9.0).

Understanding Inheritance and Polymorphism: Understanding the Basic Mechanics of Inheritance, Understanding the Second Pillar of OOP: The Details of Inheritance, Programming for Containment/Delegation, Understanding the Third Pillar of OOP: C#'s Polymorphic Support, Understanding Base Class/Derived Class Casting Rules, Understanding the Super Parent Class: System.Object.

UNIT – 4

Understanding Structured Exception Handling: Ode to Errors, Bugs, and Exceptions, The Role of .NET Exception Handling, The Simplest Possible Example, Configuring the State of an Exception, System-Level Exceptions (System.SystemException), Application-Level Exceptions (System.ApplicationException), Processing Multiple Exceptions. The Basics of Object Lifetime, Understanding Object Generations, Garbage Collection Types, Building Finalizable Objects, Building Disposable Objects, Building Finalizable and Disposable Types, Understanding Lazy Object Instantiation

Working with Interfaces : Understanding Interface Types, Defining Custom Interfaces, Implementing an Interface, Invoking Interface Members at the Object Level, Static Constructors and Members (New 8.0), Interfaces as Parameters, Interfaces as Return

Values, Arrays of Interface Types, Implementing Interfaces Using Automatically, Explicit Interface Implementation, Designing Interface Hierarchies, The IEnumerable and IEnumerator Interfaces, The ICloneable Interface, The IComparable Interface.

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TEXT BOOKS:

1. Andrew Troelsen, Phillip Japikse, “Pro C# 9 with .NET 5 Foundational Principles and Practices “, Tenth Edition, APress.

REFERENCE BOOKS:

1. E. Balaguruswamy: Programming in C#, 5th reprint, Tata McGraw Hill 2004.
2. Vijay Nicoel, Visual C#.NET, 5th reprint, Tata McGraw Hill 2004.

JOURNALS/MAGAZINES:

1. https://dotnet.microsoft.com/en-us/languages
2. https://www.javatpoint.com/c-sharp-tutorial
3. https://www.w3schools.com/cs/index.php

SELF-LEARNING EXERCISES:

Application Development on .NET framework

Course Title	Big Data Analytics Lab				Course Type		HC	
Course Code	B22EF0505	Credits	1		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE OVERVIEW:

This course is to familiarize the students with most important information technologies used in manipulating, storing, and analyzing big data. The Spark framework is introduced to the students to perform big data analytics using PySpark. The course demonstrates the application of PySpark in solving any big data analytics problem. The course also demonstrates the usage of machine learning with PySpark to analyse large datasets.

COURSE OBJECTIVES:

1. Discuss the fundamentals of Spark distributed system and Big Data Analytics.
2. Demonstrate Big Data Processing with Python and PySpark.
3. Describe the implementation of Real-Time Analytics with PySparkin real world Applications.
4. Illustrate the working of Machine Learning applications suitable to handle big data using PySpark.

COURSE OUTCOMES:

On successful completion of this course; the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate the fundamentals of Spark distributed framework for Big Data Analytics.	1,2,3,4,5,9,10 ,11	1,2,3
CO2	Demonstrate Big Data Processing with PySpark to solve simple real world problems.	1,2,3,4,5,9,10 ,11	1,2,3
CO3	Design Real-Time Analytics with PySparkfor real world Applications.	1,2,3,4,5,9,10 ,11	1,2,3
CO4	Develop data and processing models using Python based PySparkfor real world Big data Applications	1,2,3,4,5,9,10 ,11	1,2,3
CO5	Design Real-Time Analytics with PySpark for real world Applications.	1,2,3,4,5,9,10 ,11	1,2,3
CO6	Develop data and processing models using Python based PySpark for real world Big data Applications.	1,2,3,4,5,9,10 ,11	1,2,3

.**BLOOM'S LEVELOF THE COURSE OUTCOMES**

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			

CO3		✓				
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	3	3				1	1	1	1	3	3	3
CO2	3	3	3	3	3				2	1	2	3	3	3	3
CO3	3	3	3	3	3				2	1	2	3	3	3	3
CO4	3	3	3	3	3				3	3	2	3	3	3	3
CO5	3	3	3	3	3				2	1	2	3	3	3	3
CO6	3	3	3	3	3				3	3	2	3	3	3	3

PRACTICE:

S.N.	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill/Ability**
	PART-A		
	Introduction: Installing PySpark on Colab	Windows/Linux OS, IDE/Colab	Understanding the process of Installation of Java and PySpark on Colab
1.	Perform the following operations: a. Create a SparkContext object b. Create anRDD from set of words ("scala", "java", "hadoop", "spark", "akka", "spark vs had oop", "pyspark", "pyspark and spark") using *parallelize()* function. c. Find the total count of the words in the RDD d. Filter out and print the strings containing the word "spark" from the RDD	Windows/ Linux OS, IDE/Colab	Understand the skill of creating RDDs in PySpark
2.	Given the two RDDs: a. x created from the ordered pairs: ("spark", 1) and ("hadoop", 4) b. y created from the ordered pairs: ("spark", 2), ("hadoop", 5). Perform the join operation on the RDDs created above, and print the resulting RDD.	Windows/ Linux OS, IDE/Colab	Understand the skill of performing operations on RDDs in PySpark
3.	Create an RDD of set of numbers and perform the sum of these numbers using an *accumulator()* function in Spark context.	Windows/ Linux OS, IDE/Colab	Understand the skill of performing operations on RDDs in PySpark

4.	Create an RDD from the existing file having CSV data, using *read()* and *load()* functions and display the top 5 rows of the data set. And also display the statistical results from the data frame (Note: It only works for numerical values).	Windows/ Linux OS, IDE/Colab	Understand the skill of performing operations on RDDs in PySpark
5.	Create an RDD from the external text file. Find the word count in the text file using various transformation and action functions in PySpark.	Windows/ Linux OS, IDE/Colab	Understand the skill of performing operations on RDDs in PySpark
6.	Given the following data. Data = [("James","Sales","NY",90000,34,10000), ("Michael","Sales","NV",86000,56,20000), ("Robert","Sales","CA",81000,30,23000), ("Maria","Finance","CA",90000,24,23000), ("Raman","Finance","DE",99000,40,24000), ("Scott","Finance","NY",83000,36,19000), ("Jen","Finance","NY",79000,53,15000), ("Jeff","Marketing","NV",80000,25,18000), ("Kumar","Marketing","NJ",91000,50,21000)], with the following schema schema = ["employee_name","department","state","salary","age","bonus"] Perform the following using the aforementioned data. i. create an RDD from the above data using its schema ii. create the PySparkdataframe from the RDD created. iii. Using groupBy() function, display the salaries of the employees state-wise. iv. Display the state-wise salaries that are greater than 1 lakh v. Display the state-wise salaries in descending order.	Windows/ Linux OS, IDE/Colab	Understand the skill of creating PySparkdataframes from RDD and then performing operations on PySpark RDDs in PySpark
7.	Given the following data data = [("1", "john jones"), ("2", "tracey smith"), ("3", "amy sanders")], along with the following schema of the data columns = ["Seqno","Name"] Perform the following using the afore mentioned data. vi. create an RDD from the above data using its schema vii. create the PySparkdataframe from the RDD created. viii. Write python functions to convert the first letter of every string into upper case. ix. Use the above python function as udf in pySpark to convert the data in the dataframe and display the result.	Windows/Linux OS, IDE/Colab	Understand the skill of creating PySparkdataframes from RDD and then performing operations on PySpark RDDs in PySpark
	PART-B (Mini-Project)		
8	plement and demonstrate any real life big data problem using	dows/Linux OS,	erature Surveying,

	any of the publicly available big data sets.	IDE/Colab	Project Implementation, Seminars, IPR Filing, Paper Publication

Note: During the examination, the student is expected to do one of the first 7 exercises from Part-A by choosing on lots. The student is also expected to develop a Mini-Project using PySpark to solve some real time data analytics application. The overall examination marks are distributed into Part-A and Part-B. Part-B includes demonstration of project and submission of project report.

TEXT BOOKS:

1. Feng, Wenqiang. "Learning Apache Spark with Python." (2019): 231.
2. Mengle, Saket SR, and Maximo Gurmendez. Mastering machine learning on Aws: advanced machine learning in Python using SageMaker, Apache Spark, and TensorFlow. Packt Publishing Ltd, 2019.

REFERENCE BOOKS:

1. Michael Minelli, Michele chambers, AmbigaDhiraj,"Big data, big analytics", Wiley, 2013.

JOURNALS/MAGAZINES

1. IEEE, Introduction to the IEEE Transactions on Big Data.
2. Elsevier, Big data research journal Elsevier.
3. Springer, Journal on Big Data Springer.

Course Title	**Computer Networks Lab**				**Course Type**		**HC**	
Course Code	**B22EF0506**	**Credits**	**1**		**Class**		**V Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	-	-	-				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**25%**	**25%**

COURSE OVERVIEW:

This course introduces to networking and Internet protocols via programming and hands-on labs using different tools viz. ns3, NMAP, packet tracer. The concept learnt are understood more clearly pertaining to TCP/IP protocol architecture; user datagram protocol (UDP); multicasting; transmission control protocol (TCP); standard Internet services, and protocol usage by common Internet applications. Sockets programming; client/server; peer-to-peer; Internet addressing; TCP sockets; UDP sockets; Router and switch configurations, network topology, wireless internetworking, Network protocol analyzers; traffic generation.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the ns3 simulator, installation and its application.
2. Illustrate the creation of point to point link, TCP, UDP protocols its connection.

3. Demonstrate the connection establishment of network computing devices.
4. Discuss tracking, testing, analyzing the network.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the protocol stacks (OSI and TCP/IP) used for data communication.	1 to 5,9,10,12	1,3
CO2	Analyze the connection establishment of network computing devices using Packet tracer.	1 to 5, 9,10,12	1,3
CO3	Develop a program for star topologyin C++ and understand data transfer with NetAnim.	1 to 5, 9,10,12	2, 3
CO4	Make use of TCP dump to understand and analyze the network characteristics.	1 to 5, 9,10,12	1,3
CO5	Apply NMAP to understand network behavior for spurious activity.	1 to 5, 9,10,12	1,3
CO6	Demonstrate the wireshark tool for protocol analysis.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				3	3		2	3		3
CO2	3	3	2	2	1				3	3		2	3		3
CO3	3	3	2	2	2				3	3		2	1	1	3
CO4	3	3	3	1	2				3	3		2	1	-	3
CO5	3	2	2	2	3				3	3		2	3		3
CO6	3	2	2	3	3				3	3		2	3	2	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	Introduction to: (a) discrete event simulation, (b) ns3, (c) ns3 Installation, (d) NetAnim.	Windows/Linux OS, IDE, ns3	Understanding ns3 installation and NetAnim
2.	Write a NS3 program to connect two nodes with a point to point link, which have unique interface. Analyze the network performance using UDP client server.	Windows/Linux OS, VMware, ns3	Creating a point to point link and understanding UDP.
3.	Write a NS 3 program to demonstrate bus topology. Analyze the performance using UDP based applications number.	Windows/Linux OS, VMware, ns3	Understanding bus topology.
4.	Write a NS 3 program to demonstrate star topology. Analyze the performance using UDP based applications.	Windows/Linux OS,VMware, ns3	Creating a bus topology and visualize using NetAnim
5.	te a NS3 program to implement FTP using TCP bulk transfer, Analyze the performance	Windows/Linux OS,VMware, ns3	Implementing FTP and understand bulk transfer.
6.	te NS 3 Program to configure two nodes on an 802.11b physical layer, with802.11b NICs in Adhoc mode, and by default, sends one packet of 1000 (application) bytes to the other node. The physical layer is configured to receive at a fixed RSS (regardless of the distance and transmit power); therefore, changing position of the nodes has no effect. Analyze the performance.	ndows/Linux OS, VMware, ns3	nfiguration of an Adhoc Network and analyze the performance
7	all packet tracer, and consider a topology and configure VLAN	ndows/Linux OS, VMware, packet tracer	eation of a topology and understand VLAN
8	sider a network topology and demonstrate OSPF routing protocol.	ndows/Linux OS, VMware, packet tracer	eation of a topology and understand OSPFrouting protocol
9	all wireshark, and analyze the packets using it on a selected interface. Apply filters and check the packets.	ndows/Linux OS, VMware, wireshark	talling, analyzing live network behavior.
10	all NMAP, and execute atleast 10 commands to demonstrate the scanning of networks hosts and ports.	ndows/Linux OS, VMware, NMAP	talling NMAP and learning different network scanning commands

Course Title	Machine Learning Applications Lab				Course Type		HC	
Course Code	B22EF0507	Credits	1		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE OVERVIEW:

This course introduces the fundamental concepts and methods of machine learning, including the description and analysis of several modern algorithms, their theoretical basis, and the illustration of their applications. Machine learning as a field is now incredibly pervasive, with applications spanning from business intelligence to text and speech processing, bioinformatics, and other areas in real-world products and services. This will familiarize students with a broad cross-section of models and algorithms for machine learning, and prepare students for research or industry application of machine learning techniques.

COURSE OBJECTIVE (S):

1. To understand the basic concepts and techniques of Machine Learning through python programming.
2. To develop skills of using recent machine learning packages for solving practical problems.
3. To gain experience of doing independent study and research.
4. To gain good knowledge in Supervised and Unsupervised Algorithms.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of predictive data analytics tools to analyse the characteristics of datasets.	1 to 6, 9,10,12	3
CO2	Choose machine learning technique and computing environment suitable for the given application.	1 to 6, 9,10, 12	1
CO3	Apply a linear regression model for the given real world application.	1 to 6, 9,10,12	3
CO4	Develop an application to make use of decision trees to solve the real world problem.	1 to 6, 9,10,12	2,3
CO5	Make use ofunsupervised learning concepts and dimensionality Prediction techniques in real world applications.	1 to 6, 9,10, 12	1,3
CO6	Apply Machine Learning algorithms in real-world applications using Python programming.	1 to 6, 9,10,12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				

CO2			√			
CO3			√			
CO4				√		
CO5				√		
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3					3	3	3	3	3	3
CO2	3	3	3	3	3					3	3	3	3	3	3
CO3	3	3	3	3	3					3	3	3	3	3	3
CO4	3	3	3	3	3					3	3	3	3	3	3
CO5	3	3	3	3	3					3	3	3	3	3	3
CO6	3	3	3	3	3					3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

Note - Kindly choose your own dataset for each problem

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	Write a program to predict the price of the house using linear regression algorithm. Evaluate the same using Mean Squared Error and Root Mean Squared Error.	Anaconda Navigator	Python
2.	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	Anaconda Navigator	Python
3.	Write a program to classify the given instance using logistic regression. Evaluate the model using classification accuracy.	Anaconda Navigator	Python
4	Write a program to classify the instances using Naive Bayes algorithm. Evaluate the same using different metrics.	Anaconda Navigator	Python

5.	ly support vector machine to either classification / regression dataset of your choice. Analyse the performance of the same using different metrics.	Anaconda Navigator	Python
6.	Apply any ensemble based learning algorithm to any dataset of your choice. Check the performance of this algorithm with other ML algorithms.	naconda Navigator	Python
7	te a program to analyse the nearest instances to the given instances using K Nearest Neighbor algorithm. Evaluate the performance of the algorithm using different metrics.	naconda Navigator	Python
8	te a program to cluster the instances for unlabelled dataset using K Means clustering algorithm.	naconda Navigator	Python
9	te a program to reduce the dimension of the dataset using PCA.	naconda Navigator	Python
10	Write a program to predict the price of the house using linear regression algorithm. Evaluate the same using Mean Squared Error and Root Mean Squared Error.	Anaconda Navigator	Python

Course Title	Skill Development Course - 3				Course Type		SDC	
Course Code	B22EF0508	Credits	2		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	2	4	4				
	Total	2	4	4	-	56	50%	50%

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-2:

Students will be offered training and certifications on the trending technologies from the industry experts.

