REVA UNIVERSITY
Bengaluru, India

# SCHOOL OF CIVIL ENGINEERING

# HANDBOOK

## B.Tech. in Civil Engineering

**2020-2024**

Rukmini Knowledge Park,
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Rukmini Educational
Charitable Trust

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# Chancellor's Message

***"Education is the most powerful weapon which you can use to change 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 am 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, both educational 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 teamwork to build successful institutions. I welcome you to REVA University to 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

# 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. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

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 on a sprawling 45 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. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination 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. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like 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.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

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!

**Dr. M. Dhanamjaya**

Vice-Chancellor, REVA University

# Director's Message

The B.Tech in Civil Engineering is designed keeping in view the current situation and possible future developments, both at national and global levels. This course is designed to give greater emphasis on core Civil Engineering. There are ample number of courses providing knowledge in specialized areas of Structural Engineering, Water Resources Engineering, Transportation Engineering, Geotechnical Engineering, Surveying and Environmental Engineering etc. facilitating students to choose specialized areas of their interest. Adequate attention is given to provide students the basic concepts.

Civil engineering is one of the earliest to start among the core subjects. The structure of the course has undergone a face-lift with the introduction of subjects from latest advanced subjects like Town Planning, Urban Transport Planning, Prestressed & Precast Structures, Solid Waste Management, Industrial Waste Water Treatment etc. Thus, the Civil Engineering stream is designed to provide you with several options to choose from for your later years. The Indian government having plans to adopt make in India concept in this major is infrastructure development. Hence, Infrastructure development sector offers many job opportunities for well-qualified graduates.

The program is thus designed to expose students to various subjects having hand on applications in planning, design & construction, through outcome based teaching and learning process, which emphasizes practical exposure rather than memorization. A variety of activities such as mini projects, seminars, interaction with industries, cultural activities and social activities are in place to shape the all-round development of students.

If you are interested in any one of the following, then Civil Engineering is the option you should consider.

- **Structural Engineering**- to analyze and design structures, to implement earthquake-resisting structures, to maintain quality of construction, to design eco-friendly buildings etc.
- **Water Resources Engineering** - to solve the water for drinking, irrigation etc. To study ground water exploration and recharge.

- **Transportation Engineering**- to resolve the current traffic problems and plan for the future requirements of the society.
- **Environmental Engineering**- to assure and supply the quality drinking water for people and for industries. To protect environment form the air pollution, solid water management and waste water disposal.
- **Geotechnical Engineering**- To study and testing of soils to improve the safe bearing capacity of the soils so that the structure will be safe.

The benefits of choosing Civil Engineering are:

- Flexibility to choose various fields upon graduation.
- Opportunity to work on live problems.
- Opportunity to work on latest technologies.
- Opportunity for designers & planner to plan & design live projects.

I am sure the students choosing B Tech in Civil Engineering in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. The cirruculum caters to and has relevance to local, regional, national, global developmental needs. We will strive to provide all needed comfort and congenial environment for their studies. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, Gender, human values, environment and Sustainability. I wish all students pleasant stay in REVA and grand success in their career. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students pleasant stay in REVA and grand success in their career.

**Dr. Y. Ramalinga Reddy,**
**Director,**
**School of Civil Engineering,**
**REVA University**

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## 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 Trust is 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 to Post 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 13,000 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 dated 7th February, 2013. The University is recognised by UGC under Sec 2 (f) and empowered under Sec.22 of the UGC Act, 1956 to award degrees in any branch of knowledge. 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 45 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.

The University is presently offering 27 Post Graduate Degree programs, 29 Degree and PG Degree programs in various branches of studies and has 15000+ students studying in various branches of knowledge at graduate and postgraduate level and 494 Scholars pursuing research leading to PhD in 18 disciplines. It has 900+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

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. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has 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. 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. 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 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 Censor 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, Nano 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 experienced Professor & Dean, 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 & Director 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 partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

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 R Narayana 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 I.I.Sc., 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 Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is **'Life Time Achievement Award'** to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the **"Founders' Day Celebration"** of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first "REVA Life Time Achievement Award" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced "**REVA Award of Excellence"** in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

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 such cultural events is REVOTHSAVA 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 mega, event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognized by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes every day to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Within short span of time, REVA University has been recognised as a fast growing university imparting quality higher education to the youth of the country and received many awards, ranks, and accolades from various agencies, institutions at national and international level. These include Asia's Greatest Brand and Leaders, by Asia One, National Award of Leadership Excellence, by ASSOCHAM India. Most promising University, by EPSI, Promising Upcoming Private University in the Country, by The Economic Times, Best University of India (South), by Dialogue India, Gold Brand by QS University Ranking, placed under 151-200 band by NIRF, $6^{TH}$ Rank in the Super Excellence category by GHRDC, $6^{TH}$ Rank in All India Law School Survey, ranked among Top 30 Best B Schools by Business World, India's Best Law Institution by Careers 360, to mention a few.

## 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 standards".

## 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 and development
- 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 in different 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

## ABOUT SCHOOL OF CIVIL ENGINEERING

The School of Civil Engineering is headed by highly experienced Professor and is supported by well qualified faculty members. The school has the state-of-art class rooms and well equipped laboratories. It offers B.Tech and M.Tech programs in various specialized streams. The school also has research program leading to doctoral degree. The curriculum of both graduate and post graduate degree programs have been designed to bridge the gap between industry – academia and hence they are industry application oriented. The B.Tech program aims to prepare human resources to play a leading role in the competitive construction field and excel in their endeavors. The Master's Degree programs focus on research and design in the core and Computer Aided Structural Engineering & Transportation Engineering & Management to supplement and create a sustainable world and to enhance the global quality of life by adopting enhanced techniques of design and application. This is reflected in various core subjects offered within the program. Currently Civil Engineering teaching was limited to planning, analysis, design and execution of different types of infrastructure like buildings, roads, bridges, dams and power plants. However, due to increase of technological sophistication and demand for higher living standards geared up by economic growth and concerns about environmental impact have changed the scope of Civil Engineering. The challenges of today's Civil Engineering infrastructure are much more complex and interdependencies between resources.

Even though there are a large number of institutions in the country which are producing Civil Engineers, there is acute shortage of quality Civil Engineers. The REVA UNIVERSITY would like to offer Civil Engineering Programme to produce quality engineers who are effective and efficient in problem solving and providing economical and sustainable infrastructural solutions.

### VISION

"To produce young Engineers of caliber, who would be committed to their profession with ethics, will be able to contribute to Civil Engineering and allied fields in optimizing usage of resources globally making the world more eco-friendly to live in."

### MISSION

- To make the Department centre of excellence for training the undergraduate students.
- To promote involvement of staff and students in research and advanced training.

- *To develop good understanding skills in student communities about Civil Engineering, ethical practices, automation design and society need centric teaching and learning and imparting value addition skills.*

## BoS

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## Programme Overview

Civil Engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including works such as roads, bridges, canals, dams, airports, sewerage systems, pipelines, and railways. In the 18th century, the term civil engineering was coined to incorporate all things civilian as opposed to military engineering. The first engineering school, The National School of Bridges and Highways, France, was opened in 1747.

The modern day civil engineering graduate should have wider knowledge of civil engineering- surveying grading design, drainage, pavement, water supply, sewer service, dams, electric and communications supply and preparations of construction plans. Civil engineers must possess technical knowledge of geotechnical engineering, structural engineering, environmental engineering, transportation engineering and construction engineering as applied to residential, commercial, and industrial and public works projects of all sizes and levels of construction. In addition, present day civil engineers should be able to use CAD/CAE and Virtual reality tools for design and visualization of complex civil engineering structures. If they possess knowledge of IoT and Artificial intelligence will be an added advantage for maintenance and monitoring of infrastructural projects.

Employment of civil engineers is projected to grow 11 percent over the next ten years, faster than the average for all occupations. Government of India is investing on infrastructure development to rebuild, repair, and upgrade bridges, roads, levees, dams, airports, buildings, railways, metros and other structures.