The students are evaluated and certified after the training programs.

VI SEMESTER

Course Code	Title of the Course	HC/FC /SC/OE /MC/SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
			L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
B22XXO61X	Open Elective-2 (General)	OE	3	0	0	3	3	50	50	100	POE
B22EF0601	Cryptography and Network Security	HC	3	0	0	3	3	50	50	100	PCC
B22EF0602	Web Technology	HC	3	0	0	3	3	50	50	100	PCC
B22EF0603	Agile Software Development and DevOps	HC	3	0	0	3	3	50	50	100	PCC
B22EF0604	Cloud Computing	HC	3	0	0	3	3	50	50	100	PCC
B22EFS61X	Professional Elective -4	SC	3	0	0	3	3	50	50	100	PEC
B22EFS62X	Professional Elective- 5	SC	3	0	0	3	3	50	50	100	PEC
B22EF0605	Cryptography and Network Security Lab	HC	0	0	1	1	2	25	25	50	PCC
B22EF0606	Web Technology Lab	HC	0	0	1	1	2	25	25	50	PCC
B22EF0607	Cloud Computing Lab	HC	0	0	1	1	2	25	25	50	PCC
B22EF0608	Mini Project (research based)	HC	0	0	2	2	4	50	50	50	PCC
Total			**21**	**0**	**5**	**26**	**31**	**475**	**475**	**900**	
TOTAL SEMESTER CREDITS			**26**								
TOTAL CUMULATIVE CREDITS			**140**								
TOTAL CONTACT HOURS			**31**								
TOTAL MARKS			**950**								

Open Elective-II:

Course Title	Machine Learning using Python				Course Type		POE	
Course Code	B22EFO611	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The course covers the fundamentals of Python, machine learning, preprocessing features, supervised and unsupervised machine learning. It also discusses the concepts of Artificial Neural networks and performs analysis on machine learning experiments.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe the basic concepts of Python
2. Identify the fundamental problems of machine learning
3. Classifythe techniques, mathematical concepts, and algorithms used in machine learning to facilitate further study in this area
4. Examine the limitations of various machine learning algorithms and the way to evaluate performance of machine learning algorithms.

COURSE OUTCOMES (COs):

After thec ompletion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basic concepts of Python and Machine learning	1 to 5,9,10,12	
CO2	Differentiate between different types of Machine learning	1 to 5, 9,10,12	
CO3	Summarize the features of preprocessing	1 to 5, 9,10,12	
CO4	Identify the purpose of supervised and unsupervised Machine learning.	1 to 5, 9,10,12	
CO5	Implement the Machine learning algorithms using python libraries.	1 to 5, 9,10,12	
CO6	Analysis the types of neural networks.	1 to 5, 9,10,12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2		√		√		
CO3	√	√		√		
CO4	√	√		√		
CO5			√	√		
CO6		√	√	√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1							2	3	2	3
CO2	3	3	2	2	1							2	3	2	3
CO3	3	3	1	1	1	3						2	2	3	3
CO4	3	3	3	1	2							2	2	3	2
CO5	3	1	2	1	3	3						2	3	3	3
CO6	3	1	2	1	3	3						2	3	2	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Machine Learning: Introduction to Machine Learning: What is Machine Learning (ML)? - Human Learning vs Machine Learning - Need of Machine Learning - Types - Pros & Cons of ML - Life cycle of ML - Dataset - Preprocessing – Feature selection techniques - Confusion Matrix - Cross Validation - Cost Function - Entropy - Bias - variance - trade-off - Overfitting, underfitting - Perceptron - Gradient descent: batch, stochastic - Sampling - Resampling methods - Evaluation metrics - Statistics: Hypothesis testing - Confidence intervals - P-value - Scedasticity - Normal distribution - Gaussian distribution.

UNIT – 2

Introduction to Python: Variables - Data Types - Operators - Functions - Control Structures - Conditional statements; Looping statements; Jumping Statements; Python Collections: List - Set - Tuples - Dictionary - DataFrame - Python Libraries: Numpy - Scipy - Pandas - Matplotlib - Scikit-learn - TensorFlow – Keras.

UNIT – 3

Supervised Learning: Introduction to Supervised Learning – Regression: Linear Regression - Multilinear Regression - Polynomial Regression - Classification: Logistic Regression - SVM - Random Forest - Naive Bayes - Decision Tree - Case study.

UNIT – 4

Unsupervised Learning: Clustering: K Means Clustering - KNN - Hierarchal clustering - Agglomerative clustering - DBSCAN - Dimensionality Reduction: PCA – LDA - Neural Networks: ANN -CNN – RNN - Case Study.

TEXT BOOKS:

1. EthemAlpaydin, - Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014.
2. Stephen Marsland, - Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. Tom M Mitchell, - Machine Learning‖, First Edition, McGraw Hill Education, 2013.
4. Introducing Python, Oriely Publications.

REFERENCE BOOKS:

1. Michael Dawson Python Programming for absolute beginners-3rd Edition.
2. Peter Flach, - Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
3. Jason Bell, - Machine learning – Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014.

JOURNALS/MAGAZINES:

1. Journal of Machine Learning Research.
2. IEEE Transactions on Artificial Intelligence & Machine Learning

SWAYAM/NPTEL/MOOCs:

1. https://www.javatpoint.com/machine-learning
2. https://www.classcentral.com/subject/intro-ml
3. https://onlinecourses.nptel.ac.in/noc22_cs73/preview

SELF-LEARNING EXERCISES:

1. Anaconda
2. Reinforcement Learning
3. Deep Learning

<table>
<tr><td>Course Title</td><td colspan="4">Operating System</td><td colspan="2">Course Type</td><td colspan="2">POE</td></tr>
<tr><td>Course Code</td><td>B22EFO612</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

This course starts with a brief historical perspective of the evolution of operating system and then covers the major components of most of the operating systems. The operating system provides a well-known, convenient, and efficient interface between user

programs and the bare hardware of the computer on which they run. The operating system is responsible for allowing resources (e.g., disks, networks, and processors) to be shared, providing common services needed by many different programs (e.g., file service, the ability to start or stop processes, and access to the printer) and protecting individual programs from one another. Emphasis is given to three major OS subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging, swapping) and file systems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the major components and different services of Operating system.
2. Implement process management and scheduling schemes.
3. Discuss synchronization and deadlock techniques in real time applications.
4. Demonstrate memory management techniques for a given machine architecture.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the major components and services of Operating System.	1 to 5,12	
CO2	Summarize process scheduling, scheduling algorithm and multithreading of Operating System.	1 to 5,12	
CO3	Assess the Performance of different CPU Scheduling algorithm for the given real-world applications.	1 to 5,12	
CO4	Understand the concept of memory management.	1 to 5,12	
CO5	Devise methods to manage memory efficiently.	1 to 5, 9,12	
CO6	Compare and contrast the physical and virtual memory management techniques.	1 to 5,12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			✓			
CO2		✓				
CO3					✓	
CO4		✓				
CO5						✓
CO6			✓			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1							1			
CO2	2	2	2	2	1							1			
CO3	2	1	2	2	1							1			

CO4	2	1	2	3	1							1			
CO5	1	2	1	1	1							1			
CO6	1	2	2	1	1							1			

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Operating System Principles: Evolution of Operating Systems, Structural overview, Types of Operating System and operations, Computing environments, Operating System Services, User - Operating System interface, System calls and system programs, Operating System structure.

UNIT – 2

Process Management: Process concept, process scheduling, Operations on processes, Inter process communication.

UNIT – 3

Multi-Threaded Programming: Overview, Multithreading models, Thread Libraries, threading issues. Process scheduling: Basic concepts, scheduling criteria, scheduling algorithms.

Memory Management: Memory Management Strategies, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation.

UNIT – 4

Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Allocation methods, Thrashing.

Self-learning components:

Virtual machines and Introduction to Linux Operating System, Introduction to Distributed computing, Parallel computing, grid computing, cloud computing,File System.

TEXT BOOKS:

1. Abraham Silberschatz, Peter Bear Galvin, Greg Gagne, Operating System Principles, Wiley Asia Student Edition, 2009.
2. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India, seventh edition, 2011.
3. M. Dhamdhere; Operating Systems: A Concept-Based Approach; Tata McGraw-Hill, Third edition 2012.

REFERENCE BOOKS:

1. Frederic Magoules, Jie Pan, Kiat-An Tan, Abhinit Kumar, Introduction to Grid Computing, CRC Press, Second Edition, 2014
2. Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation. Prentice-Hall, Third edition, 2014.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/1658969
2. https://ieeexplore.ieee.org/document/1646682
3. https://ieeexplore.ieee.org/abstract/document/402081

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs04/preview
2. https://www.coursera.org/lecture/os-power-user/introduction-r0c5h
3. https://onlinecourses.swayam2.ac.in/cec20_cs06/preview

Course Title	Cryptography and Network Security				Course Type		HC	
Course Code	B22EF0601	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course will emphasise on principles and practice of cryptography and network security: classical systems, symmetric block ciphers (DES, AES, other contemporary symmetric ciphers), linear and differential cryptanalysis, perfect secrecy, public-key cryptography algorithms for factoring and discrete logarithms, cryptographic protocols, hash functions, authentication, key management, key exchange, signature schemes and email security, viruses, firewalls, digital right management, and other topics. In this course students will learn as aspects of network security and cryptography.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamental concepts of cryptography.
2. Describe public key cryptography and message authentication.
3: Demonstrate the key distribution using Symmetric or Asymmetric encryption.
4. Discuss security applications in the field of Information technology.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the fundamental concepts of cryptography.	1 to 5	1
CO2	Use symmetric and asymmetric key algorithms for cryptography	1 to 5	2
CO3	Apply the key distribution technique using Symmetric or Asymmetric encryption	1 to 5	2,3
CO4	Develop real-world security applications in the field of Information technology.	1 to 5	2,3

CO5	Understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works.	1 to 5	1,2
CO6	Apply the System security concepts for real-time secure applications.	1 to 5	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4						√
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1								3		
CO2	3	2	3	1	2									3	
CO3	3	1	2	2	3									3	3
CO4	2	2	2	1	1									3	3
CO5	3	2	3	2	1								3	3	
CO6	2	1	2	2	2									3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

INTRODUCTION: Security trends, The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network security.

CLASSICAL ENCRYPTION TECHNIQUES: Overview of Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, andStenography.

INTRODUCTION TO NUMBER THEORY: Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality, The Chinese Remainder Theorem, Discrete logarithms.

TOOLS DEMONSTRATION: Wireshark, Metasploit, Snort, Nmap, Kali Linux.

UNIT – II

SYMMETRIC KEY CRYPTOGRAPHY: Block Cipher Principles, Data Encryption Standards, Advanced Encryption Standards, Block Cipher Modes of Operation, Stream Cipher and RC4.

PUBLIC KEY CRYPTOGRAPHY: Principles Public key crypto Systems, RSA algorithm, Key Management, Diffie Hellman Key Exchange, Overview of Elliptic Curve Cryptography.

UNIT – III

MESSAGE AUTHENTICATION AND HASH FUNCTIONS: Authentication Requirement, Authentication Function, Message Authentication Code, List of Hash Function, Secure Hash Algorithm, HMAC, CMAC, an overview of Digital Signature.

AUTHENTICATION APPLICATION: Kerberos, X.509 Authentication Service, Public Key Infrastructure.

UNIT – IV

EMAIL SECURITY: Pretty Good Privacy (PGP) and S/MIME**.**

IP SECURITY: Overview, IP Security Architecture.

SYSTEM SECURITY: Intrusion Detection, Overview of Packet Sniffing, Penetration testing, Database testing, DoS attacks. Password Management, Virus and threats, Virus Counter measures.

FIREWALLS: The Need for Firewalls, Firewall Characteristics, Types of Firewalls.

SELF-LEARNING EXERCISES:

The student is expected to study more about the following topics: IoT complexity leads to security issues and further DDoS attacks, Malware, Cloud security, Roles of AI and machine learning in cyber security.

TEXT BOOKS:

1. William Stallings, “Cryptography and Network Security Principles and Practice”, Pearson, Sixth edition, 2013
2. Behrouz A. Forouzan, “Cryptography and Network Security”, McGraw Hill, 2007.

REFERENCE BOOKS:

1. William Stallings, “Network Security Essentials Applications and Standards”, Fourth edition, Prentice Hall, 2011.
2. Joseph MiggaKizza,” Guide to Computer Security, Springer Science & Media Inc., Third edition, 2015
3. Andrew S.Tanenbaum, “Computer Networks”, Pearson, Fifth edition, 2015.
4. AtulKahate, “Cryptography and Network Security”, McGraw Hill, 2013.

JOURNALS/MAGAZINES:

1. Springer Journal of Cryptographic Engineering, ISSN 2190-8508
2. ACM, ACM- International Journal of Applied Cryptography, ISSN:1753-0563
3. IEEE, IEEE Transactions on Information Forensics and Security.
4. Elsevier, Journal of Information Security and Applications.