A growing population and urbanization means more buildings, new water systems, roads, waste treatment plants leading to increased demand for Civil Engineers.

The work of civil engineers will be needed for renewable-energy projects. Thus, as these new projects gain approval, civil engineers will be further involved in overseeing the construction of structures such as wind farms and solar arrays.

Prospects for Civil Engineers are expected to be good. They will be best for those with training in the latest software tools, particularly for computational design and simulation. Such tools allow engineers and designers to take a project from the conceptual phase till the end. Engineers who have experience or training in three-dimensional printing of concrete structures also will have better job prospects.

**The School of Civil Engineering at REVA UNIVERSITY offers B. Tech., Civil Engineering –an undergraduate programme** to create motivated, innovative, creative and thinking graduates to fill the roles of civil engineers who can work on various infrastructure projects including construction of buildings.

The B. Tech., in Civil Engineering curriculum developed by the faculty at the **School of Civil Engineering**, is outcome based and it comprises required theoretical concepts and practical skills in the domain. By undergoing this programme, students develop critical, innovative, creative thinking and problem solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in interdisciplinary topics and attitudinal skills to enhance their scope. The above-mentioned features of the programme, advanced teaching and learning resources, and experience of the faculty members with their strong connections with infrastructure sector makes this programme unique.

## Program Educational Objectives (PEO’s)

**After few years of graduation, the graduates of B.Tech CE (Civil Engineering) will be able to:**

**PEO 1:** Have successful professional careers in construction industry, government, academia and military as innovative engineers.

**PEO 2:** Successfully solve engineering problems associated with planning, design & construction of civil engineering projects by executing construction works effectively either leading a team or as a team member.

**PEO 3:** Continue to learn and advance their careers through activities such as participation in professional organizations, attainment of professional certification for lifelong learning and seeking higher education.

**PEO 4:** Active members ready to serve the society locally and internationally and will take up entrepreneurship for the growth of economy and to generate employment

## Program Outcomes (POs)

**On successful completion of the program, the graduates of B.Tech CE (Civil Engineering) program will be able to:**

**PO-1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals for the solution of complex problems in civil Engineering.

**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 team work:** 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 (PSO)

**On successful completion of the program, the graduates of B.Tech CE (Civil Engineering) program will be able to:**

**PSO 1:** Apply knowledge of Construction Engineering, Environmental Engineering, Geotechnical Engineering, Structural Engineering, Surveying, Transportation Engineering and Water Resources Engineering in real time.

**PSO 2:** Analyze a system, component or process in the knowledge areas of civil engineering in real time problems.

**PSO 3:** Design a system, component, or process in more than one areas of Civil Engineering.

**PSO 4:** Conduct investigations and address complex civil engineering problems; utilize and develop innovative tools and techniques that are appropriate in civil engineering discipline.

**Quality Policy - School of Civil Engineering**

1. To provide global standards of excellence in teaching and to remain accountable in our core and support functions, through processes of self-evaluation and continuous improvement.

2. Enhancing the competence of the faculty to a very high level and to make them adopt all modern and innovative methods in teaching-learning process.

3. Inculcating moral and ethical values among the students and staff.

4. Collaborating with industry, other institutions and organizations for promoting Research and Development programme for the overall growth of the student.

# Regulations – 4 years B. Tech., Degree Program

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

1. **Title and Commencement:**

   **1.1** These Regulations shall be called **"REVA University Academic Regulations – B. Tech., Degree Program 2020-21 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board 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 2019-20

   **B Tech in:**
   Bioelectronics Engineering
   Civil Engineering
   Computer Science and Engineering
   Computer Science and Information Technology
   Computer Science and Systems Engineering
   Computer Science and Engineering (AI and ML)
   Electrical and Electronics Engineering
   Electrical and Computer Engineering
   Electronics and Communication Engineering
   Electronics and Computer Engineering
   Information Science and Engineering
   Mechanical Engineering
   Mechatronics 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, listed under a programme;** 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** | **Lecture** |
| **T** | **Tutorial** |
| **P** | **Practice** |

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 / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much required skill component.

**4.2 Classification of Courses**

**Courses offered are classified as: Core Courses, Open Elective Courses, Project work/Dissertation**

**4.2.1** **Core Course:** A course which should compulsorily be studied by a candidate choosing a particular program of study

**4.2.2** **Foundation Course:** The foundation Course is a mandatory course which should be completed successfully as a part of graduate degree program irrespective of the program of study

**4.2.3** **Hard Core Course (HC) simply 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

**4.2.4** **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/related branch of study, which supports the main branch of study

**4.2.5 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**

**4.2.6 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 (7th Semester), Consists of literature survey, problem identification, formulation and methodology. In Phase-II (8th Semester) student should complete the project work by designing or creating an innovative process or development of product as an outcome. A project work carrying **TWO**, **FOUR or SIX** credits is called Minor Project work / Dissertation. A project work of **SIX, EIGHT, or TEN,** credits is called Major Project work / Dissertation. **A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned. But the Major Project shall be Hard Core.**

**4.2.7** **"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 subject Obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together. |
| 2 | Bachelor of Technology (B Tech) | Lateral entry to second year | A. Passed Diploma examination from an AICTE approved Institution with at least 45% marks (40% in case of candidates belonging to SC/ST category) in appropriate branch of Engineering / 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.<br><br>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 the first year Engineering program along with the second year subjects.<br><br>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.<br><br>E. Provided further that student, who have passed Diploma in Engineering & Technology from an AICTE approved Institution or B. Sc., Degree from a recognized University as 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. |
| | Bachelor of Technology (B Tech) | Lateral entry to fourth year (final year) | 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 in the concerned branch of study, provided he/she fulfils the University requirements. |
| 4 | B. Tech. in Bioelectronics | | Pass in PUC / 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry / Biotechnology / Biology / Computer Science / Electronics / Technical Vocational subjects and obtained minimum 45% marks (40% in case of candidates belonging to SC / ST category) in the above subjects taken together of any board recognized by the respective State |

| | | | |
|---|---|---|---|
| | | | Government / Central Government / Union Territories or any other qualification recognized as equivalent there to. |

**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 final 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.

1 credit = 13 credit hours spread over 16 weeks or spread over the semester

**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 C**ourses of Study**:

Different C**ourses 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. Project Work / Dissertation:

g. A project work carrying **TWO, FOUR or SIX** credits is called Minor Project work / Dissertation. A project work of **EIGHT, TEN, TWELVE or SIXTEEN** credits is called Major Project work / Dissertation. A Project work may be a hard core or a Soft Core as decided by the BoS / concerned.

These are defined under Section 4 of these regulations.

## 8. Credits and Credit Distribution

**8.1** **A candidate has to earn 160 credits for successful completion of B Tech degree** with the distribution of credits for different courses as given in table below:

| **Course Type** | **Credits (Range)** For B Tech Degree (8 Semesters) |
|---|---|
| Foundation Core Course | A minimum of 06 but not exceeding 12 |
| Hard Core Course | A minimum of 118 but not exceeding 121 |
| Soft Core Course | A minimum of 15 but not exceeding 21 |
| Open Elective | A minimum of 04 but not exceeding 12 |

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

**8.3.** Every course including project work, practical work, fieldwork, self-study elective should be entitled as **Foundation Course (FC), Hard Core (HC) or Soft Core (SC) or Open Elective (OE)** or **Core Course** (**CC**) by the BoS concerned. However, following shall be the **Foundation Courses** with credits mentioned against them, common to all branches of study.

**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.

**8.5.** A candidate can enrol for a maximum of 28 credits and a minimum of 19 credits per Semester. However he / she may not successfully earn a maximum of 28 credits per semester. This maximum of 28 credits does not include the credits of courses carried forward by a candidate.

8.6 **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 160 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 and for hostel facilities.