SWAYAM/NPTEL/MOOCs:

1. Foundations of Cryptography: https://nptel.ac.in/courses/106/106/106106221/
2. Cryptography and Network Security: https://nptel.ac.in/courses/106/105/106105162/

Course Title	Web Technology				Course Type		HC	
Course Code	B22EF0602	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

Building on the basic Web Technologies unit in the CSE course, students will learn to create more dynamic and interactive websites using JavaScript. Advanced HTML, CSS, and basic JavaScript enhances the client-side webpages and students will learn to use these technologies for their specific purposes. Students begin working with server-side scripting and web applications development using Server side scripting.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Build dynamic web pages with the help of various HTML tags and perform validation using Java Script objects by applying different event handling mechanisms.
2. Comprehend the importance of CSS in designing a creative and dynamic website and embedding Java Script code in HTML.
3. Understand and be able to develop JavaScript code to access the DOM structure of web document and object properties.
4. Develop dynamic web pages with usage of server-side scripting.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of HTML tags and CSS to build web pages for various applications.	1 to 5, 9,10,12	1,2,3
CO2	Demonstrate the usage of form data to validate the correctness of given input.	1 to 5, 9,10,12	1,2,3
CO3	Apply the variety of presentation effects in HTML documents, including explicit positioning of elements using CSS.	1 to 5, 9,10,12	1,3
CO4	Prepare a HTML document for Interactive webpage using JavaScript.	1 to 5, 9,10,12	1,3
CO5	Analyze the concepts of server side technologies for dynamic web applications.	1 to 5, 9,12	1,3
CO6	Illustrate the concept of ReactJS for creation of reusable UI Components.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			

CO3			√			
CO4			√			
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	1	3				3	1		3	3	1	2
CO2	3	3	3	1	3				3	1		3	3	1	2
CO3	3	1	3	1	3				3	1		3	3		3
CO4	3	1	3	1	3				3	1		3	3		2
CO5	3	1	3	1	3				3			3	3		3
CO6	2	1	2	1	2				2			2	2	1	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit 1

Introduction to Web Essentials and HTML:

Clients, Servers, and Communication, The Internet-Basic Internet Protocols -The World Wide Web, HTTP request message-response message, Web Clients Web Servers-Case Study, Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative, The and tags ,Lists, Tables.

Unit 2

Forms and Style Sheets

HTML Frames and Forms.Introduction to CSS, Levels of style Sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images , Conflict resolution.

Unit 3

JavaScript

Java Script Client side scripting using JavaScript, Introduction to JavaScript, internal and external Java script files, variables, control statements, loops, Arrays , string handling , functions, How to write functions inJavaScript, inputting and outputting from form elements to JavaScript, DOM concept, creating html elements using JavaScript. Drawing 2D shapes, handling events.

Unit 4

ReactJS

Introduction to ReactJS and its syntax, Introduction to Components: Communication between Component, Types of Components, States and Props: What is State and its significance, Read State and Set state, Passing data to components using props, React JS

Environment setups: Node Setup, NMP installation, How to write optimized code in React JS, React with Redux: What is React Redux, Why React Redux, Install and Setup.

TEXT BOOKS:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
2. The Complete Reference, HTML and CSS by Thomas A Powell latest edition
3. Learning React, Free unaffiliated eBook created from stack overflow contributors.The Complete Reference, HTML and CSS by Thomas A Powell latest edition

REFERENCE BOOKS:

1. Web Programming, building internet applications, Chris Bates 2nd edition, Wiley Dremtech
2. Java Script, D.Flanagan, O'Reilly, SPD

JOURNALS/MAGAZINES:

1. https://www.inderscience.com/jhome.php?jcode=IJWET
2. http://www.w3schools.com/
3. http://getbootstrap.com/

SWAYAM/NPTEL/MOOCs:

1. http://nptel.ac.in
2. https://www.udemy.com/course/angularjs-for-beginners-udemy/
3. https://www.coursera.org/learn/introduction-to-front-end-development

SELF-LEARNING EXERCISES:

1. Node JS, React JS
2. jQuery

<table>
<tr><td>Course Title</td><td colspan="3">Agile Software Development and DevOps</td><td>Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0603</td><td>Credits</td><td colspan="2">3</td><td>Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The course provides students with a knowledge on the basic principles of software development life cycle, activities involved in software requirements engineering, software development, testing, evolution and maintenance. It introduces concepts such as software processes and agile methodsand essential software development activities. New methods to approach old development problems with DevOps.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the importance of the software development process.
2. Demonstrate the workflow of Automating process.
3. Explain the development of a software using Agile method
4. Illustrate with case study, the importance of DevOps.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply software development process to solve complex problems of engineering.	1,2	1,2
CO2	Make use of Agile principle for rapid software development and automation.	1,3	3
CO3	Summarize the basic principles of agile approach and need of integration, delivery and deployment.	1,3,5	1
CO4	Apply the concepts of process modeling and automation in real world applications.	1,3,5	2,3
CO5	Distinguish between the traditional SDLC and agile ALM model for efficient and effective product delivery.	1,3,4	1
CO6	Develop the real-world applications using DevOps tools for continuous business improvement.	1,3,4,5,9	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			√			
CO2			√			
CO3		√				
CO4			√			
CO5				√		
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3	3	
CO2	3		3												3
CO3	3		3		3								3		

CO4	3		3		3									3	3
CO5	3		3	3									3		
CO6	3		3	3	3				3					3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Requirements and Development process: Software Processes: Models, Process iteration, Process activities. Software Requirements: Functional and Non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements Engineering Processes: Feasibility studies, Requirements elicitation and analysis.

UNIT – 2

Agile Application Life Cycle Management: Goals of Agile Application Life Cycle Management, Why Is Agile ALM Important? Understanding the Paradigm Shift, Rapid Iterative Development, Focuson12 Agile Principles, Agile Manifesto, Fixed Time box Sprints, Customer Collaboration, Requirements and Documentation.

UNIT – 3

Automating the agile ALM: Goals of Automating the Agile ALM, Why Automating the ALMIs Important, Tools, Do Tools Matter? Process over Tools, Understanding Tools in the Scope of ALM, Staying Tools Agnostic, Commercial versus Open Source, Automating the Workflow, Process Modeling Automation, Managing the Lifecycle with ALM, Broad Scope of ALM Tools, Achieving Seamless Integration, Managing Requirements of the ALM, Creating Epics and Stories, Systems and Driven Development, Environment Management, Gold Copies, Supporting the CMDB, SupportingOperations, IncidentManagement, Project Management, Planning the PMO, Planning for Implementation, Evaluating and Selecting the Right Tools, Defining the Use Case, Training Is Essential, Vendor Relationships, Keeping Tools Current.

UNIT – 4

DevOps: Goals of DevOps, Why Is DevOps Important? Where Do I Start? How Do I Implement DevOps? Developers and Operations Conflicts, Developers and Operations Collaboration, Need for Rapid Change, Knowledge Management, the Cross-Functional Team, Is DevOps Agile? The DevOps Ecosystem, Moving the Process Upstream, Left-Shift, Right-Shift, DevOps inDev, DevOps as Development, Deployment Pipeline, Dependency Control, Configuration Control, Configuration Audits, QA and DevOps, Information Security, Infrastructure as Code, Taming Complexity, Automate Everything, Disaster Recovery and Business Continuity, Continuous Process Improvement.

TEXT BOOKS:

1. Ian Summerville, “Software Engineering”, 8th Edition, Pearson Education, 2007.
2. BobAiello and LeslieSachs, “Agile Application Life cycle Management Using DevOps to Drive Process Improvement”, Addison Wesly, First printing, 2016.

REFERENCE BOOKS:

1. Roger S, “Software Engineering-A Practitioner’s Approach”, Seventh edition, Pressman, 2010.
2. Roger Pressman, Ian sommerville, “Software Engineering”, Pearson, 9th edition, 2010.
3. HansVanVliet, “Software Engineering: Principles and Practices”, Wiley, 2008.
4. Richard Fairley, “Software Engineering Concepts”, McGraw-Hill ,2008
5. ACM Transactions on Software Engineering and Methodology (TOSEM).
6. IEEE Transactions on Software Engineering.

JOURNALS/MAGAZINES:

1. Journal of Software Engineering Research and Development
2. International Journal of Agile and Extreme Software Development
3. A decade of agile methodologies: Towards explaining agile software development
4. Journal of Systems and Software

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/devops-core-fundamentals
2. https://www.scaledagile.com/certification/courses/safe-devops/
3. https://www.coursera.org/learn/devops-culture-and-mindset
4. https://www.coursera.org/learn/uva-darden-continous-delivery-devops

SELF-LEARNING EXERCISES

1. Case study on Critical system
2. Case study on ATM using agile method

Course Title	Cloud Computing				Course Type		HC	
Course Code	B22EF0604	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course provides a comprehensive study of Cloud concepts and capabilities across the various cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as aService (SaaS). It gives insight into various cloud infrastructure and management. It provides the various functional domain architectures.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the various Cloud computing service models like Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
2. Explain the working of cloud computing technologies like datacenter technology, web technology, multitenant technology and service technology.
3. Illustrate the use of various cloud computing mechanisms like load balancer, automated scaled listener, failover system in real world applications.
4. Categorize the cloud technology architecture formalize various functional domains within cloud.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify basic requirements related to cloud computing technologies.	1 to 5,6,8,11,12	1,3
CO2	Compare and contrast different services of cloud computing viz. Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).	1 to 5,6,11,12	1,3
CO3	Summarize the Broadband Networks and Internet Architecture used in cloud.	1 to 5,6,11,12	1, 3
CO4	Shows the working of cloud computing technologies like data center technology, virtualization technology, web technology, multitenant technology and service technology.	1 to 5,6,11,12	1
CO5	Interpret various cloud computing mechanisms like load balancer, automated scaled listener, failover system and more.	1 to 5,6,11,12	1,3
CO6	Illustrate the cloud technology architecture formalize various functional domains.	1 to 5,6,11,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√					
CO2		√				
CO3		√				
CO4			√			
CO5		√				
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2		2			2	3	3		3
CO2	3	3	3	3	2	2					2	3	3		3
CO3	3	3	3	3	2	2					2	3	3		3
CO4	3	3	3	3	2	2					2	3	3		
CO5	3	3	3	3	2	2					2	3	3		3
CO6	3	3	3	3	2	2					2	3	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Cloud Computing: Origins and Influences; Basic Concepts and Terminology; Goals and Benefits; Risks and Challenges.

Fundamental Concepts and Models: Roles and Boundaries; Cloud Characteristics; Cloud Delivery Models; Cloud Deployment Models.

UNIT – 2

Cloud Computing Technologies: Broadband Networks and Internet Architecture; Data Center Technology; Virtualization Technology; Web Technology; Multitenant Technology; Service Technology; Case study.

Cloud Infrastructure Mechanisms: Logical Network Perimeter; Virtual Server; Cloud Storage Device; Cloud Usage Monitor; Resource Replication; Ready-made environment.

UNIT – 3

Specialized Cloud Mechanisms: Automated Scaling Listener; Load Balancer; SLA Monitor;Pay-per-use Monitor; Audit Monitor; Failover System; Hypervisor; Resource cluster; Multi-device Broker; State Management.

Cloud Management Mechanisms: Remote Administration System; Resource Management System; SLA Management System; Billing Management System.

UNIT – 4

Fundamental Cloud Architectures: Workload Distribution Architecture; Resource Pooling Architecture; Dynamic Scalability Architecture; Elastic Resource Capacity Architecture; Service Load Balancing Architecture; Cloud Bursting Architecture; Elastic Disk Provisioning Architecture; Redundant Storage Architecture.

Advanced Cloud Architectures: Hypervisor Clustering Architecture; Load Balanced Virtual Server Instances Architecture; Non-Disruptive Service Relocation Architecture; Zero Downtime Architecture; Cloud Balancing Architecture; Resource Reservation Architecture; Dynamic Failure Detection and Recovery Architecture; Bare-Metal Provisioning Architecture; Rapid Provisioning Architecture; Storage Workload Management Architecture.

TEXT BOOKS: (links)

1. Thomas Erl, Ricardo Puttini, ZaighamMahmood, "Cloud Computing: Concepts, Technology& Architecture", PHI, 2019.Cloud Computing: Concepts, Technology & Architecture (pearsoncmg.com)
2. Kai Hwang, Geoffrey C. Fox, Jack J Dongarra, "Distributed and Cloud Computing", MK, 2012.
3. Dan C. Marinescu, Cloud Computing: Theory and Practice, MK
4. Michael Miller," Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", Que Publishing, August 2008.

REFERENCE BOOKS:

1. RajkumarBuyya, James Broberg, AndrzejGoscinski, "Cloud Computing- Principles and Pradigms", Wiley.
2. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing, A practical approach", TATA McGraw HILL.
3. DharanipragadaJanakiram," Grid and Cloud Computing", McGraw-Hill 2016.
4. Gautam Shroff, "Enterprise Cloud Computing- Technology, Architecture, Applications", CAMBRIDGE.

JOURNALS/MAGAZINES:

1. IEEE Transactions on Cloud Computing
2. Journal of Cloud Computing -Advances, Systems and Applications, Springer Open.
3. International Journal of Cloud Computing, INDERSCIENCE Publishers.
4. International Journal of Cloud Applications and Computing (IJCAC), IGI Global.

SWAYAM NPTEL/MOOCs:

1. Cloud Computing Course - SWAYAM
2. Google Cloud Computing Foundation Course – NPTEL
3. Introduction to Cloud Computing by IBM - Coursera

SELF-LEARNING EXERCISES:

1. https://www.vmware.com/try-vmware/try-hands-on-labs.html
2. https://www.cloudpro.co.uk/case-studies
3. https://www.ibm.com/cloud/case-studies/

Professional Elective – 4

Course Title	Bioinformatics				Course Type		SC	
Course Code	B22EFS611	Credits	3		Class		Semester VI	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	0	50%	50%

COURSE OVERVIEW:

This course introduces the basics of bioinformatics, modern genomics and the experimental tools and databases. In this course, students gain extensive knowledge and experience on sequence alignment and scoring methods. An introduction to the key concepts proteomics and biodata analysis usingBiopython are covered.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the concepts of computational biology and biological databases.
2. Illustrate the various sequence alignment methods.
3. Discuss theconcepts of genomes and the different approaches to analyze the genomes.
4. Demonstrate the significance of proteomics and analysis with Bio python.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the concepts of computational biology and biological databases.	1,2 5,6,8,12	1,2,3
CO2	Integrate sequence alignment methods to evaluate sequence similarity and homology.	1 to 5,6,8,12	1,3
CO3	Develop models of organisms and communities to predict their behavior under different environmental conditions.	1 to 5,6,8,12	1,2,3
CO4	Understand Microarray gene expression profiles.	1,2,6,8,12	1,3
CO5	Apply genome analysis, mapping and genome sequencing.	1 to 5,6,8,12	1, 3
CO6	Make use of Bio python for solving bioinformatics task.	1 to 5,6,8,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1		√				
CO2			√			
CO3		√	√			
CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			1	1		2				2	3		3
CO2	3	3	2	1	2	1		2				2	3		3
CO3	3	3	2	2	1	1		2				2	3	2	3
CO4	3	3				1		2				2	3		3
CO5	3	3	3	2	2	1		2				2	3		3
CO6	3	3	2	2	2	1		2				2	3	2	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Basics of Bioinformatics: Introduction to Bioinformatics; Bioinformatics applications; Molecular Biology and Bioinformatics; Introduction to major biological databases; Bioinformatics tools; Information Search; Information Retrieval.

UNIT – 2

Sequence Alignment: Alignment of pair of sequences; Sequence Analysis; Sequence Alignment; Methods of Sequence Alignment; Dynamic programming algorithm; Concept of scoring matrix; Global; local- Pair wise alignment; Methods of multiple sequence alignment; Evaluating multiple alignments.

UNIT – 3

Genomics and Microarray: Genomics; Understanding Genomics; Genome Analysis; Genome Mapping; Genome Annotation; Sequence assembly problem; Genome sequencing; Structural and Functional Genomics.

Microarray: Understanding of microarray data; Working with DNA Microarray; Gene Expression profiles; Data sources and tools for Microarray analysis.

UNIT – 4

Proteomics and Biopython: Proteomics; Tools and techniques in proteomics; protein protein interactions; methods of gene family identification; biomarkers; introduction; biomarker classification; biomarker discovery.

Biopython: Introduction; Control Statements; Sequences alignment; Database search using Biopython.

TEXT BOOKS:

1. S C Rastogi, N Mendiratta and P Rastogi, " Bioinformatics: Methods and Applications" , ISBN : 978-81-203-4785-4, PHI Learning Private Limited, 2015.
2. David W Mount," Bioinformatics- Sequence and Genome Analysis", second Edition, CBS Publishers, 2014.
3. Lesk, A. K., "Introduction to Bioinformatics" 4th Edition, Oxford University Press, 2013.
4. Andreas D. Baxevanis, B. F. Francis Ouellette," BIOINFORMATICS A Practical Guide to the Analysis of Genes and Proteins", 2nd Edition, Wiley Inderscience, 2001.

REFERENCE BOOKS:

1. CynthiaGibas, PerJambeck, Developing Bioinformatics Computer Skills O'Reilly MediaInca 2001.
2. David Edwards, Jason Eric Stajich, David Hansen, Bioinformatics Tools and Applications, Springer, 2009.
3. Attwood, T.K., Parry, D.J., Smith, Introduction to Bioinformatics, Pearson Education, 2005.

JOURNALS/MAGAZINES:

1. https://academic.oup.com/bioinformatics
2. BMC Bioinformatics
3. Proteins: Structure, Function and Bioinformatics
4. IEEE/ACM Transactions on Computational Biology and Bioinformatics
5. Journal of Bioinformatics and Computational Biology
6. Bentham Science- Current Bioinformatics

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_bt06/Bioinformatics: Applications and Algorithms
2. https://www.classcentral.com/course/swayam-bioinformatics-algorithms
3. https://www.coursera.org/specializations/genomic-data-science

SELF-LEARNING EXERCISES:

1. Electronic Libraries
2. Data Mining in Biological Databases
3. Gene Prediction Methods

<table>
<tr><td>Course Title</td><td colspan="4">Advances in Computer Networks</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22EFS612</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The course emphasize on introducing advanced concepts in computer networks. The course is designed for the intermediate learners having basic understanding of digital communication, network models, routing protocols, applications and services. The course introduces theoretical concepts of switched networks, high speed networks, WSN, MANETS, VANETS, optical networks,

delay tolerant networks, high speed mobile networks and also, wireless security concepts. Towards the end of the course, the students learn about QoS services, VPNs, VoIP, Multimedia networking and security concepts.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe different network models, switching, coding and spread spectrum techniques for high speed networks.
2. Illustrate the advanced architectures, routing and working principles of ATM, WSNs, MANETs, VANETs, and cyber physical systems.
3. Emphasize the importance of delay tolerant networks, 4G LTE, 5G and cognitive networks.
4. Discuss wireless security concepts, QoS services, VPNsand also, protocolslike RSVP, MPLS, SIP, RTP and RTCP.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe network architectures, routing and spread spectrum techniques used in high speed computer networks.	1 to 4, 10, 12	1
CO2	Differentiate wireless communication technologies, cellular networks, WSNs, and VANETs.	1 to 4, 10, 12	1
CO3	Identify the issues and challenges in delay tolerant networks andcompare mobile network technologies.	1 to 3, 10, 12	1
CO4	Outline QoS requirements required and employ security mechanisms for a given computer network.	1 to 4, 10, 12	1
CO5	Illustrate the latest developments in computer network architectures, protocols and applications.	1 to 3, 10, 12	1
CO6	Apply the knowledge of architectures, protocols, and services in setting up a computer network.	1 to 4, 10, 12	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1	√	√				
CO2		√		√		
CO3	√			√		
CO4			√		√	
CO5	√					
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1								2	3		
CO2	3	2	2	1								2	3		

CO3	3	3	1									3	3		
CO4	3	2	2	2								3	3		
CO5	2	2	2									2	3		
CO6	3	2	2	2								3	3		

Note: 1-Low,2-Medium,3-High

COURSE CONTENT

Unit – 1

Introduction: Introductionto digital communication, Network Models, Switched Networks, Asynchronous Transfer Mode Networks, Frame Relay, Optical Networks, Wireless Communication, Coding, Spread Spectrum Techniques, OFDM, MIMO, Traffic Models, Loss Models in Wireless Communication.

Routing Architectures and Scheduling: Router architecture, Scheduling (FCFS, WFQ)

Unit – 2

Wireless Networks: Wireless Network, Wireless Switching Technology, Wireless Communication Problems, Wireless Network Reference Model, Wireless Networking Issues, Wireless Networking Standards, WBAN Technologies (Bluetooth, ZigBee, Ultra-Wide Band), Wi-Fi, WiMAX, WWAN, Cellular Networks, GPRS, Satellite Networks.

Wireless Sensor Networks: Wireless Sensor Networks (LEACH and SPIN), Vehicular Ad Hoc Networks (VANETs), **Cyber Physical Systems and IoT Protocols:** CoAP, MQTT**,** Software Defined Networking, Network Functions Virtualization.

Unit –3

Delay Tolerant Networks: Introduction, DTN Architecture, DTN Issues and Challenges, The Bundle Layer, DTN Applications.

4G LTE Networks: Introduction, Comparison of 1G to 6G Architectures,Long-Term Evolution (LTE), LTE Architecture, Protocol Layer Architecture, LTE Advanced, 5G Networks (Network Architecture) and Cognitive Networks Overview.

Wireless Security: Introduction, Wired Equivalent Privacy.

Unit – 4

Quality of Service (QoS) and Resource Allocation: Overview of QoS,Integrated Services QoS, Differentiated ServicesQoS, Resource Allocation.

VPNs, Tunnelling and Overlay Networks: Virtual Private Networks (VPNs), Multiprotocol Label Switching (MPLS), Overlay Networks.

VoIP and Multimedia Networking: Overview of IP Telephony, SIP, RTP, RTCP.

TEXT BOOKS:

1. Dr.SunilKumar S. Manvi, Dr.Mahabaleswar S. Kakkasageri, “Wireless and Mobile Networks”, 2nd Edition, Wiley– 2016.ISBN: 978-81-265-5855-1.(Chapters 1, 2, 3, 5, 6, 7, 8, 10, 11, 12).
2. Nader F. Mir, “Computers and Communication Networks”, Pearson. ISBN: 978-81-317-1543-7.(Chapters 12,16, 18).

REFERENCE BOOKS:

1. Larry L. Peterson and Bruce S. Davie, “Computer Networks- A system Approach”, 5th Edition, Elsevier, 2012.
2. William Stallings, “Data and Computer Communications”, 10th Edition, Pearson Education, 2008.
3. James F.Kurose, Keith W. Ross, “Computer Networking”, 8th Edition, Pearson, 2010.
4. Andrew S. Tanenbaum, “Computer Networks”, 4th Edition, Pearson Education, 2005.
5. ArshdeepBhaga, Vijay Madisetti, “Internet of Things”, Universities Press, 2014.
6. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals”, Pearson, 2018.

JOURNALS/MAGAZINES

1. IEEE Transactions on Networking.
2. Elsevier Journal of Computer Networks
3. Springer Journal of communications and Information networks.
4. Dangi, R.; Lalwani, P.; Choudhary, G.; You, I.; Pau, G. Study and Investigation on 5G Technology: A Systematic Review. Sensors 2022, 22, 26. https://doi.org/10.3390/s22010026.
5. Yang Lu, Xianrong Zheng, “6G: A survey on technologies, scenarios, challenges, and the related issues”, Journal of Industrial Information Integration,Volume 19,2020,100158,ISSN 2452-414X,https://doi.org/10.1016/j.jii.2020.100158.
6. Natasha Devroye, Chapter 11 - Information theoretical limits on cognitive radio networks, Editor(s): Alexander M. Wyglinski, MaziarNekovee, Y. Thomas Hou,
7. Cognitive Radio Communications and Networks, Academic Press, 2010, Pages 307-333, ISBN 9780123747150, https://doi.org/10.1016/B978-0-12-374715-0.00011.

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/topic/computer-network/
2. https://www.coursera.org/courses?query=computer%20network
3. https://archive.nptel.ac.in/courses/106/105/106105160/
4. https://www.edx.org/learn/computer-networking

SELF-LEARNING EXERCISES:

1. IPv6, Mobile IP, IPSec, 6G
2. UAV Communication, Quantum Communication
3. IoT Architecture, IoT communication technologies

Course Title	Advanced Python Programming				Course Type		SC	
Course Code	B22EFS613	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course presents advanced topics in Python for professional programming. It covers theory only where it will enhance programming ability. The course gives a detailed overview of advanced python programming topics like, define classes, files and exception handling, pattern matching using regular expression, query databases and code graphical interfaces for applications.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe the semantics of Python programming language.
2. Illustrate the process of structuring the data using lists, dictionaries, tuples, strings and sets.
3. Illustrate the Object-oriented Programming concepts in Python.
4. Demonstrate the basic database design for storing data as part of a multi-step data gathering, analysis, and processing.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Interpret the basic principles of Python programming language	1,2,3,4,5	1,2
CO2	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python	1,2,3,4,5	1,2
CO3	Appraise Exception handling mechanism in real world scenario.	1,2,3,4,5	1,2
CO4	Identify the commonly used operations involving file systems.	1,2,3,4,5	1,2
CO5	Demonstrate the commonly used regular expressions.	1,2,3,4,5	1,2
CO6	Develop database and GUI applications	1,2,3,4,5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			

CO3					√	
CO4	√					
CO5			√			
CO6						√

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3								3	2	
CO2	2	2	2	1	3								3	2	
CO3	3	3	2	2	3								3	2	
CO4	2	1	1	3									3	2	
CO5	3	3	2	2	3								3	2	
CO6	3	2	2	2	2								3	2	

Note: 1-Low,2-Medium,3-High

COURSE CONTENT

UNIT – 1

Introduction to Python: Use IDLE to develop programs, Basic coding skills, working with data types and variables, working with numeric data, working with string data, Python functions, Boolean expressions, selection structure, iteration structure, working with lists, work with a list of lists, work with tuples, work with dates and times, get started with dictionaries

UNIT – 2

Classes in Python: OOPS Concepts, Classes and objects, Classes in Python, Constructors, Data hiding, Creating Classes, Instance Methods, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes, Iterators, generators and decorators.

UNIT – 3

I/O and Error Handling in Python: Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data From a File, Additional File Methods, Handling IO Exceptions, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Working with Directories.

UNIT – 4

An Introduction to relational databases: SQL statements for data manipulation, Using SQLite Manager to work with a database, Using Python to work with a database, Creating a GUI that handles an event, working with components.

Text book/s:

1. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016.

2. Halterman, Richard L. "Learning to program with Python" Python Software Foundation 283 (2011).

3. Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010.

Reference Books:

1. Pilgrim, Mark, and Simon Willison. Dive into python 3. Vol.2. New York, NY, USA: Apress, 2009.

2. Martelli, Alex, Anna Ravenscroft, and David Ascher, Python cookbook, "O'Reilly Media, Inc.", 2005.

3. Sneeringer, Luke, Professional Python, John Wiley & Sons, 2015.

4. Cassell, Laura, and Alan Gauld, Python projects, John Wiley & Sons, 2014.

5. Vaingast, Shai, Beginning Python visualization: crafting visual transformation scripts, Apress, 2014.

Online Resources:

1. https://www.w3schools.com/python
2. https://docs.python.org/3/tutorial/index.html
3. https://www.python-course.eu/advanced_topics.php

<table>
<tr><td>Course Title</td><td colspan="4">Edge and Fog Computing</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22EFS614</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

To realize the full potential of fog and edge computing and similar paradigms, researchers and practitioners need to address several challenges and develop suitable conceptual and technological solutions for tackling them. These include development of scalable architectures, moving from closed systems to open systems, dealing with privacy and ethical issues involved in data sensing, storage, processing, and actions, designing interaction protocols, and autonomic management.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the state-of-the-art in fog and edge computing, their applications, architectures, and technologies.

2. Analyze Internet of Things (IoT) and New Computing Paradigms with limitations.
3. Addressing the Challenges in Federating Edge Resources.
4. Identify potential research directions and technologies that willfacilitate insight generation in various domains from smart home, smart cities, science, industry, business, and consumer applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the state-of-the-art in fog and edge computing.	1 to 5	1,3
CO2	Analyze the architectures and technologies of fog and edge computing with limitations.	1 to 5	1,3
CO3	Design solutions for the limitations identified in the paradigms, technologies of fog and edge computing.	1 to 5	2, 3
CO4	Conduct Investigation on the designed solutions and validate the results.	1 to 5	2
CO5	Identify different application areas of fog and edge computing.	1 to 5	1,3
CO6	Update the skill of identifying the research problem in IoT, fog and edge computing.	1 to 5, 12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√	√		
CO3			√	√		
CO4					√	
CO5			√	√		
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1								3	3	1
CO2	3	3	3	1	1								3	3	1
CO3	3	3	3	1	1								3	3	1
CO4	3	3	3	3	2			1					3	3	2
CO5	3	3	3	3	2			1					3	3	2
CO6	3	3	3	3	2			1				3	3	3	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Internet of Things (IoT) and New Computing Paradigms: Introduction, Relevant Technologies, Hierarchy of Fog and Edge Computing, Business Models, Opportunities and Challenges, Addressing the Challenges in Federating Edge Resources, Integrating IoT, Fog and Cloud Infrastructures: System Modeling and Research Challenges.

UNIT – 2

Optimization Problems in Fog and Edge Computing: Background and related research work, The Case for Optimization in Fog Computing, Middleware for Fog and Edge Computing: Design Issues, A Lightweight Container Middleware for Edge Cloud Architectures.

UNIT – 3

Data Management in Fog Computing, Predictive Analysis to Support Fog Application Deployment, Using Machine Learning for Protecting the Security and Privacy of Internet of Things (IoT) Systems

UNIT – 4

Applications and Issues: Fog Computing Realization for Big Data Analytics, Exploiting Fog Computing in Health Monitoring, Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking, Fog Computing Model for Evolving Smart Transportation Applications.

TEXT BOOKS:

1. Buyya, Rajkumar, and SatishNarayanaSrirama, eds. Fog and edge computing: principles and paradigms. John Wiley & Sons, 2019. ISBN 9781119525066 (ePub)
2. Raj, Pethuru, Pethuru Raj, and Anupama Raman. "Handbook of Research on Cloud and Fog Computing Infrastructures for Data Science." 2018.Advances in computer and electrical engineering ISSN: 2327-039X.