**8.7 Add- on Proficiency Certification:**

To acquire Add on Proficiency Certification a candidate can opt to complete a minimum of 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 160 credits for the B Tech Degree program**.**

**8.7.1. 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 160 credits for the 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. Internal Assessment (IA); 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 internal assessment shall comprise of:

| | |
|---|---|
| Internal Test | 30 marks |
| Assignments / Seminars / Model Making / Integrated Lab / Project Based Learning / Quizzes etc. | 20 marks |

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

- 1st test is conducted for 15 marks during **6th week** of the Semester;
- 2nd test is conducted for 15 marks during **12th 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 40 %of the total syllabus**;
- Question paper of the **2nd test should be based on second 40 %of the total syllabus**;
- An assignment must be designed to cover the last **20% of the Syllabus**

**9.6** There shall be one Assignment / Project Based Learning / Field Visit / Quiz test carrying 20 marks covering the last 20% of the Syllabus

**9.7** The Semester End Examination for 50 marks shall be held in the 18th and 19th week of the beginning of the semester and the syllabus for the semester end examination shall be entire syllabus.

**9.8** A test paper is set for a maximum of 30 marks to be answered in 1 hour duration. A test paper can have 4 main questions. Each main question is set for 10 marks. The main question can have 2-3 sub questions all totalling 10 marks. Students are required to answer any three main questions. Each question is set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document.

**9.9** 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 to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.

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

**9.11** 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 plagiarise the answer from web or any other resources. An assignment / Quiz can be set for a maximum of 20. 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.

**9.12** Internal assessment marks must be decided well before the commencement of Semester End examinations

**9.13** Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 18th and 19th week of the semester and the entire course syllabus must be covered while setting the question paper. Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Each main question be set for a maximum of 25 marks, main questions can have a 3-4 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. (Please note question papers have to be set to test the course outcomes)

**9.14** There shall be three sets of question papers for the semester end examination of 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 three sets shall be scrutinized by the Board of Examiners. It shall be responsibility of the Board of Examiners 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.

**9.15** There shall be single evaluation by the internal teachers who have taught the subject. However, there shall be moderation by the external examiner. In such cases where sufficient number of external examiners are not available to serve as moderators internal senior faculty member shall be appointed as moderators.

**9.16** 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.

**9.17** 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.

**9.18** 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

**9.19** 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

**9.20** University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper

**9.21** Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor

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

1. 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 University norms.
2. 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
3. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

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

**9.23** 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.

**9.24** 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

**9.25** **Summary of Internal Assessment, Semester End Examination and Evaluation** Schedule is provided in the table given below.

**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 6th week | First 40% | 30 | 15 | 7th week |
| 2 | Test -2 | During 12th Week | Second 40% | 30 | 15 | 13th Week |
| 3 | Assignment / Quiz | 15th Week | Last 20% | 20 | 20 | 16th Week |
| 4 | SEE | 18/19th Week | 100% | 100 | 50 | 20th Week |

## 10 Assessment of Students Performance in Practical Courses

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** The 50 marks meant for Internal Assessment (IA) of the performance in carrying 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 mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment. | 20 marks |
| | **Total** | **50 marks** |

**10.2** The 50 marks meant for Semester End Examination (SEE), shall be allocated as under:

| | | |
|---|---|---|
| i | Conducting of semester end practical examination | 30 marks |
| ii | Write up about the experiment / practical conducted | 10 marks |
| iii | Viva Voce | 10 marks |
| | **Total** | **50 marks** |

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

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

**For > 3 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 & 2 credit courses**

| | | |
|---|---|---|
| i | IA-I | 15 marks |
| ii | IA-2 | 15 marks |
| iii | Semester end examination by the concern school board (demo, test, viva voice etc.) | 20 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 the regular 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. 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 25% (13 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 in the 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 which is **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 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 completion of 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 | 19 | 6.83 | 19 x 6.83 = 129.77 |
| 2 | 21 | 7.29 | 21 x 7.29 = 153.09 |
| 3 | 22 | 8.11 | 22 x 8.11 = 178.42 |
| 4 | 22 | 7.40 | 22 x 7.40 = 162.80 |
| 5 | 22 | 8.29 | 22 x 8.29 = 182.38 |
| 6 | 22 | 8.58 | 22 x 8.58 = 188.76 |
| 7 | 22 | 9.12 | 22 x 9.12 = 200.64 |
| 8 | 10 | 9.25 | 10 x 9.25 =92.50 |
| **Cumulative** | **160** | | **1288.36** |

Thus, **CGPA** = $\frac{19x6.83+21x7.29+22x8.11+22x7.40+22x8.29+22x8.58+22x9.12+10x9.25}{\mathbf{160}}$ = 8.05

**a. 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 8.05 x 10=80.5**

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

**13. Classification of Results**

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

| CGPA | Grade (Numerical Index) | Letter Grade | Performance | FGP |
|---|---|---|---|---|
| | G | | | 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**

a. **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).**

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

**14. Attendance Requirement:**

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

**14.2** 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.

**14.3** 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 to appear 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 have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

**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 seek re-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.

**19. 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

**20. Provision for Supplementary Examination**

In case a candidate fails to secure a minimum of 25% (13 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.

**21. Provision to Carry Forward the Failed Subjects / Courses:**

The student who has failed in a maximum of 4 courses in odd and even semesters together shall move to next semester of succeeding year(s) of study till 8$^{th}$ semester. And he / she shall appear for Semester End examination of failed courses of previous semesters concurrently with odd semester end examinations and / or even semester end examinations of current year of study.

**Case 1:** A student who has failed in a maximum of 4 courses in 1$^{st}$ and 2$^{nd}$ semester together shall move to the 3$^{rd}$ semester of the succeeding year.

**Case 2:** A student who has failed in a maximum of 4 courses from semester 1 to 4 together shall move to the 5$^{th}$ semester of the succeeding year.

**Case 3:** A students who has failed in a maximum of 4 courses from semester 1 to 6 together shall move to the 7$^{th}$ semester of the succeeding year.

**22. Challenge Valuation:**

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Controller of Examinations within 10 days after the announcement of the results. This challenge valuation is only for semester end examination.

b. The answer scripts (in whatever form) for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

**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.

# B. Tech in Civil Engineering

## Scheme of Instructions

### (Effective from Academic Year 2020 - 21)

**I SEMESTER**

| Sl. No | Course Code | Title of the Course | HC/FC/ SC/OE | Pre requisite | Credit Pattern & Credit Value | | | | Contact Hours/ Week |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total | |
| 1 | B20AS0103 | Differential Equations and Linear Algebra | FC | PUC/ Equivalent | 3 | 0 | 0 | 3 | 3 |
| 2 | B20AS0101 | Applied Physics | FC | PUC/ Equivalent | 3 | 0 | 0 | 3 | 3 |
| 3 | B20CS0101 | Introduction to Data Science | FC | PUC/ Equivalent | 2 | 0 | 1 | 3 | 4 |
| 4 | B20ED0101 | Engineering Mechanics | HC | PUC/ Equivalent | 3 | 0 | 1 | 4 | 5 |
| **TOTAL** | | | | | **11** | **0** | **2** | **13** | **15** |
| | **Practical /Term Work / Practice Sessions/Online /MOOC** | | | | | | | | |
| 5 | B20ME0104 | Entrepreneurship | FC | PUC/ Equivalent | 1 | 0 | 0 | 1 | 1 |
| 6 | B20EC0101 | IoT and Applications | FC | PUC/ Equivalent | 1 | 0 | 1 | 2 | 3 |
| 7 | B20ED0102 | Engineering Drawing (Manual) | HC | PUC/ Equivalent | 2 | 0 | 1 | 3 | 4 |
| **TOTAL** | | | | | **4** | **0** | **2** | **06** | **8** |
| **TOTAL SEMESTER CREDITS** | | | | | | | | **19** | |
| **TOTAL CUMULATIVE CREDITS** | | | | | | | | **19** | |
| **TOTAL CONTACT HOURS** | | | | | | | | **23** | |