REFERENCE BOOKS:

1. Tanwar, Sudeep. "Fog Data Analytics for IoT Applications Next Generation Process Model with State of the Art Technologies." 2020. eISBN: 978-981-15-6044-6.
2. Chang W, Wu J, editors. Fog/Edge Computing For Security, Privacy, and Applications. Springer International Publishing; 2021. eISBN: 978-3-030-57328-7.

JOURNALS/MAGAZINES:

1. Foundations and Trends in Machine Learning
2. IEEE Transactions on Smart Grid
3. International Journal of Information Management

SWAYAM/NPTEL/MOOCs:

1. Swayam: Cloud Computing By Prof. SoumyaKanti Ghosh, IIT Kharagpur.
2. Coursera: An Introduction to Programming the Internet of Things (IOT) Specialization, Ian Harris.

SELF-LEARNING EXERCISES:

1. Pick a research problem statement and design solution for the same.

Course Title	Augmented Reality and Virtual Reality				Course Type		SC	
Course Code	B22EFS615	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course covers basic concepts of augmented reality and virtual reality. The course also introduces the student to the working of projects in both AR &VR. The course also helps the student to understand the current state of AR &VR. Further, this course helps the student to explore the use cases of AR & VR.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic concepts in augmented reality and virtual reality.
2. Illustrate the consuming content in augmented reality and virtual reality.
3. Explore thecurrent state of augmented reality and virtual reality and its use cases.
4. Demonstrate the augmented reality and virtual reality projects.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describethe concepts in augmented reality and virtual reality.	1 to 5,9,10,12	1,3
CO2	Explain the factors, features, and the current issues with augmented reality and virtual reality.	1 to 5, 9,10,12	1,3
CO3	Illustratethe consuming content in augmented reality and virtual reality.	1 to 5, 9,10,12	1,3
CO4	Explorethecurrent state of augmented reality and virtual reality and its use cases.	1 to 5, 9,10,12	1,3
CO5	Apply the concepts of ROS Command tools and GUI tools	1 to 5, 9,10,12	1,3
CO6	Demonstratethe augmented reality and virtual reality projects.	1 to 5, 9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2				3	3		2	2		3
CO2	3	3	3	2	1				3	3		2	2		3
CO3	3	3	3	2	1				3	3		2	2		3
CO4	3	3	3	2	2				3	3		2	2		3
CO5	3	2	2	2	3				3	3		2	2		3
CO6	3	2	2	2	3				3	3		2	2		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Defining Augmented Reality and Virtual Reality: IntroducingAugmented Reality (AR) and Virtual Reality (VR), Looking at Some Other Types of AR & VR, Taking a Quick History Tour, Evaluating the Technology Hype Cycle.

Exploring the Current State ofAugmented Reality and Virtual Reality: Looking at the Available Form Factors, Focusing on Features, Considering Controllers, Recognizing the Current Issues with AR & VR.

UNIT – 2

Consuming Content inAugmented Reality and Virtual Reality: Exploring Consumer-Grade AR & VR, Identifying Near-Future Hardware, Comparing Current and Future Options, Assessing Your Project's Technology Needs, Choosing AR & VR.

UNIT – 3

Planning YourAugmented Reality and Virtual Reality Project: Defining Your AR & VR Project, Exploring Design Principles in AR & VR, Defining Your Social Experience.

Creating Content forAugmented Reality and Virtual Reality: Assessing Design Software, Capturing Real Life, Assessing Development Software, Distributing Your Content.

UNIT – 4

ExploringAugmented Reality and Virtual Reality Use Cases: Art, Education, Entertainment, Healthcare, Gaming, Aerospace, Retail, Military, Real Estate, Advertising and Marketing.

PRACTICE:

Sl. No.	Mini Project
1.	ld an Augmented Reality application for making your syllabus topics interactive and fun to learn. This could be an application providing information about particular topics or subject.
2.	ld an Augmented Reality application that can bring changes in the Education sector by enabling Augmented triggers around the Laboratory so when students scan through them, they can learn different safety procedures and protocols of the laboratory equipment.
3.	ld an Augmented Reality application that makes the teachers to have augmented their field trips and added layers of learning and interaction to the day's activity.
4.	ld an Augmented Reality application that uses face filters – a mask-like augmented reality that adds virtual objects to an individual's face during video call.
5.	ld an Augmented Reality application that uses your mobile device's camera to visualize how virtual items like furnitures, home appliances, kitchen utensils would look and fits in any given space.
6.	ld an Augmented Reality food menu application that displays virtual food consisting of multiple 3D digital rendering photographs of food on the plate.
7.	ld a Virtual Reality application for the promotion of a tourist destination of your choice. This could be an application providing information about a particular destination, providing 360-degree pictures and videos of the location. The user should be able to navigate scene-by-scene through the destination that you have built the tour for.
8.	ld a Virtual Reality application that allows prospective students, parents, or elderly person to actually see a campus without having too physically be there.
9.	ld a Virtual Reality application for athletics or the spectators by providing real-life images of what it's like to sit in certain seats during a game, to offering behind-the-scenes VR tours of pre-game and the athletics facilities, so it's easy to get people excited about the athletics.
10.	ld a Virtual Reality gaming application to play virtual Holi with colors by avoiding harmful chemicals and wastage of water.

TEXT BOOKS:

1. Paul Mealy, "Virtual & Augmented Reality For Dummies", John Wiley & Sons, First Edition, 2018.

REFERENCE BOOKS:

1. Timothy Jung and M. Claudia Tom Dieck, "Augmented Reality and Virtual Reality–Empowering Human, Place and Business", Springer, First Edition, 2018.
2. Dengzhe Ma, Jürgen Gausemeier, Xiumin Fan and Michael Grafe, "Virtual Reality & Augmented Reality in Industry", Springer,

First Edition, 2011.

JOURNALS/MAGAZINES:

1. International Journal of Virtual and Augmented Reality (IJVAR).
2. Springer, Virtual Reality.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/specializations/virtual-reality
2. https://www.coursera.org/learn/augmented-reality
3. https://www.udemy.com/course/virtual-reality/
4. https://www.udemy.com/tutorial/develop-augmented-reality-book-ar-business-card-with-unity/what-is-augmented-reality/
5. https://elearn.nptel.ac.in/shop/iit-workshops/ongoing/foundation-course-on-virtual-reality-and-augmented-reality/

SELF-LEARNING EXERCISES:

1. Google Translate
2. Amazon AR View
3. AR City
4. Ingress and Pokémon Go
5. InkHunter
6. Sketch AR

Professional Elective – 5

Course Title	Social Network Analysis				Course Type		SC	
Course Code	B22EFS621	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial				Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

Social network analysis (SNA) is the process of investigating social structures through the use of networks and graph theory. It characterizes networked structures in terms of nodes (individual actors, people, or things within the network) and the ties, edges, or links (relationships or interactions) that connect them.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. To understand the concept of semantic web and related applications.
2. To learn knowledge representation using ontology.
3. To understand human behavior in social web and related communities.
4. To learn visualization of social networks.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply semantic web related applications.	1 to 5, 12	1,2,3
CO2	Classify the knowledge using ontology.	1 to 5, 12	1,2,3
CO3	Distinguish the human behavior in social web.	1 to 5,12	1,2,3
CO4	Identify the human behavior in related communities.	1 to 5,12	1,2,3
CO5	Analyze mining communities in social networks	1 to 5,12	1,2,3
CO6	Classify the Privacy Issues in social networks	1 to 5,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			

CO2		√				
CO3				√		
CO4		√				
CO5				√		
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3							2	3		3
CO2	3	3	2	2	3							2	3		3
CO3	3	3	2	2	3							2		3	3
CO4	3	3	3	2	2							2		3	
CO5	3	2	2	2	3							2	3		3
CO6	3	2	2	2	3							2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

UNIT – 2

Modeling, Aggregating And Knowledge Representation: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modeling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

UNIT – 3

Extraction And Mining Communities In Web Social Networks: Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

UNIT – 4

Predicting Human Behaviour and Privacy Issues: Understanding and predicting human behavior for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy

in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

TEXT BOOKS:

1. Peter Mika, —Social Networks and the Semantic Web‖, First Edition, Springer 2007.
2. Borko Furht, —Handbook of Social Network Technologies and Applications‖, 1st Edition, Springer, 2010.

REFERENCE BOOKS:

1. Guandong Xu ,Yanchun Zhang and Lin Li, —Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo, —Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, —Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling‖, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, —The Social Semantic Web‖, Springer, 2009.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/6921601
2. https://ieeexplore.ieee.org/document/6921602
3. https://towardsdatascience.com/social-network-analysis-from-theory-to-applications-with-python-d12e9a34c2c7
4. https://www.sciencedirect.com/topics/social-sciences/social-network-analysis

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_cs117/preview
2. https://www.edx.org/course/social-network-analysis-sna?index=product&queryID=73f65173c331f8cf6c722d23cc516ea2&position=1

SELF-LEARNING EXERCISES:

1. Anaconda IDE
2. Spyder
3. Jupiter

Course Title	Compiler Design				Course Type		SC	
Course Code	B22EFS622	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The course deals with the basic techniques of Compiler Construction and tools that can used to perform Syntax-directed translation of a high-level programming language into an executable code. This will provide deeper insights into the more advanced semantics aspects of programming languages, code generation, machine independent optimizations, dynamic memory allocation, types and their inferences, object orientation. The course is presented to the students by using power point projections, lecture notes, subjective, objective tests, and assignments.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Illustrate the concepts of language translation and phases of compiler design.
2. Describe the steps involved in the construction of a syntax tree.
3. Discuss different types of parsers and syntax directed definition & translation.
4. Demonstrate code optimization and code generation for a given source code.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the concepts and different phases of compilation.	1,2,3,4,5,8,9,10, 12	1,2
CO2	Identify the tokens using regular expressions, context free grammar and finiteautomata and design lexical analyzer for a language.	1,2,3,4,5,8,9,10, 12	1,2
CO3	Compare top down with bottom up parsers, and develop an appropriate parser to produce parse tree representation.	1,2,3,4,5,8,9,10, 12	1,2
CO4	Illustrate intermediate code for statements in high level language.	1,2,3,4,5,8,9,10, 12	1,2
CO5	Apply syntax directed translation schemes for a given context free grammar.	1,2,3,4,5,8,9,10, 12	1,2
CO6	Design optimization techniques to intermediate code and generate machine code for highlevel language program.	1,2,3,4,5,8,9,10, 12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	-	-	3	3	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	2	3	2
CO3	3	3	2	2	2	-	-	-	3	-	-	3	3	3	2
CO4	3	3	2	2	3	-	-	-	3	-	-	3	2	3	3
CO5	3	3	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	3	3	2	2	3	-	-	-	3	-	-	3	1	2	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit- 1

Introduction to Computer Systems: Introduction: Language processors, Language processing system (cousins of compiler); Analysis of source program: The phases of compiler, grouping of phases;Compiler construction tools.

Lexical Analysis : The role of lexical analyzer, lexical analysis vs. parsing, tokens, patterns, lexemes, attributes for tokens; Input Buffering; Specification of tokens; Recognition of tokens and construction of lexical analyzer.

Unit -2

Syntax analysis 1: Introduction, Context-free grammars, Derivations, Sentence, Ambiguous grammars.

Parsing: The Role of parser: Parsing techniques, Error recovery strategies. Top-down parsing:Recursive descent parser, Recursive descent parserwith backtracking, Left recursion, left factoring, Recursive descent parserwith no-backtracking(predictive parsers); LL(1) grammars, Error recovery in predictive parsing;

Bottom-up parsing: Definition of bottom up parsing, handles, handle pruning, stack Implementation of shift-reduce parsing, conflicts during shift-reduce parsing;

Unit- 3

Syntax Analysis 2:

LR parsers-LR grammars, Simple LR(SLR), Canonical LR(CLR) and Look Ahead LR (LALR) parsers, error recovery in parsing, parsing ambiguous grammars;

Syntax Directed Translation: Synthesized attribute, Inherited attribute, Syntax-directed definitions; Evaluation orders for SDDs; Applications of syntax-directed translation; Parser stack implementation of Postfix SDT;

Unit- 4

Intermediate code generation: Intermediate forms of source programs– abstract syntax tree, polish notation and three address code, types of three address statements and its implementation, syntax directed translation into three-address code, translation of simple statements, Boolean expressions flow-of-control statements.

Code optimization and generation: Basic blocks and Flow graphs; Optimization of basic blocks; Variants of syntax trees; Three-address code; Control flow; back patching;

TEXT BOOKS:

1. Alfred V. Aho, Monica S. Lam,Ravi Sethi, Jeffrey D. Ullman Compilers Principles, Techniques and Tools, Second Edition, Pearson, 2007.
2. Compiler Design, K. Muneeswaran., Oxford University Press, 2012.

REFERENCE BOOKS:

1. Compiler Construction, K.V.N Sunitha, Pearson, 2013
2. Engineering a Compiler, Second Edition, Keith D. Cooper & Linda Torczon., Morgan Kaufmann, Elsevier.
3. Compilers Principles and Practice, Parag H. Dave, Himanshu B. Dave., Pearson.
4. Compiler Design, Sandeep Saxena, Rajkumar Singh Rathore., S.Chand publications.
5. Compiler Design, Santanu Chattopadhyay.
6. Principles of Compiler Design, Nadhni Prasad, Elsevier.

JOURNALS/MAGAZINES:

1. https://www.researchgate.net/publication/351762702_An_Overview_of_Compiler_Construction
2. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9765328
3. https://ieeexplore.ieee.org/document/9352525
4. https://dl.acm.org/doi/10.1109/CGO51591.2021.9370308
5. https://compilers.cs.uni-saarland.de/publications.php

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106105190
2. https://www.classcentral.com/course/swayam-compiler-design-12926
3. https://courses.grainger.illinois.edu/cs426/fa2021/
4. https://www.coursera.org/lecture/nand2tetris2/unit-4-10-perspective-XLbb9

SELF-LEARNING EXERCISES:

More Recent Applications: Translating regular expressions into finite state automata; survey of latest compilers for dealing with parallel programming.

Course Title	Block Chain Technology and Applications				Course Type		SC	
Course Code	B22EFS623	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

Course Overview:

This course covers the technical aspects of public distributed ledgers, blockchain systems, cryptocurrencies, and smart contracts. Students will learn how these systems are built, how to interact with them, how to design and build secure distributed applications.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of Blockchain.
2. Illustrate the knowledge about technologies of Blockchain.
3. Understand the concepts of cryptocurrency.
4. Discuss the applications of Blockchain.

COURSE OUTCOMES

CO#	Course Outcomes	POs	PSOs
CO1	Understand the Advantage of blockchain over conventional distributed database.	1to5,7	1 to 3
CO2	Illustrate working of blockchain including private and public platform.	1to5,7	1 to 3
CO3	Make useof blockchain concepts to analyse examples, proposals, case studies, and other preliminary discussions in blockchain system design.	1 to 5, 7,8	1,2
CO4	Understand cryptocurrency and associated peer to peer network.	1 to 6,8	1,2
CO5	Apply the concepts, tools, and frameworks for building blockchainin decentralized applications.	1 to 6, 8	1 to 3
CO6	Analyze secure smart contract applications using blockchain.	1 to 5, 7,8	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4		√				
CO5			√			
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1		1						2	2	
CO2	3	3	2	2	1		2						3	2	1
CO3	3	3	1	1	1		1	2					3	1	
CO4	3	3	3	1	2	1		1					3	1	
CO5	3	1	2	1	3	1		2					2	1	1
CO6	3	1	2	1	3		1	1					1	1	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

UNIT – 2

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate

UNIT – 3

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin. Cryptocurrency Regulation Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy.

UNIT – 4

Blockchain Applications: Advantages of integrating Blockchain to IoT, Trust Building, Cost Reduction, Accelerate Data Exchanges, Scaled Security for IoT, Medical Record Management System, Domain Name Service and future of Blockchain.

TEXT BOOKS:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. William Magnuson, "Blockchain Democracy- Technology, Law and the Rule of the Crowd", Cambridge University Press, 2020.

REFERENCE BOOKS:

1. Chandramouli Subramanian, "Blockchain Technology", Universities Press, 2020.
2. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies.
3. Wattenhofer, The Science of the Blockchain.
4. Pethuru Raj, Kavita Saini, ChellammalSurianarayanan, "Blockchain Technology and Applications", CRC Press, 2021.

JOURNALS/MAGAZINES:

https://www.sciencedirect.com/science/article/pii/S0736585318306324

SWAYAM/NPTEL/MOOCs:

https://nptel.ac.in/courses/106104220

Self Learning:

https://www.frontiersin.org/articles/10.3389/fbloc.2019.00016/full

<table>
<tr><td>Course Title</td><td colspan="3">High Performance and Quantum Computing</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22EFS624</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td></td><td></td><td></td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

High Performance Computing (HPC) refers to high speed computation, which may be provided via a supercomputer or via parallel processing techniques such as leveraging clusters of computers to aggregate computing power. HPC is well-suited for applications that require high performance data computation and analysis such as high frequency trading, autonomous vehicles, genomics-based personalized medicine, computer-aided design, deep learning, and more. Quantum computing relies upon quantum theory, which deals with physical phenomena at the nano-scale. Quantum computation captured the imagination of computer scientists

with the discovery of efficient quantum algorithms for factoring and fast algorithm for search. The aim of quantum computing is to do computation using the quantum mechanical effects.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the features of Modern processors and parallel computers.
2. Describe different levels of parallelism along with the synchronization and scheduling.
3. Demonstrate the use of features of OpenMP programming.
4. Make the use of features of Open MPI programming.
5. Evaluate the program assignment on open MPI using parallel programming
6. Illustrate the CUDA programmingto solve problems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify different levels of parallelism that can be applied to solve the given real-world problems.	1 to 5	1,3
CO2	Develop the programs using different levels of parallelism to solve the real-world problems.	1 to 5	2,3
CO3	Make use of features of OpenMP to develop parallel programs for solving real world problems.	1 to 5	2, 3
CO4	Apply the features of Distributed-memory parallel programming with openMPI for solving real world problems.	1 to 5	2,3
CO5	Make use of understand the program assignment on matrix multiplication or sparse matrix using parallel programming	1 to 5,6	2,3
CO6	Develop to write CUDA programs to solve problems.	1 to 5, 6	1,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√	√		
CO6			√	√		

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2								3	3	3

CO2	3	3	2	2	3								3	3	3
CO3	3	3	1	3	3								3	3	3
CO4	3	3	3	2	3								3	3	3
CO5	3	2	2	1	3								3	3	3
CO6	3	2	2	2	3								3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Modern Processors: Stored-program computer architect; Memory hierarchies; Multicore processors; multi-threaded processors; Vector processors.

Parallel computers: Taxonomy of parallel computing paradigms; Shared-memory computers; Distributed-memory computers; Hierarchical (hybrid) systems; Networks.

UNIT – 2

Quantum computing: Introduction of the quantum computing, Quantum Measurements, Basic architecture.

UNIT – 3

Shared-memory parallel programming with OpenMP: Introduction to OpenMP; Advanced OpenMP and Wavefront parallelization.

UNIT – 4

Distributed-memory parallel programming with MPI: Message passing; A short introduction to MPI, Synchronization, serialization, contention.

Text Books

1. An Introduction to Parallel Programming, Peter S Pacheco, Elsevier, 2011
2. Programming Massively Parallel Processors, Kirk & Hwu, Elsevier, 2012
3. High Performance Cluster Computing, Volume 1, Architecture and Systems, Rajkumar Buyya, Pearson Education.

Reference Books

1. High Performance Heterogeneous Computing, Jack Dongarra, Alexey & Lastovetsky, Wiley
2. Parallel computing theory and practice, Michel J.Quinn, TMH
3. Berman, Fox and Hey, Grid Computing – Making the Global Infrastructure a Reality, Wiley India.
4. Hurwitz, Bllor, Kaufman, Halper, Cloud Computing for Dummies, Wiley India.
5. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.

a. Silberschatz, P. B. Galvin, G. Gagne, Operating System Concepts, John Wiley.

6. R. E. Bryant and D. R. O'Hallaron, Computer Systems: A Programmer's Perspective, Prentice Hall.
7. CUDA by example: An introduction to General Purpose GPU Programming, Jason, Sanders, Edward Kandrit, Perason, 2011
8. CUDA Programming, Shame Cook, Elsevier

SWAYAM/NPTEL/MOOCs

1. https://onlinecourses.nptel.ac.in/noc19_cy31/preview
2. https://www.edx.org/course/quantum-mechanics-and-quantum-computation
3. https://onlinecourses.nptel.ac.in/noc20_me61/preview
4. https://www.coursera.org/learn/introduction-high-performance-computing
5. https://www.coursera.org/lecture/introduction-high-performance-computing/course-overview-EHeuJ
6. https://www.ncbi.nlm.nih.gov/books/NBK538701/
7. https://www.youtube.com/watch?v=LmuYsMXwibY

SELF-LEARNINGEXERCISES

1. https://www.udacity.com/course/high-performance-computing--ud281 Streams
2. https://www.youtube.com/watch?v=M2o4tzCEAek
3. https://www.youtube.com/watch?v=6hcK6bahQBc
4. https://www.youtube.com/watch?v=fkpofukvGeg
5. https://www.youtube.com/watch?v=uI02dn7PsHI
6. https://www.youtube.com/watch?v=-fttE1SzpD8
7. https://www.youtube.com/watch?v=LmuYsMXwibY
8. https://www.youtube.com/watch?v=G_Uk0t0tte0

Course Title	Soft Computing				Course Type		SC	
Course Code	B22EFS625	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

Soft computing techniques are becoming even more popular and particularly amenable to model the complex behaviors of most geotechnical engineering systems since they have demonstrated superior predictive capacity, compared to the traditional methods. This course presents an overview of some soft computing techniques as well as their applications in underground excavations.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the fundamental concepts and Definition involved in Soft computing techniques.
2. Understand the basic ideas of fuzzy logic, fuzzy sets, fuzzy relations, and fuzzy reasoning, and demonstrate how they may be applied to real time problems.
3. Identify essential tools in machine learning that have drawn increasing attention in neuroscience
4. Implement the elementary searching techniques in solving the real time problem.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the Soft computing techniques such as fuzzy logic, genetic algorithms, artificial neural networks, machine learning, and expert systems.	1-5	1-3
CO2	Perform current state of soft computing techniques and describes the advantages and disadvantages of soft computing compared to traditional hard computing techniques.	1-5	1-3
CO3	Understand the guiding principle of soft computing is to exploit the tolerance for imprecision, uncertainty, and partial truth to achieve tractability, robustness, low solution cost, better rapport with reality.	1-5	1-3
CO4	Apply the knowledge gained from the soft computing techniques to solve real time problem.	1-5	1-3
CO5	Design a framework with low-cost and very high performance digital processors memory chips.	1-5	1-3
CO6	Make use of soft computingtechniques being used successfully in many domestic, commercial, and industrial applications.	1-5	1-3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1		√				
CO2		√				
CO3		√				
CO4			√	√	√	√
CO5			√	√	√	√
CO6				√	√	√

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3								3	3	3
CO2	3	3	3	3	3								2	2	2
CO3	3	3	3	2	2								2	3	3
CO4	3	3	3	3	3								3	3	3
CO5	3	3	3	2	3								3	3	3
CO6	3	3	3	2	3								3	3	3

Note: 1-Low, 2-Medium, 3-High

Unit-1:

Introduction to Soft Computing: What is Soft Computing?,Fuzzy Systems, Rough Sets, Artificial Neural Networks, Evolutionary Search Strategies; **Fuzzy Sets**: Crisp Sets: Basic Concepts, Operations on Sets, Properties of Sets; Fuzzy Sets: Fuzziness/Vagueness/Inexactness, Set Membership, Fuzzy Sets, Fuzzyness vs. Probability, Features of Fuzzy Sets; Fuzzy Membership Functions: Some Popular Fuzzy Membership Functions, Transformations, Linguistic Variables, Operations on Fuzzy Sets; Fuzzy Relations: Crisp Relations, Fuzzy Relations, Operations on Fuzzy Relations; Fuzzy Extension Principle: Preliminaries, The Extension Principle;

Unit-2:

Fuzzy Logic:Crisp Logic: Propositional Logic, Predicate Logic, Rules of Inference; Fuzzy Logic Basics: Fuzzy Truth Values; Fuzzy Truth in Terms of Fuzzy Sets; Fuzzy Rules: Fuzzy If-Then, Fuzzy If-Then-Else, Fuzzy Reasoning, Fuzzy Quantifiers, Generalized Modus Ponens, Generalized Modus Tollens;**Fuzzy Inference Systems:**Introduction:Fuzzification of the Input Variables; Application of Fuzzy Operators on the Antecedent Parts of the Rules; Evaluation of the Fuzzy Rules; Aggregation of Output Fuzzy Sets Across the Rules; Defuzzification of the Resultant Aggregate Fuzzy Set: Centroid Method, Centre-of-Sums (CoS) Method, Mean-of-Maxima (MoM) Method; Fuzzy Controllers: Fuzzy Air Conditioner Controller;

Unit-3:

Artificial Neural Networks: Basic Concepts: Introduction: The Biological Neuron, The Artificial Neuron, Characteristics of the Brain; Computation in Terms of Patterns:Pattern Classification, Pattern Association; The McCulloch–Pitts Neural Model; The Perceptron: The Structure, Linear Separability, The XOR Problem; Neural Network Architectures: Single Layer Feed Forward ANNs, Multilayer Feed Forward ANNs, Competitive Network, Recurrent Networks; Activation Functions: Identity Function, Step Function;

Unit-4:

Elementary Search Techniques: State Spaces; State Space Search: Basic Graph Search Algorithm, Informed and Uninformed Search; Exhaustive Search: Breadth-first Search (BFS), Depth-first Search (DFS), Comparison Between BFS and DFS, Depth-first Iterative Deepening, Bidirectional Search, Comparison of Basic Uninformed Search Strategies; Heuristic Search: Best-first Search, Generalized State Space Search, Hill Climbing, The A/A* Algorithms, Problem Reduction, Means-ends Analysis, Mini-Max Search, Constraint Satisfaction, Measures of Search; Production Systems;

Text Book:

1. SAMIR; CHAKRABORTY ROY (UDIT.). (2013). SOFT COMPUTING: Neuro-fuzzy and Genetic Algorithms; neuro-fuzzy and Genetic Algorithms. Pearson.

Reference Book:

1. Ray, K. S. (2014). *Soft Computing and Its Applications, Volume One: A Unified Engineering Concept* (Vol. 1). CRC Press.

JOURNALS/MAGAZINES:

1. IEEE Pattern recognition and machine learning
2. ACM International Journal of Pattern Recognition and Artificial Intelligence
3. Elesevier Pattern Recognition

SELF-LEARNING EXERCISES:

1. Pick a research problem statement and design solution for the same.

Course Title	Cryptography and Network Security Lab				Course Type		HC	
Course Code	B22EF0605	Credits	1		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE DESCRIPTION:

This laboratory course supplements the material taught in the theory course Cryptography and Network Security. The objective of this lab is to get hands-on experience in Computer Networks, Cryptography and Network Security concepts using simulation tools Viz.Wireshark, Nmap, SNIFF, SNORT, JCRYPT, etc.. Laboratory exercises will normally be conducted on UNIX Operating system. The students will be exposed to simulating and analyzing concepts.

COURSE OBJECTIVE (S):

1. To understand basics of Cryptography and Network Security.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of data.
4. To understand various protocols for network security to protect against the threats in the networks.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	y the cryptographic algorithms for data communication.	1- 4 ,9- 12	1,2,3
CO2	pare the performance of various security algorithms.	1-4,6,9-12	1,2
CO3	y the Digital signature for secure data transmission.	1-6,	1,2,3
CO4	ulate the message digest of a text using the SHA-1algorithm.	1-6	1,2,3
CO5	ze the different open source tools for network security and analysis.	1-6,	1,2,3
CO6	onstrate intrusion detection system using network security tool.	1-6	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2				✓		

CO3			✓			
CO4				✓		
CO5			✓			
CO6				✓		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2		2	2	2		3	3		
CO2	3	3	3	3	2	3		2	2	2		3		3	
CO3	3	3	3	3	2	3		3	2	2		3		3	3
CO4	3	3	2	3	3	3		3	3	2		3		3	3
CO5	3	3	2	1	3	3		2	2	1		3	3	3	
CO6	3	3	3	3	2	3		2	2	2		3		3	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

Part A	
Sl No	**Topic**
1	Write a Java program to perform encryption and decryptionusing the following algorithms a) Ceaser Cipher b) Substitution Cipher c) Hill Cipher
2	Write a program to implement the DES algorithm logic
3	Write a program to implement RSA Algorithm
4	Implement the Diffie-Hellman Key Exchange mechanismusing HTML and JavaScript. Consider the end user as one ofthe parties (Alice) and the JavaScript application as other party (bob).
5	Calculate the message digest of a text using the SHA-1 algorithm.
Part B	
1	Performa an experiment to demonstrate how to Sniff for Router traffic by using the tool Wireshark.
2	Perform a Wireless Audit of an Access Point / Router and Decrypt Wep and Wpa.
3	Perform an axperiment to Sniff Traffic using Arp Poisoning.
4	Install Jcrypt Tool (Or Any Other Equivalent) and demonstrate Asymmetric, Symmetric Crypto Algorithm, Hash and Digital/Pki Signatures.
5	Demonstrate Intrusion Detection System (Ids) using any tool. Eg. Snort or any other S/W.

NOTE: A STUDENT MUST EXECUTE ONE EXPERIMENT FROM EACH PART IN THE EXAM.