## II SEMESTER

| Sl. No | Course Code | Title of the Course | HC/FC/SC/OE | Pre requisite | Credit Pattern & Credit Value | | | | Contact Hours/ Week |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total | |
| 1 | B20AS0205 | Vector Calculus and Partial Differential Equations | FC | PUC /Equivalent | 3 | 1 | 0 | 4 | 4 |
| 2 | B20AS0201 | Applied Chemistry | FC | PUC/ Equivalent | 3 | 0 | 0 | 3 | 3 |
| 3 | B20CI0101 | Introduction to Python Programming | FC | PUC /Equivalent | 2 | 0 | 1 | 3 | 4 |
| 4 | B20EE0101 | Basics of Electrical and Electronics Engineering | FC | PUC/ Equivalent | 3 | 0 | 1 | 4 | 5 |
| 5 | B20ED0201 | Building Materials and Construction | HC | PUC/ Equivalent | 3 | 0 | 1 | 4 | 5 |
| **TOTAL** | | | | | **14** | **1** | **3** | **18** | **21** |
| | **Practical /Term Work / Practice Sessions/Online/MOOC** | | | | | | | | |
| 6 | B20AS0109 | Biology for Engineers | FC | PUC/ Equivalent | 1 | 0 | 0 | 1 | 1 |
| 7 | B20ME0102 | Design Thinking | FC | PUC/ Equivalent | 1 | 0 | 1 | 2 | 3 |
| **TOTAL** | | | | | **2** | **0** | **1** | **3** | **4** |
| **TOTAL SEMESTER CREDITS** | | | | | | | | **21** | |
| **TOTAL CUMULATIVE CREDITS** | | | | | | | | **40** | |
| **TOTAL CONTACT HOURS** | | | | | | | | **25** | |

# III SEMESTER

| Sl. No | Course Code | Title of the Course | HC/FC/ SC/OE | Pre requisite | Credit Pattern & Credit Value | | | | Contact Hours/ Week |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total | |
| 1 | B20AS0304 | Laplace Transforms ,Fourier Series and Numerical Methods | HC | PUC/ Equivalent | 3 | 0 | 0 | 3 | 3 |
| 2 | B20ED0301 | Fluid Mechanics | HC | B20ED0101 | 3 | 0 | 0 | 3 | 3 |
| 3 | B20ED0302 | Strength of Materials | HC | B20ED0101 | 3 | 0 | 1 | 4 | 5 |
| 4 | B20ED0303 | Surveying and Geomatics | HC | PUC/ Equivalent | 3 | 0 | 1 | 4 | 5 |
| 5 | B20ED0305 | Water and Waste water Engineering | HC | PUC/ Equivalent | 3 | 0 | 1 | 4 | 5 |
| **TOTAL** | | | | | **15** | **0** | **3** | **18** | **21** |
| | **Practical /Term Work / Practice Sessions/Online/MOOC** | | | | | | | | |
| 6 | B20AHM303 | Communication Skills | FC | PUC/ Equivalent | 2 | 0 | 0 | 2 | 2 |
| 7 | B20LSM301 | Indian Constitution and Professional Ethics | FC | PUC/ Equivalent | 2 | 0 | 0 | 2 | 2 |
| 8 | B20AHM301 | Advanced Kannada | MLC1 | PUC/ Equivalent | 0 | 0 | 0 | 0 | 0 |
| | B20AHM302 | Basics of Kannada | | | | | | | |
| **TOTAL** | | | | | **4** | **0** | **0** | **4** | **4** |
| **TOTAL SEMESTER CREDITS** | | | | | | | | **22** | |
| **TOTAL CUMULATIVE CREDITS** | | | | | | | | **62** | |
| **TOTAL CONTACT HOURS** | | | | | | | | **25** | |

# IV SEMESTER

| Sl. No | Course Code | Title of the Course | HC/FC /SC/OE | Pre requisite | Credit Pattern & Credit Value | | | | Contact Hours/ Week |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total | |
| 1 | B20AS0404 | Probability and Sampling Theory | HC | PUC/ Equivalent | 3 | 0 | 0 | 3 | 3 |
| 2 | B20ED0401 | Building Planning and Drawing with AutoCAD | HC | B20ED0303 | 1 | 0 | 1 | 2 | 3 |
| 3 | B20ED0402 | Concrete Technology | HC | B20ED0302 | 2 | 0 | 0 | 2 | 2 |
| 3 | B20ED0403 | Highway Engineering | HC | B20ED0302 | 3 | 0 | 1 | 4 | 5 |
| 4 | B20ED0404 | Hydrology and Irrigation Engineering | HC | B20ED0305 | 3 | 0 | 1 | 4 | 5 |
| 6 | B20ED0405 | Structural Analysis | HC | B20ED0302 | 3 | 0 | 0 | 3 | 5 |
| **TOTAL** | | | | | **15** | **0** | **3** | **18** | **23** |
| | **Practical /Term Work / Practice Sessions/Online/MOOC** | | | | | | | | |
| 7 | B20MG0301 | Management Science | FC | - | 2 | 0 | 0 | 2 | 2 |
| 8 | B20AS0301 | Environmental Science | FC | - | 2 | 0 | 0 | 2 | 2 |
| 9 | B20AHM401 | Universal Human Values | MLC2 | - | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | | | | | **4** | **0** | **0** | **4** | **4** |
| **TOTAL SEMESTER CREDITS** | | | | | | | | **22** | |
| **TOTAL CUMULATIVE CREDITS** | | | | | | | | **84** | |
| **TOTAL CONTACT HOURS** | | | | | | | | **27** | |

# V SEMESTER

| Sl. No | Course Code | Title of the Course | HC/FC/ SC/OE | Pre requisite | Credit Pattern & Credit Value | | | | Contact Hours/ Week |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total | |
| 1 | B20ED0501 | Basic Geotechnical Engineering | HC | B20ED0301, B20ED0302 | 3 | 0 | 1 | 4 | 5 |
| 2 | B20ED0502 | Design of Hydraulic Structures | HC | B20ED0404 | 3 | 0 | 0 | 3 | 3 |
| 3 | B20ED0503 | Design RC Structural Elements | HC | B20ED0405 | 3 | 0 | 1 | 4 | 5 |
| 4 | B20ED0504 | Railways, Airways, Waterways and Tunnel Engineering | HC | B20ED0403 | 3 | 0 | 0 | 3 | 3 |
| 5 | B20ED0505 | Solid Waste Management | HC | B20MG0301 | 3 | 0 | 0 | 3 | 3 |
| **Professional Electives-I** | | | | | | | | | |
| 6 | B20EDS501 | Energy Science and Engineering | SC | B20MG0301 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS502 | IoT Applications & Smart cities | | B20EC0101 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS503 | Open Channel Hydraulics | | B20ED0404 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS504 | Pavement Materials and Construction | | B20ED0403 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS505 | Rural Water Supply and onsite Sanitation Systems | | B20ED0404 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS506 | Applied Geology | | --- | 3 | 0 | 0 | 3 | 3 |
| **Open Elective-I for other school students** | | | | | | | | | |
| 7 | B20EDO501 | Building Materials and Construction | OE | B20ED0402 | 3 | 0 | 0 | 3 | 3 |
| **TOTAL** | | | | | **18** | **0** | **2** | **20** | **22** |
| | **Practical /Term Work / Practice Sessions/Online/MOOC** | | | | | | | | |
| 8 | B20PA0501 | Indian Tradition and Culture | FC | --- | 1 | 0 | 0 | 1 | 1 |
| **TOTAL** | | | | | **1** | **0** | **0** | **1** | **3** |
| **TOTAL SEMESTER CREDITS** | | | | | | | | **24** | |
| **TOTAL CUMULATIVE CREDITS** | | | | | | | | **108** | |
| **TOTAL CONTACT HOURS** | | | | | | | | **26** | |