VI. ADDITIONAL EXPERIMENTS:

1. Write a program to implement the BlowFish algorithm logic
2. Write a program to implement the Rijndael algorithm logic.
3. Calculate the message digest of a text using the MD5 algorithm.
4. Perform an experiment to grab a banner with Telnet and perform the task using Netcat Utility.
5. Perform an experiment for Port Scanning with Nmap, Superscan or any other Software.
6. Using Nmap 1) Find Open Ports on a System 2) Find the machines which are Active 3) Find The version of Remote OS on other Systems 4) Find the version of S/W installed on other System.
7. Perform an experiment on Active and Passive Fingerprinting using Xprobe2 and Nmap.

Course Title	Web Technology Lab				Course Type		HC	
Course Code	B22EF0606	Credits	1		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

COURSE DESCRIPTION:

The basics of Web application tools such as HTML, XHTML and CSS are introduced. The course also provides knowledge about advanced research topics such as XML, Perl PHP and Angular JS, Java Scripts.

COURSE OBJECTIVE (S):

1. Build dynamic web pages with the help of various HTML tags and perform validation using Java Script objects by applying different event handling mechanisms.
2. Comprehend the importance of CSS in designing a creative and dynamic website and embedding Java Script code in HTML.
3. Understand and be able to develop JavaScript code to access the DOM structure of web document and object properties.
4. Develop dynamic web pages with usage of server-side scripting.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of HTML tags and CSS to build web pages for various applications.	1- 4 ,9- 12	1,2,3
CO2	Demonstrate the usage of form data to validate the correctness of given input.	1-4,6,9-12	1,2
CO3	Build the variety of presentation effects in HTML documents, including explicit positioning of elements using CSS.	1-6,	1,2,3
CO4	Develop a well formed HTML document to create Interactive webpage by the use of JavaScript.	1-6	1,2,3
CO5	Apply the concepts of server side technologies for dynamic web applications.	1-6,	1,2,3
CO6	Utilize the concept of ReactJS for creation of reusable UI Components	1-6	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			

CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1					3	1	1	3	1	1	1
CO2	3	3	3	2		1			3	1	2	3	2	2	
CO3	3	3	2	2	1	2							2	2	1
CO4	2	3	2	3	1	1							2	2	1
CO5	3	3	2	2	1	1							2	2	1
CO6	2	3	2	3	1	1							2	2	1

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	Write JavaScript to validate the following fields of the Registration page. **1. First Name** (Name should contains alphabets and the length should not be less than 6 characters). **2. Password** (Password should not be less than 6 characters length). **3. E-mail id** (should not contain any invalid and must follow the standard pattern name@domain.com) **4. Mobile Number** (Phone number should contain 10 digits only). **5. Last Name and Address** (should not be Empty).	Web browser &any editor	Event handling capabilities of Java script
2.	Write a JavaScript code that displays text **"TEXT-GROWING"** with increasing font size in the interval of 100ms in RED COLOR, when the font size reaches 50pt it displays **"TEXT-SHRINKING"** in BLUE color. Then the font size decreases to 5pt.	Web browser & any editor	Event handling capabilities of Java script
3.	Write an HTML page that contains a selection box with a list of 5 countries. When the user selects a country, its capital should be printed next to the list. Add CSS to customize the properties of the font of the capital (color, bold and font size).	Web browser & any editor	Implementation of HTML Basics
4.	Write an HTML page that has one input, which can take multi line text and a submit button. Once the user clicks the submit button, it should show the number of characters, words and lines in the text entered using an alert message. Words are separated with white space and lines are separated with new line character.	Web browser & any editor	Implementation of HTML Basics

5.	elop and demonstrate JavaScript with POP-UP boxes and functions for the following problems: **nput:** Click on Display Date button using onclick( ) function Output: Display date in the textbox. **nput:** A number n obtained using prompt Output: Factorial of n number using alert. **nput:** A number n obtained using prompt Output: A multiplication table of numbers from 1 to 10 of n using alert d) Input: A number n obtained using prompt and add another number using confirm **Output:** Sum of the entire n numbers using alert.	Web browser & any editor	
6.	elop and demonstrate the usage of inline, internal and external style sheet using CSS	Veb browser & any editor	Implementation of CSS
7.	te a program Develop and demonstrate, using JavaScript script, a XHTML document that contains three short paragraphs of text, stacked on top of each other, with only enough of each showing so that the mouse cursor can be placed over some part of them. When the cursor is placed over the exposed part of any paragraph, it should rise to the top to become completely visible. Modify the above document so that when a paragraph is moved from the top stacking position, it returns to its original position rather than to the bottom	Veb browser & any editor	Concepts of XHTML with Javascripts
8.	Write a XHTML Program using Java script to create a web page with images where these images navigate between images using: a. click/arrow button b. automation c. Text/Image	Veb browser & any editor	Concepts of XHTML with Javascripts
9	te a XHTML Program using Java script to create multiple line of content. Use various buttons to a. Adding new content b. Replacing the existing content c. Deleting the Content	Veb browser & any editor	Concepts of XHTML with Javascripts
10	monstrate how to create components in ReactJS 1. React functional components 2. React class-based component	Creating React Application And Installing Module	troduction to Virtual DOM

Course Title	**Cloud Computing Lab**				**Course Type**		**HC**	
Course Code	**B22EF0607**	**Credits**	**1**		**Class**		**VI Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture							
	Tutorial	1	2	2	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**1**	**2**	**2**	**-**	**28**	**25**	**25**

COURSE OVERVIEW:

Cloud Computing is emerging rapidly as the new computing paradigm of the coming decade. The Cloud Computing Lab will provide the students with access to virtual machines running various operating systems and applications. At present the cloud

computing is focusing on areas like Resource allocation in clouds, Cloud Security, Big Data Analytics, Software Defined Networks, Cloud Storage and Cloud for Telecom sector.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. To provide hands on experience to create a Virtual Machine platform.
2. To simulate the Cloud Environment for different entity configuration using cloudsim.
3. Ability to understand the Hadoop framework for bigdata computation.
4. To demonstrate the installation of OpenNebula and kubernates cluster.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the creation of virtual environment and perform the communication between the physical and virtual machine.	1,2,5	1,2
CO2	Make use of Cloudsim to build a Cloud Computing platform for different entity configurations.	1,2,3,5	1,2
CO3	Illustrate the MapReduce programs on Hadoop and analyze the results for different workloads.	1,2,3,5	1,2
CO4	Demonstrate the installation of OpenNebula Cloud platform.	1,2,3,5	1,2
CO5	Analyze the creation of kubernates cluster forcontainerized applications.	1,2,3,5	1,2
CO6	Compare and contrast different cloud platforms with case-studies.	1,2,3,5	1,2

BLOOM'S LEVEL OF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	1	3								3		1
CO2	3	1	3	1	3								3		3

CO3	3	2	3	1	3				2			2	3		3
CO4	3	1	2	1	2								3		1
CO5	3	2	3	1	3								3		3
CO6	3	1	3	1	3				3	2		3	3	1	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No		Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	1.	monstrate on the Virtual Environment on hypervisor. Communication between the VM's. The backup and restore mechanism.	Windows/Linux OS, hypervisor, vSphere Client	Understanding to create virtual machine, communication between Physical and Virtual Machine
	2.	Demonstrate the mechanism of cloning and create a switch with multiple networks having the different VM's.	Windows/Linux OS, hypervisor, vSphere Client	Creating multiple Virtual machines with multiple networks.
	3.	monstrates how to simulate a Data Center with one host and run one Cloudlet on it using Cloudsim.	Windows/Linux OS, IDE, Cloudsim	Understand Cloudsim and build a network with different entity configuration
4.		monstrates how to create a datacenter with one host, two virtual machines and run two cloudlets on it. Both virtual machine (vm1, vm2) has same machine configuration.	Windows/Linux OS, IDE, Cloudsim	Understand Cloudsim and build a network with different entity configuration
5.		monstrates how to create a datacenter with two hosts, two virtual machines and run two cloudlets on it. The cloudlets run in VMs with different MIPS requirements. The second VM will have twice the priority of virtual machine one (VM1) and so cloudlet will receive twice CPU time to complete the execution.	Windows/Linux OS, IDE, Cloudsim	Understand Cloudsim and build a network with different entity configuration
6.		Demonstrate how to create two datacenters with one host each and run two cloudlets on them.	Windows/Linux OS, IDE, Cloudsim	Understand Cloudsim and build a network with different entity configuration.
7.		Implement and Evaluate the performance of MapReduce program on word count for different file size.	Windows/Linux OS, IDE, Cloudera	Understand Map Reduce concept
8.		Implement and Evaluate the performance of MapReduce program on character count for different file size.	Windows/Linux OS, IDE, Cloudera	Understand Map Reduce concept

9.	e Front-end is the central part of an OpenNebula installation and is the very first thing that needs to be deployed. Typically it's a host where the OpenNebula server-side components are installed and which is responsible for the management of an entire virtualization stack. It can be a physical host or a virtual machine. Demonstrate the installation of OpenNebula cloud Computing and host the Virtual Machines.	Linux OS	Understand installation of Open Source Cloud Computing Platform.
10.	Demonstrate the step by step installing and deploying of the kubernates cluster.	Linux OS	Understand installation process.

Additional Lab Programs

Further exploring of following programs to be discussed:

1. Understanding and Creation of AWS EC2 VMs
2. Web Server, Firewall Access and Monitoring Cloud Usage in AWS Cloud Computing
3. Virtual Private Cloud in AWS
4. AWS Simple Notification Service {SNS)
5. Installing Docker Engine on EC2 Instance
6. Work Queues in Docker
7. Setting-Up Jenkins in Docker
8. Configuring AWS EMR Cluster
9. Configuring AWS Lambda
10. Exploring Users and Groups in Identity and Access Management (IAM) service in AWS Cloud Computing

Course Title	Mini Project (Research Based)				Course Type		HC	
Course Code	B22EF0608	Credits	2		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Practical	2	4	4				
	Total	2	4	4	-	56	50%	50%

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3

CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-2:

Students will be offered training and certifications on the trending technologies from the industry experts.

The students are evaluated and certified after the training programs.

4th Year Syllabus

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE /MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22XXO71X	Open Elective - 3	OE	3	0	0	3	3	50	50	100	POE
2	B22XXO72X	Open Elective - 4 (MOOC)	OE	3	0	0	3	3	50	50	100	POE
3	B22EF0701	Computer Vision	HC	3	0	0	3	3	50	50	100	PCC
4	B22EF0702	Skill Development Course - 4 (MOOC)	SDC	1	0	1	2	3	50	50	100	SDC
5	B22EF0703	Internship	HC	0	0	2	2	4	50	50	100	PCC
6	B22EF0704/5	Project – Phase 1 / Start-up	HC	0	0	3	3	6	50	50	100	PCC
Total				**10**	**0**	**6**	**16**	**22**	**300**	**300**	**600**	
TOTAL SEMESTER CREDITS				**16**								
TOTAL CUMULATIVE CREDITS				**156**								
TOTAL CONTACT HOURS				**22**								
TOTAL MARKS				**600**								

Open Elective – III

Course Title	Java Programming				Course Type		POE	
Course Code	B22EFO711	Credits	3		Class		VII Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course provides the fundamentals of Java programming language which is an object oriented language through which the students shall be able to understand and apply the knowledge of Java programming in solving the real world problems. The students shall also acquire the skills throughout and enhance their problem solving ability.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Impart fundamentals of Java programming language
2. Illustrate the concept of inheritance and Polymorphism to reuse code

3. Introduce the implementation of packages and interfaces and handle exceptions
4. Inculcate the concepts of Multithreading and Collection.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify object oriented programming features and concepts in solving the given problem.	1 to 5,9,10,12	1,2,3
CO2	Make use of concepts of inheritance and polymorphism to improve the code reusability.	1 to 5, 9,10,12	1,2,3
CO3	Develop application usingpackages and interfaces in solving complex problems.	1 to 5, 9,10,12	1,2,3
CO4	Apply the knowledge of Collections to process collective information.	1 to 5, 9 to 12	1,2,3
CO5	Implement exception handling to develop effective application.	1 to 5, 9 to 12	1,2,3
CO6	Develop java-based applications using multithreading.	1 to 5, 9 to 12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3				3	1		3	3	3	3
CO2	3	2	3	1	3				3	1		3	3	3	3
CO3	3	2	3	2	3				3	2		3	3	3	3
CO4	3	2	3	2	3				3	2	1	3	3	3	3
CO5	3	2	3	2	3				3	2	1	3	3	3	3
CO6	3	2	3	2	3				3	3	2	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

JAVA FUNDAMENTALS: Java programming: History of java, Java Programming environment, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions,control flow statements, simple java stand alone programs, arrays, console input and output,Introducing classes, Methods and Constructors.

Unit-2

INHERITANCE, POLYMORPHISM: Basic concepts, Types of inheritance, Member access rules, Usage of this and Super key word Polymorphism: Method Overloading, Method overriding, Abstract classes, Dynamic method dispatch, Usage of final keyword.

Unit-3

PACKAGES, INTERFACES& EXCEPTION HANDLING

PACKAGES AND INTERFACES: Defining package, Access protection, importing packages, Defining and Implementing interfaces, and Extending interfaces.

Exception Handling: Fundamentals of exception handling, Exception types, Termination or resumptive models, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception sub classes.

Unit-4

THE COLLECTIONS & MULTITHREADING:

Collections: Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque: Accessing a Collection via an Iterator, Using an Iterator.

Multithreading: Thread life cycle, creating threads, thread synchronization.

TEXT BOOKS:

1. Herbert Schildt, “Java™: The Complete Reference”, McGraw-Hill, Twelfth Edition, 2021.
2. Understanding OOP with Java, updated edition, T.Budd, Pearson education.

REFERENCE BOOKS:

1. Kathy Sierra and Bert Bates Head First Java, O reilly, 2nd Edition, 2020.
2. Cay S. Horstmann, “Core Java™ Volume I—Fundamentals”, Prentice Hall, Tenth Edition, 2015.
3. Joshua Bloch, “Effective Java”, Addison-WesleyProfessional, Third Edition, 2017.
4. David Gallardo, Ed Burnette, Robert Mcgovern,“Eclipse in Action a guide for java developers”, Manning Publications, 2003.
5. Ed Burnette, “Eclipse IDE Pocket Guide: Using the Full-Featured IDE”, O'Reilly Media, Inc, USA, 2005.
6. Ken Kousen, “Modern Java Recipes”, O'Reilly Media, Inc.,2017.
7. Oracle Java Documentation. (https://docs.oracle.com/javase/tutorial/)

JOURNALS/MAGAZINES:

1. https://www.javadevjournal.com/
2. https://blogs.oracle.com/javamagazine/
3. https://ieeexplore.ieee.org/document/5464387
4. https://files.eric.ed.gov/fulltext/EJ1075126.pdf

5. https://www.sciencedirect.com/science/article/pii/S0167642304000590
6. https://www.informingscience.org/Publications/4322?Source=%2FJournals%2FJITEIIP%2FArticles%3FVolume%3D0-0

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
2. https://www.classcentral.com/course/swayam-programming-in-java-12930
3. https://swayam.gov.in/explorer?searchText=java

SELF-LEARNING EXERCISES:

1. The Eclipse-IDE
2. Streams
3. AWT and Swing
4. JavaFX
5. Networking- JDBC

<table>
<tr><td>Course Title</td><td colspan="3">Networking Fundamentals</td><td colspan="2">Course Type</td><td colspan="2">POE</td></tr>
<tr><td>Course Code</td><td>B22EFO712</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The main emphasis of this course is on the organization and management of local area networks (LANs). Thecourse description includes learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and about Open Systems Interconnection (OSI) communication model with TCP/IP

protocol; This course provides knowledge of error detection and recovery; local area networks; bridges, routers and gateways; network naming and addressing;and local and remote procedures. This course also emphasis on User Datagram Protocol, TCP Congestion Control; DNS Message Formatting and Remote Login Protocols.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Explain the protocol stacks (OSI and TCP/IP) for data communication.
2. Discuss the MAC protocols, error detection & correction strategies for data transmission over the networking devices.
3. Describe the standards for data communication with routing protocols.
4. Illustrate the client server communication using TCP or UDP protocols and other application level protocol.

.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the physical layer concepts in computer communications and networking.	1 to 3	1
CO2	Analyze and Design the computer network withsimplicity, scalability and better performance.	1 to 5	2
CO3	Appraise the working principles of Internet.	1,2,5	3
CO4	Compile the effectiveness of MAC Layer, Network Layer and Transport Layer Protocols in designing network applications.	1 to 4	2
CO5	Summarize the key components and protocols used in interconnection of the Network.	1,3,4	1,3
CO6	Demonstrate different application and transport protocols used in real world application.	1 to 5	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2				√		
CO3			√			
CO4			√			
CO5		√				
CO6		√	√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2										2		
CO2	3	3	3	2	2									2	
CO3	3	2			2										3

CO4	3	3	2	2										2	
CO5	2		2	2									3		3
CO6	3	3	3	3	2									3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

UNIT–1

Introduction to Data Communication and Networking: Internet history and Internet today, Data Communications, Networks, Network Topologies, Classification of Networks, Protocols & Standards.

Layered Architectures: Tasks, The OSI model, Layers in OSI model, TCP/IP Protocol suite, Addressing

Introduction to switching: Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks.

Physical Layer: Introduction to Transmission Media, Parallel transmission, serial transmission, ASK, FSK, PSK.

UNIT–2

Coding: LineCoding, **Introduction to Multiplexing**: FDM, WDM, TDM

Error Detection and Correction: Introduction, cyclic Codes: CRC, Internet checksum, Framing.

MAC Protocols: Random access (CSMA/CD, CSMA/CA), Controlled Access (Reservation, Polling, Token passing).

Introduction to Networking Devices: Repeaters, Hubs, Bridges, Routers, and High layered switches, Gateways.

UNIT–3

Standards: IEEE Standards, Standard Ethernet, Gigabit Ethernet. IEEE 802.11: Architecture, MAC Sub layer, Addressing Mechanism.

Network Layer: IPv4 addresses, IP Datagram format, IPv6 addresses, IPv6 Packet Format, Transition from IPv4 to IPv6.

UNIT–4

Transport Layer: User Datagram Protocol (UDP): UDP Segment, Transmission Control Protocol (TCP): TCP Segment, TCP Connection Setup, Application of TCP and UDP, TCP flow control, TCP error control.

Application Layer: Domain Name System (DNS): Name/Address Mapping, DNS Message Format, SMTP, Introduction to Remote LoginProtocols: TELNET Protocol and SSH Protocol, Electronic Mail (E-Mail).

TEXT BOOKS:

1. Behrouz A Forouzan, “Data Communications and Networking”, 5th Edition, McGraw–Hill, 2016.
2. Nader F.Mir, “Computer and Communication Networks”, Pearson Education, 2009.

REFERENCE BOOKS:

1. Alberto Leon-Garcia and Indra idjaja, “Communication Networks – Fundamental Concepts and KeyArchitectures”, 2nd Edition Tata McGraw–Hill, 2004.
2. AndrewS.Tanenbaum, “ComputerNetworks”, 4th Edition, Pearson Education, 2005.
3. Larry L. Peterson and Bruce S. Davie, “Computer Networks- A system Approach”, 5th Edition, Elsevier, 2012.
4. William Stallings,“Data and Computer Communications”,10th Edition,Pearson Education, 2008.
5. Douglas E.Comer,“Internet working with TCP/IP Vol.1”,6th Edition, Pearson, 1995.

JOURNALS/MAGAZINES

1. IEEE Transactions on Networking
2. Elsevier Journal of Computer Networks
3. Springer Journal of communications and Information networks

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/topic/computer-network/
2. https://www.coursera.org/courses?query=computer%20netrk
3. https://nptel.ac.in/courses/106/105/106105183/
4. https://www.edx.org/learn/computer-networking

SELF-LEARNING EXERCISES:

SDN, Wifi, WiMAX, 4G, 5G, Satellite Networks, MPLS, VPN, ATM. Bluetooth Architecture. World Wide Web (WWW).

Open Elective – IV

<table>
<tr><td>Course Title</td><td colspan="4">MOOC/COMPETITIVE EXAM</td><td colspan="2">Course Type</td><td colspan="2">POE</td></tr>
<tr><td>Course Code</td><td>B22EFO721</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>6</td><td>6</td><td>-</td><td>42</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The MOOC Course is a one semester intensive project-based learning approach to cater with the Industry requirement. It prepares the students to up skill their knowledge base to compete in terms of latest technology and become competent enough to the industry requirment. In this, students will be able to solve complex real-world problems pertaining to the domain chosen and gain confidence. It is an individual course and students have to earn the certificate based on their performances in terms of project assignment and aptitude. Students have to choose one MOOC course.

COURSE OBJECTIVE (S):

1. To allow students to learn skills of their choice required in the current Industry perspective.
2. To encourage building multidisciplinary skill set through the integration of courses learned.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To prepare them to face the interview as professionals by improving communication skills.

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic.	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3

CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3

CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the MOOC EXAM:

- Student should choose one **MOOC** among the available Industry ready courses to cope up with the vast changing software world.
- Student should register for the course having minimum of 42 hours of teaching and should have 100 percent attendance for all the sessions.
- Each student shall be reviewed and evaluated in two reviews through the semester.
- Review 1 shall be on the presentation of the course, assignment completed followed by viva.
- Review 2 shall be on the presentation of their overall skills learned in the course followed by their certification verification.

Course Title	Computer Vision				Course Type		HC	
Course Code	B22EF0701	Credits	3		Class		VII Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The automatic analysis and understanding of images by the system have occupied significant importance in all applications. This course provides an introduction to computer vision, including fundamentals of image formation, camera imaging geometry, feature detection, feature matching, motion estimation, motion tracking, and image classification.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the foundation of image formation, measurement, and analysis.
2. Analyze the methods for robust image matching and alignment;
3. Gain exposure to object and scene recognition and categorization from images;
4. Able to develop the theoretical and practical skills necessary to build computer vision applications.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basics of image formation, Camera	1 to 5	1,2
CO2	Apply morphological process and region growing methods for image processing.	1 to 5	1,2
CO3	Make use of threshold techniques for Feature detection, feature matching, and edge detection in images.	1 to 5	1,2
CO4	Use clustering-based segmentation methods for image synthesis.	1 to 5	1,2
CO5	Analyze reconstruction algorithm for 3D objects	1 to 5	1,2
CO6	Evaluate appropriate techniques for object recognition and detection in computer vision-based applications.	1 to 5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5				√		
CO6					√	

COURSE ARTICULATION MATRIX

CO# / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1								3	3	1
CO2	3	2	2	1	1								3	3	1
CO3	3	2	2	2	2								3	3	1
CO4	3	2	1	2	2								3	3	2
CO5	3	2	2	2	2				2			2	3	3	2
CO6	3	2	2	2	2				2			2	3	3	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to computer vision, Image formation: Geometric primitives and transformation, Photometric image formation, The Digital Camera, Sources, Shadows and Shading: Local shading models- point, line and area sources; photometric stereo, Camera calibration.

UNIT – 2

Image processing: Point operators, Linear filtering, Fourier transforms, Feature detection and matching: Points and patches, Edge detection: Estimating Derivatives with Finite Differences, Noise, and Edges and Gradient-based Edge Detectors.

UNIT – 3

Segmentation using clustering methods: Human Vision and applications, Segmentation by graph theoretic clustering, Fitting: Hough transform, Fitting lines, Fitting curves, Structure from motion: Two frame structure from motion, Dense motion estimation: Parametric motion, Spline based Motion.

UNIT – 4

3D reconstruction: Shape from X, Active rangefinding, Surface representation, Point-based representations, Volumetric representations, Model-based reconstruction, Recognition: Object detection, Face recognition, Instance recognition, category recognition.

TEXT BOOKS:

1. Szeliski R. Computer vision: algorithms and applications. Springer Science & Business Media; 2010.
2. Forsyth, David, and Jean Ponce. Computer vision: A modern approach. Prentice hall, 2011.

REFERENCE BOOKS:

1. Shapiro LG, Stockman GC. Computer Vision: Theory and Applications. 2001.
2. Trucco, Emanuele, and Alessandro Verri. Introductory techniques for 3-D computer vision. Vol. 201. Englewood Cliffs: Prentice Hall, 1998.

JOURNALS/MAGAZINES:

1. IEEE-T-PAMI (IEEE Transactions on Pattern Analysis and Machine Intelligence)
2. IJCV (International Journal of Computer Vision) - Springer.

SWAYAM/NPTEL/MOOCs:

1. Swayam: Computer vision By Prof.Jayanta Mukhopadhyay, IIT Kharagpur.
2. Coursera: An Introduction to computer vision and image processing, Aije Egwaikhide and Joseph Santarcangelo.

SELF-LEARNING EXERCISES:

1. Case study on Veggie vision: A system for checking out vegetables.
2. Case study on identifying humans via the Iris of an eye.

<table>
<tr><td>Course Title</td><td colspan="4">Skill Development Course – 4</td><td colspan="2">Course Type</td><td colspan="2">SDC</td></tr>
<tr><td>Course Code</td><td>B22EF0702</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>1</td><td></td><td></td></tr>
<tr><td>Tutorial</td><td>-</td><td></td><td></td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td></td><td></td></tr>
<tr><td>Total</td><td>2</td><td></td><td></td><td>-</td><td>56</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				

CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATION MATRIX;

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-4:

Students will be offered training and certifications on the trending technologies from the industry experts.

The students are evaluated and certified after the training programs.

Course Title	**Internship**				**Course Type**		**HC**	
Course Code	**B22EF0703**	**Credits**	**2**		**Class**		**VII Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture							
	Tutorial				Theory	Practical	CIE	SEE
	Practical							
	Total						**50%**	**50%**

COURSE OVERVIEW:

An internship can present students with new skills and opportunities. Interns not only gain technical knowledge within the industry of their choice, but they also learn how to interact with professionals in a workplace setting, and develop essential soft skills like time management, organization, adaptability, problem-solving and teamwork.

COURSE OBJECTIVE (S):

1. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
2. To encourage team work.
3. To help students to gain exposure into industries.
4. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation.

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			

CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low,2-Medium,3-High

The students are informed to follow the following instructions to complete the Internship:

- The internship should be paid internship in IT industry.
- The internship should be for minimum of three months.
- The project title must be submitted in form a document (synopsis) that contains the proposed title of the project, an abstract, Introduction and their roles and responsibilities in company.
- Each student shall be reviewed and evaluated in two reviews through the semester.
- Review 1 shall be on the presentation of the synopsis.
- Review 2 shall be on the presentation on the roles and responsibilities carried out with module completion results (as applicable).

Course Title	Project Phase-1 / Start- up				Course Type		HC	
Course Code	B22EF0704/5	Credits	1		Class		VII Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	3	6	6				
	Total	**3**	**6**	**6**	**-**	**84**	**50%**	**50%**

COURSE OVERVIEW:

The major project is a two semester-long practical project with the main objective that students show their ability to apply theoretical concepts learned in lectures to solve (complex) practical problems. The results are to be presented in a project report and as an oral presentation.

The major project must be completed as a team project. Team projects are limited to a minimum of two students to a maximum number of four students.

COURSE OBJECTIVE (S):

1. To allow students to demonstrate a wide range of the skills learned during theircourse of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation.
2. To encourage multidisciplinary research through the integration learned in a number of courses.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation.

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs

CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Project Phase-1:

- Student should carry out project work in a group which is formed in the VII semester. Student must select group members from the same section as they belong to and select a faculty member from department of CSE as aninternal project guide based on research domain and expertise. Student may optionally also select external guide bearing domain expertise from different departments within University and Industry to carry out multidisciplinary project.
- Student group must propose a project title, after consultation with guides and after carrying out a literature survey. The proposed title must be submitted in form a document (synopsis) that contains the proposed title of the project, an abstract, Introduction, Survey, Feasibility, and cost estimation to carry out the project.
- Further with the help of respective guide, each student group have to the literature review based on the literature survey, identify the research gaps in the selected research/project domain, and then finalize the problem statement and objectives for the project.
- Each student groups shall be reviewed and evaluated in two reviews through the semester.
- Review 1 shall be on the presentation of the synopsis and justification of the title and feasibility of the project
- Review 2 shall be on the presentation on the literature survey carried out.

  Finally, the Project Phase-1 shall conclude with each project group apply for idea patent or copyright and publish a survey paper in SCOPUS indexed journals, write research proposals for fundings from various governmental organizations or industries

VIII SEMESTER

Course Title	Project Phase-2				Course Type		HC	
Course Code	B22EF0801	Credits	6		Class		VIII Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	6	12	12				
	Total	**6**	**12**	**12**	**-**	**182**	**50**	**50**

COURSE OVERVIEW:

Project Phase-2 is continuation of Project Phase-1 from semester VII.

COURSE OBJECTIVE (S):

1. To allow students to demonstrate a wide range of the skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation.
2. To encourage multidisciplinary research through the integration learned in a number of courses.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		

CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Project Phase-2:

- Each student group shall, conduct the required experiment to implement the proposed project with the consultation of respective guides.
- Each student groups shall be reviewed and evaluated in two reviews through the semester and finally each group shall demonstrate the completed project to a team of examiners.
- Review 1 shall be on the presentation of the methodology employed and model created.
- Review 2 shall be on the presentation on the functional project.
- Finally, the Capstone-Project Phase-2 shall conclude with each project group apply for patent or copyright and publish a paper in SCOPUS indexed journals.
- In Semester end examination, each student in groups shall be evaluated, based on the course outcomes.