## VI SEMESTER

| Sl. No | Course Code | Title of the Course | HC/FC/SC/OE | Pre requisite | Credit Pattern & Credit Value | | | | Contact Hours/ Week |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total | |
| 1 | B20ED0601 | Advanced Geotechnical Engineering | HC | B20ED0501 | 3 | 0 | 0 | 3 | 3 |
| 2 | B20ED0602 | Design of Pre-stressed and Prefabricated Structures | HC | B20ED0503 | 3 | 0 | 0 | 3 | 3 |
| 3 | B20ED0603 | Design of Steel Structures | HC | B20ED0503 | 3 | 0 | 1 | 4 | 5 |
| 4 | B20ED0604 | Financial and Construction Management | HC | B20MG0301 | 3 | 0 | 0 | 3 | 3 |
| **Professional Electives- II** | | | | | | | | | |
| 5 | B20EDS606 | Construction Engineering & Management | SC | B20EDO501 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS607 | Disaster Preparedness, Planning and Management | | B20ED0505 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS608 | Earthquake Resistant Structures | | B20ED0503, B20ED0501 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS609 | Global Warming and Climate Change | | B20ED0505 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS610 | Industrial Waste water treatment | | B20ED0505 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS611 | Air and Noise pollution | | B20ED0505 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS612 | Traffic Engineering & Management | | B20ED0505 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS613 | Introduction to Remote sensing & Geographical Information System | | B20ED0303 | 3 | 0 | 0 | 3 | 3 |
| **Open Elective-II for other school students** | | | | | | | | | |
| 6 | B20EDO602 | Building planning and bye laws | OE | B20ED0303 | 3 | 0 | 0 | 3 | 3 |
| **TOTAL** | | | | | **18** | **0** | **0** | **18** | **18** |
| | **Practical /Term Work / Practice Sessions/Online/MOOC** | | | | | | | | |
| 7 | B20ED6070 | Technical Documentation | FC | ----- | 1 | 0 | 0 | 1 | 1 |
| 8 | B20ED0605 | Extensive Survey Lab | HC | B20ED0303 | 1 | 0 | 1 | 2 | 3 |
| 9 | B20ED0606 | Project Management Lab | HC | B20ED0604 | 0 | 0 | 1 | 1 | 2 |
| **TOTAL** | | | | | **2** | **0** | **2** | **4** | **6** |
| **TOTAL SEMESTER CREDITS** | | | | | | | | **23** | |
| **TOTAL CUMULATIVE CREDITS** | | | | | | | | **131** | |
| **TOTAL CONTACT HOURS** | | | | | | | | **26** | |

## VII SEMESTER

| Sl. No | Course Code | Title of the Course | HC/FC /SC/OE | Pre requisite | Credit Pattern & Credit Value | | | | Contact Hours/ Week |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total | |
| 1 | B20ED0702 | Estimation , Costing and Valuation, Project Report | HC | B20ED0303 | 2 | 0 | 1 | 3 | 4 |
| 2 | B20ED0701 | Analysis and Design of Bridges | HC | B20ED0602 | 3 | 0 | 0 | 3 | 3 |
| **Professional Electives – III & IV** | | | | | | | | | |
| **3** | B20EDS713 | Civil Engineering- Societal & Global Impact | SC | | 3 | 0 | 0 | 3 | 3 |
| | B20EDS714 | Earth and Earth Retaining Structures | | B20ED0601 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS715 | Ground Water Hydraulics | | B20ED0305 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS716 | Repair and Rehabilitation of Structures | | B20ED0602 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS717 | Structural Dynamics | | B20ED0405 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS718 | Urban Transport Planning | | B20ED0505 | | | | | |
| 4 | B20EDS719 | Construction Materials and Sustainability | SC | B20ED0201 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS720 | Environmental Geo-Technology | | B20ED0601 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS721 | Environmental Impact Assessment and Life Cycle Analysis | | B20ED0505 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS722 | Finite Elements Analysis | | B20ED0503 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS723 | Intelligent Transportation Systems | | B20ED0505 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS724 | Theory of Elasticity | | B20ED0503 | 3 | 0 | 0 | 3 | 3 |
| | B20EDS725 | Applications of Remote sensing and Geographical Information System | | B20EDS613 | 3 | 0 | 0 | 3 | 3 |
| **Open Elective-IV for other school students** | | | | | | | | | |
| 5 | B20EDO703 | Disaster Preparedness, Planning and Management | OE | B20EDS607 | 3 | 0 | 0 | 3 | 3 |
| **TOTAL** | | | | | **14** | **0** | **1** | **15** | **16** |
| | **Practical /Term Work / Practice Sessions/Online/MOOC** | | | | | | | | |
| 6 | B20ED0703 | Structural Design, Drawing and Detailing ( RCC & Steel) | HC | B20ED0503, B20ED0603 | 2 | 0 | 1 | 3 | 4 |
| 7 | B20ED0704 | Project Phase-I | HC | --- | 2 | 0 | 0 | 2 | 4 |
| **TOTAL** | | | | | **4** | **0** | **1** | **5** | **8** |
| **TOTAL SEMESTER CREDITS** | | | | | | | | **20** | |
| **TOTAL CUMULATIVE CREDITS** | | | | | | | | **150** | |
| **TOTAL CONTACT HOURS** | | | | | | | | **24** | |

## VIII SEMESTER

| Sl. No | Course Code | Title of the Course | HC/FC/ SC/OE | Pre requisite | Credit Pattern & Credit Value | | | | Contact Hours/ Week |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total | |
| 1 | B20ED0802 | Technical Seminar/Internship/ Mini-Project | HC | ----- | 0 | 0 | 1 | 1 | 2 |
| **Open Elective-4 for other school students** | | | | | | | | | |
| 2 | B20EDO804 | Road safety and Management | OE | B20ED0505 | 3 | 0 | 0 | 3 | 3 |
| **Practical /Term Work / Practice Sessions/Online/MOOC** | | | | | | | | | |
| 3 | B20ED0802 | Project Work Phase-II | HC | ----- | 1 | 0 | 5 | 6 | 12 |
| **TOTAL** | | | | | **7** | **0** | **5** | **10** | **17** |
| **TOTAL SEMESTER CREDITS** | | | | | | | | **10** | |
| **TOTAL CUMULATIVE CREDITS** | | | | | | | | **160** | |
| **TOTAL CONTACT HOURS** | | | | | | | | **17** | |

# Detailed Syllabus
# Semester-I

## COURSE PACK FOR CIVIL ENGINEERING

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **Differential Equation and Linear Algebra** | | | | **Course Type** | | HC | |
| **Course Code** | B20AS0103 | **Credits** | **3** | | **Class** | | **I semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number ofClasses Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 4 | 3 | | | | |
| | Practice | - | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | **3** | **4** | **3** | **48** | **-** | **50%** | **50%** |

**Course Overview:**
This course is overview to applied mathematics, which is useful for Civil engineering students and it covers various methods of solving differential equation of first and higher order, linear algebra and transformation, solving linear system of equations and determining Eigen values and Eigen vectors along with applications to engineering problems.

**Course Objective:** Student shall be able to learn,

1. The impart knowledge of first order ordinary differential equations and its applications in the field of engineering.
2. The impart knowledge of higher order linear differential with constant coefficients
3. The impart knowledge of higher order linear differential equations with variable coefficients and its applications in the field of engineering.
4. Different methods to solve consistent system of algebraic equations.
5. The Eigen values and Eigen vectors of a square matrix
6. Diagonalization of a square matrix and canonical forms

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Study various methods to solve first order ordinary differential equations and its application. | 1 | 1,2 |
| CO2 | Solve Non-Homogeneous Linear Differential Equations with constant coefficients using direct method and the method of variation of parameters | 1 | 1,2 |

| | | | |
|---|---|---|---|
| CO3 | Solve Non-Homogeneous Linear Differential Equations with variable coefficients | 1 | 1,2 |
| C04 | Compute the solution of system of equations by various methods | 1 | 1,2 |
| CO5 | Compute the Eigen values and Eigen vectors of square matrix and to diagonalize the square matrices. | 1 | 1,2 |
| C06 | Study linear transformation and canonical form of matrix. | 1 | 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

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 1 | | | | | | | | | | 1 | | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 1 | | | |
| CO3 | 3 | 1 | 1 | | | | | | | | | | 1 | 1 | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 1 | | | |
| CO5 | 3 | 1 | 1 | | | | | | | | | | 1 | | | |
| CO6 | 3 | 1 | 2 | | | | | | | | | | 1 | 1 | | |

COURSE CONTENT -THEORY

Unit – 1: Differential equations of First order and first degree
(Recap: Variable separable, Homogenous and Linear equations) Bernoulli's equation, Exact Differential Equations, Equation reducible to exact [IF for the case of $\frac{1}{M}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ ***and*** $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ ***only*** ].Orthogonal trajectories (both Cartesian and polar form), Engineering applications.

Unit – 2: Linear differential equations
Linear differential equations with constant coefficients: inverse differential operator method and method of variation of parameters. Linear differential equations with variable coefficients: Solution of Cauchy's and Legendre's linear differential equations, engineering applications.

Unit – 3: Linear Algebra
Rank of Matrix by elementary transformations, Linear System of Equations, Conditions of Existence and Uniqueness of Solutions. Solution of linear system of equations by Gauss Elimination, Gauss –Jordan and Gauss-Seidel method, Engineering applications.

Unit – 4: Matrix theory
Eigen Values and Eigen Vectors, Rayleigh's power method to find the largest Eigen value and the corresponding Eigen vector. Linear transformation, diagonalization of a square matrix. Reduction of Quadratic form to Canonical form, engineering applications.

TEXTBOOK:
1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Reprint edition, 2013
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015

REFERENCE BOOKS:
1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition,2013
2. P.V. O'Neil, "Advanced Engineering Mathematics", Thomson Mathematical Methods by Potter & Goldberg; Publisher: PHI.

JOURNALS / MAGAZINES:
1. https://www.journals.elsevier.com/journal-of-differential-equations
2. https://www.journals.elsevier.com/linear-algebra-and-its-applications

SWAYAM/NPTEL/MOOCs:
1. https://nptel.ac.in/courses/111/106/111106051/
2. https://nptel.ac.in/courses/111/104/111104031/
3. https://www.coursera.org/learn/differential-equations-engineers

**PROBLEMS BASED LEARNING**

**Differential equations of first order and first degree**

| | |
|---|---|
| 1. | Solve $\frac{dy}{dx} = e^{3x-2y} + x^2e^{-2y}$ |
| 2. | Solve $e^x \tan y \, dx + (1 - e^x) \, dy = 0$ |
| 3. | Solve $\frac{dy}{dx} = \frac{y}{x-\sqrt{xy}}$ |
| 4. | Solve $y^2 + x^2 \frac{dy}{dx} = xy \frac{dy}{dx}$ |
| 5. | Solve $\frac{dy}{dx} = \frac{y}{x} + \sin\left(\frac{y}{x}\right)$ |
| 6. | Solve $(y^3 - 3x^2y)dx - (x^3 - 3xy^2dy = 0)$ |
| 7. | Solve y $e^{xy}dx + (xe^{xy} + 2y)dy = 0$ |
| 8 | Solve $\frac{dy}{dx} + 3x^2y = x^5e^{x^3}$ |
| 9. | Solve $\frac{dy}{dx} - \frac{2y}{x} = x + x^2$ |
| 10. | Solve $x\frac{dy}{dx} + y = x^3y^6$ |
| 11. | Solve: $\frac{dy}{dx} + y \cot x \ \cos x$ |

**Linear differential equation**

| | |
|---|---|
| 1. | Solve $\frac{d^2y}{dx^2} + 10\frac{dy}{dx} + 25y = 0$ |
| 2. | Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - 3y = 0$ |
| 3. | Solve $\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} + 3\frac{dy}{dx} - y = 0$ |
| 4. | Solve $\frac{d^2y}{dx^2} - 4y = cosh2x + 3^x$ |
| 5. | Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 6e^{3x} + 7e^{-2x} - log2$ |
| 6. | Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 12y = sin2x + e^{-4x}$ |
| 7. | Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 12y = 2x + x^2$ |
| 8. | Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 4y = e^x\cos x$ |
| 9. | Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xcosx$ |
| 10. | Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = e^{2x} - 4$ |
| 11. | Solve by the method of variation of parameters $(D^2 + 4)y = tan2x$ |
| 12. | Solve by the method of variation of parameters $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = e^x tanx$ |
| 13. | Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + y = secx\ tanx$ |
| 14. | Solve by the method of variation of parameters $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}$ |
| 15. | Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + a^2y = secax$ |
| 16. | Solve $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = logx$ |
| 17. | Solve $(1+2x)^2\frac{d^2y}{dx^2} - 2(1+2x)\frac{dy}{dx} - 12y = 6x + 5$ |
| 18. | Solve $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + 2y = x\sin(logx)$ |
| 19. | Solve $(1+x)^2\frac{d^2y}{dx^2} + (1+x)\frac{dy}{dx} + y = 2\sin[log[1+x]]$ |
| 20. | Solve $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = logx\sin(logx)$ |

**Matrix Theory**

| | |
|---|---|
| 1 | Reduce the following matrix $\begin{bmatrix} 1 & 2 & -3 & 1 & 2 \\ 2 & 3 & -4 & 6 & 10 \\ 3 & 6 & -6 & 9 & 13 \end{bmatrix}$ to row reduced echelon form. |
| 2 | Find the row-reduced Echelon form of the matrix $\begin{bmatrix} 91 & 92 & 93 & 94 & 95 \\ 92 & 93 & 94 & 95 & 96 \\ 93 & 94 & 95 & 96 & 97 \\ 94 & 95 & 96 & 97 & 98 \\ 95 & 96 & 97 & 98 & 99 \end{bmatrix}$ |
| 3 | Find the Rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$ |
| 4 | Find the Rank of the matrix $\begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$ |
| 5 | Test for consistency and solve $x + y + z = 6$, $x - y + 2z = 5$, $3x + y + z = 8$ . |
| 6 | Test for consistency and solve $x + 2y + 3z = 14$, $4x + 5y + 7z = 35$, $3x + 3y + 4z = 21$ |
| 7 | Investigate the values of $\lambda$ *and* $\mu$ so that the equations $2x + 3y + 5z = 9$ ; $7x + 3y - 2z = 8$ ; $2x + 3y + \lambda z = \mu$ have i) no solution ii) unique solution iii) infinite number of solution. |
| 8 | Determine the values of a and b for which the system $x + ay + z = 3$ ; $x + 2y + 2z = b$ ; $x + 5y + 3z = 9$ are consistent. When will these equations have unique solution. |
| 9 | Using Gauss elimination method solve $x_1 - 2x_2 + x_3 = 0$, $2x_2 - 8x_3 = 8$, $-4x_1 + 5x_2 + 9x_3 = -9$ |
| 10 | Using Gauss elimination method solve $x + 2y - 3z = 1$, $2x + 5y - 8z = 4$, $3x + 8y - 13z = 7$ |
| 11 | Using Gauss elimination method solve $x + y + z = 6$, $x - y + 2z = 5$, $3x + y + z = 8$ |
| 12 | Using Gauss elimination method solve $x_1 - 2x_2 + x_3 = 0$, $2x_2 - 8x_3 = 8$, $-4x_1 + 5x_2 + 9x_3 = -9$ |
| 13 | Using Gauss Jordan method solve $2x + y + 4z = 12$, $4x + 11y - z = 33$, $8x - 3y + 2z = 20$ |
| 14 | Using Gauss Jordan method solve $x + 2y + z = 3$, $2x + 3y + 3z = 10$, $3x - y + 2z = 13$ |
| 15 | Using Gauss Jordan method solve $x + y + z = 6$, $x - y + 2z = 5$, $3x + y + z = 8$ |
| 16 | Using Gauss Jordan method solve $x + y + z = 9$ ; $x - 2y + 3z = 8$ ; $2x + y - z = 3$ |
| 17 | Solve the system of equations using Gauss - Seidel method $10x + y + z = 12$, $x + 10y + z = 12$, $x + y + 10z = 12$ |
| 18 | Solve the system of equations using Gauss - Seidel method $10x + y + z = 12$, $2x + 10y + z = 13$, $2x + 2y + 10z = 14$ |
| 19 | Solve the system of equations using Gauss - Seidel method $20x + y - 2z = 17$, $3x + 20y - z = -18$, $2x - 3y + 20z = 25$. |
| 20 | Solve the system of equations using Gauss - Seidel method $x + y + 54z = 110$, $27x + 6y - z = 85$, $6x + 15y + 2z = 72$. |

**COURSE PACK FOR: APPLIED PHYSICS**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **Applied Physics** | | | | **Course Type** | | **Regular** | |
| **CourseCode** | **B20AS0101** | **Credits** | **3** | | **Class** | | **I semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 0 | 0 | 0 | Theory | Practical | CIE | SEE |
| | Tutorial | 0 | - | - | | | | |
| | **Total** | **3** | **3** | **3** | **4** | **0** | **50%** | **50%** |

**COURSE OVERVIEW**

Applied Physics is very important and necessary basic subject for all branches of engineering. Itprovides the fundamental knowledge and basic principles of Physics, which is required for basic foundation in engineering education irrespective of the branch. It provides this knowledge under four units, i.e. hydrostatics and engineering mechanics. This subject has basic laws, Statements, expressions and theories which helps to understand the scientific and technological aspects. The course also consists of real time and numerical examples which makes subject interesting and attractive.

**COURSE OBJECTIVE**

This course enables graduating students

1. To make a bridge between the physics fundamentals which they studied in schools and their applications which they are going to study in Civil Engineering.
2. To be acquainted with the basic concepts of properties of fluids, pressure and its measurements.
3. To get exposed to basic concepts of elastic properties of solids, vibrations.
4. To know about the different types of measuring instruments
5. To be acquainted with concepts of Kinematics.
6. To know about the rectilinear and curvilinear motions.

**COURSEOUTCOMES (COs)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Understand the basic properties of fluids and their applications. | PO1, PO2, PO4 | PSO1, PSO2,PSO3 |
| CO2 | Understanding the different types of pressure measuring gauges. | PO1,PO2, PO3 | PSO1, PSO2,PSO3 |

| | | | |
|---|---|---|---|
| CO3 | Understand the advanced concepts of Hydraulics and Fluid Machines. | PO1,PO2, PO3 | PSO1, PSO2,PSO 3 |
| C04 | Explain the construction and working of different of mechanical measuring instruments and Strength of Materials. | PO1,PO2 | PSO1, PSO2,PSO 3 |
| C05 | Understand the Concepts of Kinematics. | PO1,PO2, PO7 | PSO1, PSO2,PSO 3 |
| CO6 | Explain the differential equations and concepts of rectilinear and curvilinear motion. | PO1,PO2, PO7 | PSO1, PSO2,PSO 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 | ✓ | ✓ | ✓ | ✓ | | |
| C04 | ✓ | ✓ | ✓ | ✓ | | |
| CO5 | ✓ | ✓ | ✓ | ✓ | | |
| CO6 | ✓ | ✓ | ✓ | ✓ | | |

**COURSE ARTICULATIONMATRIX**

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | | 1 | | | | | | | | | 3 | 3 | 3 | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 3 | 3 | |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 3 | 3 | |
| CO4 | 3 | 2 | | | | | | | | | | | 3 | 3 | 3 | |
| C05 | 3 | 2 | | | | | 3 | | | | | | 3 | 3 | 3 | |
| CO6 | 3 | 2 | | | | | 3 | | | | | | 3 | 3 | 3 | |

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

**COURSE CONTENT THEORY**

| Contents |
|---|
| **10 hrs** |
| **UNIT: 1 Properties of Fluids:** Physical properties of fluids like Density, Specific Weight, Specific Gravity, Specific Volume, Surface Tension, Capillarity, Viscosity, Compressibility and Bulk Modulus, Classifications of Fluids. **Pressure and its Measurements:** Pressure, Pascal's law, pressure at a point, hydrostatic Law, atmospheric pressure, absolute pressure, gauge pressure and Vacuum pressure, Manometers. |
| **10 hrs** |

| |
|---|
| **UNIT:2 Hydrostatics Forces:** On plane submerged surfaces, Forces on Horizontal surfaces, Vertical Surfaces, Inclined Surfaces Centre of Buoyancy. Buoyancy and Flotation, Archimedes' Principle, Stability of Immersed and floating bodies, determination of metacentric height. |
| **10 hrs** |
| **UNIT:3 Mechanical Properties of Materials**: Stress and Strain, Tensile strength, Stress-Strain- behavior, Ductile and Brittle Materials, Impact test, Toughness, Hardness test, Fatigue and fatigue test, Creep and Creep test, Fracture. Vibrations: Simple harmonic motion, free vibration, damped vibration and forced vibration, resonance and its importance. |
| **10 hrs** |
| **UNIT:4 Kinematics of Rectilinear Motion**: Principles of dynamics, differential equation of rectilinear motion, D'Alembert's principle, Momentum and Impulse, Work and Energy, Impact. **Curvilinear Translation:** Kinematics of Curvilinear motion, Differential equations of curvilinear motion, motion of projectile, D'Alembert's principles in curvilinear motion, work and energy in curvilinear motion. |

**Text Books:**

1. Hydraulics and Fluid Mechanics, Dr.P.N.Modi & Dr.S.M.Seth , Standard Book House.
2. Fluid Mechanics by A.K.Mohanty, PHI

**Reference Books:**

1. Material Science by M.S.Vijaya, G.Rangarajan, Tata McGraw Hill.
2. Engineering Mechanics by S.Timoshenko, D.H.Young and J.V.RAo, McGraw Hill.
3. Engineering Mechanics by I.S.Gujral, Laxmi Publications.
4. Material Science for Engineers by James F. Shackeford.

**PROJECT BASED LEARNING**

To enhance the skill set in the integrated course, the students are advised to execute course-based**Design projects**. Some sample projects are given below:

| No. | Suggested sample Projects |
|---|---|
| 1. | Build a model of different types of manometer. |
| 2. | Build a working model of Pascal law. |
| 3. | Collect different type of materials and compare their mechanical properties. |

**COURSE PACK FOR: INTRODUCTION TO DATA SCIENCE**

<table>
<tr><th>Course Title</th><th colspan="4">Introduction to Data Science</th><th colspan="2">Course Type</th><th colspan="2">Integrated</th></tr>
<tr><th>Course Code</th><th>B20CS0101</th><th>Credits</th><th colspan="2">3</th><th colspan="2">Class</th><th colspan="2">I semester</th></tr>
<tr><th rowspan="5">Course Structure</th><th>TLP</th><th>Credits</th><th>Contact Hours</th><th>Work Load</th><th colspan="2" rowspan="2">Total Number of Classes Per Semester</th><th colspan="2" rowspan="2">Assessment in Weightage</th></tr>
<tr><th>Theory</th><td>2</td><td>2</td><td>2</td></tr>
<tr><th>Practice</th><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><th>Tutorial</th><td>-</td><td>-</td><td>-</td></tr>
<tr><th>Total</th><th>3</th><th>4</th><th>4</th><th>26</th><th>26</th><th>50%</th><th>50%</th></tr>
</table>

**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 by using MS-Excel.

**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
5. Illustrate modeling Error in Linear Regression
6. Demonstrate applications of Data Science

**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 5, 8 to 10 | 1,2,3 |
| CO2 | Apply the SQL commands in developing the real-world applications. | 1 to 5, 8 to 10 | 1,2,3 |
| CO3 | Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data. | 1 to 5, 8 to 10 | 1, 2, 3 |
| CO4 | Create the real world AI based solutions using different machine learning algorithms | 1 to 5, 8 to 10 | 1, 2, 3 |

| | | | |
|---|---|---|---|
| CO5 | Illustrate modeling Error in Linear Regression | 1 to 5, 8 to 10 | 1, 2, 3 |
| CO6 | Demonstrate applications of Data Science | 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 | | | ✓ | ✓ | | |
| 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 | | | 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 |
| **C04** | 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 |

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

**Course Content**

| Contents |
|---|
| **Unit-I**<br>**Introduction to Microsoft Excel**<br>Creating Excel tables, Understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Filters, Grouping. 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 – II**

**Introduction to Data Science**

What is Data Science? Probability theory, bayes theorem, bayes probability; Cartesian plane, equations of lines, graphs; exponents.

**Introduction to SQL**

SQL: creation, insertion, deletion, retrieval of Tables by experimental demonstrations. Import SQL Database Data into Excel

**Unit-III**

**Data science components**

Tools for data science, definition of AI, types of machine learning (ML), list of ML algorithms for classification, clustering, and feature selection. 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-IV**

**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

**Applications of Data Science**

Data science life cycle, Applications of data science with demonstration of experiments either by using Microsoft Excel.

**PRACTICE:.**

<table>
<tr><th>No</th><th colspan="11">Title of the Experiment</th><th>Tools and Techniques</th><th>Expected Skill/Ability</th></tr>
<tr><td rowspan="3">1</td><td colspan="11">The height (in cm) of a group of fathers and sons are given below, Find the lines of regression and estimate the height of son when the height of father is 164 cm.</td><td rowspan="3">MS Excel</td><td rowspan="3">Create and perform operations on Excel data set by applying Linear regression</td></tr>
<tr><td>Plot the graph. Hgt of Fathers</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 Sons</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>
<tr><td>2</td><td colspan="11">Using the data file DISPOSABLE INCOME AND VEHICLE SALES, perform the following:<br>i) Plot a scatter diagram.<br>ii) Determine the regression equation.<br>iii) Plot the regression line (hint: use MS Excel's Add Trendline feature).<br>iv) Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900.<br>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>
</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.<br><br>i) Plot a scatter diagram.<br>ii) Determine the regression equation.<br>iii) Plot the regression line (hint: use MS Excel's Add Trendline feature).<br>iv) Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.<br>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>mont h</th><th>interes t rate</th><th>unemployment rate</th><th>stock index price</th></tr>
<tr><td>2020</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 a loan availed of
<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>5.20%</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>
Rs.10,00,000 during 3 years.</td>
<td>MS Excel</td>
<td>Create Excel data and perform EMI estimator</td>
</tr>
</table>

<table>
<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 customers 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 linear regression to find the weather (temperature) of a city with the amount of rain in centimeters. Create your own database with following details.<table><tr><td>CITY</td><td>Temperature in Centigrade</td><td>Rain in Centimeters</td></tr><tr><td></td><td></td><td></td></tr></table></td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>9</td><td>Use the linear regression technique to compare the age of humans with the amount of sleep in hours.<table><tr><td>Name</td><td>Age in Years</td><td>Sleep in hours</td></tr></table>Create your own database with above details.</td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>10</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>11</td><td>Design the ER diagram and create schema of the REVA library management system.</td><td>Entity Relationship</td><td>Entity Relationship diagrams</td></tr>
<tr><td>12</td><td>Design the ER diagram and create schema for Hospital Management system.</td><td>Entity Relationship</td><td>Schema design</td></tr>
</table>

**Text Book:**


1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 43nd edition, 2015.
2. Ramakrishnan and Gehrke , “Database Management systems”, Third 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”, Tata McGraw Hill Publications, 19th edition, 2013.
2. ErwinKreyszig, “Advanced Engineering Mathematics”, Wiley Publications, 9th edition, 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

**SWAYAM/NPTEL/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 University (https://www.coursera.org/learn/datasciencemathskills)
4. https://www.edx.org/course/subject/data-science
5. https://onlinecourses.nptel.ac.in/noc19_cs60/preview

**Self-Learning Exercises:**

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

**COURSE PACK FOR: ENGINEERING MECHANICS**

<table>
<tr><td>Course Title</td><td colspan="4">Engineering Mechanics</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0101</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">I semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

**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**

This course enables graduating students

1. To understand a broad concept of Engineering Mechanics.
2. To enable students to apply fundamental laws and basic concepts of rigid bodies mechanics to solve problems of bodies under motion or in rest.
3. To enable the students to apply conditions of static equilibrium to analyze physical system of coplanar forces.
4. To enable students to find frictional force between the surfaces.
5. To provide an overview of centroid of plane area
6. To provide an overview of Moment of Inertia of plane area.

**COURSE OUT COMES (COs)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Ability to understand basics of mechanics related to Particle, Continuum and Rigid body; Forces, Couple & moment of couple. | 1, 2 | 1, 2 |
| CO2 | Compute the resultant of system of forces in plane and space acting on bodies. | 1, 2 | 1, 2 |
| CO3 | Analyze equilibrium problems with coplanar forces and friction. | 1, 2 | 1, 2 |

| | | | |
|---|---|---|---|
| C04 | Compute the frictional force between the surfaces | 1, 2 | 1, 2 |
| CO5 | Predict the centroid of different geometrical shapes. | 1, 2 | 1, 2 |
| C06 | Predict the Moment of Inertia of different geometrical shapes. | 1, 2 | 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 | | ✓ | ✓ | ✓ | ✓ | |
| C04 | | ✓ | ✓ | ✓ | ✓ | |
| CO5 | | ✓ | ✓ | ✓ | ✓ | |
| C06 | | ✓ | ✓ | ✓ | ✓ | |

**COURSE ARTICULATION MATRIX**

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | | | | | | | | | | | 3 | 1 | | |
| CO2 | 2 | 2 | | | | | | | | | | | 2 | 2 | | |
| CO3 | 1 | 3 | | | | | | | | | | | 1 | 3 | | |
| C04 | 1 | 3 | | | | | | | | | | | 1 | 3 | | |
| CO5 | 1 | 3 | | | | | | | | | | | 1 | 3 | | |
| C06 | 1 | 3 | | | | | | | | | | | 1 | 3 | | |

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

**COURSE CONTENT THEORY**

| Contents |
|---|
| **UNIT:1 Engineering Mechanics:** Basic idealizations - Particle, Continuum and Rigid body; Force and its characteristics, Classification of force systems; Principle of physical independence of forces, Principle of superposition of forces, Principle of transmissibility of forces, Introduction to SI units, Moment of a force, couple, moment of a couple, characteristics of couple, Equivalent force - couple system. |
| **UNIT:2 Analysis of Force Systems:** Resolution of forces, Composition of forces - Definition of Resultant, Composition of coplanar -concurrent force system, Parallelogram Law of forces, Principle of resolved parts, Numerical problems on composition of coplanar concurrent force systems, Composition of coplanar - non-concurrent force system, Varignon's principle of moments; Numerical problems on force systems. |
| **UNIT:3 Equilibrium of Coplanar Forces:** Definition of static equilibrium and equilibrant, Conditions of static equilibrium for different coplanar force systems, Lami's theorem, Concept of Free Body Diagram, Types of beams, loads, types of support conditions and simple support reactions problems. Plane trusses: Method of joints and sections (maximum 5 members).<br>**Friction:** Frictional forces, Laws of friction, Angle of friction, Angle of repose and cone of friction (Theory only). |
| **UNIT:4 Centroid:** Introduction to the concept, Centroid of plane figures, Locating the centroid of triangle, semicircle, quadrant of a circle and sector of a circle using method of integration, Centroid of composite sections; Numerical problems (symmetric).<br>**Moment of Inertia:** Introduction to the concept, Rectangular and polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem, Moment of Inertia of rectangle, circle, semi-circle, quarter circle and triangle from method of integration, Moment of inertia of composite areas, Numerical problems (symmetric). |

**Practice:**

| No | Title of the Experiment | Tools and Techniques | Expected Skill |
|---|---|---|---|
| 1. | Determination of Young’s Modulus by Uniform bending method. | Wooden bar, Screw gauge, Venire calipers, Weights. | Hands on experienc e |
| 2 | Determination of Rigidity Modulus by Static Torsion Method. | Searle's static torsion apparatus: rod with attached pulley, weight hanger, slotted weights, telescope, mirror and scale. | Hands on experience |
| 3. | Determination of Tensile strength of mild steel materials | Universal Testing Machine | Hands on Experience |

| | | | |
|---|---|---|---|
| 4. | Determination of viscosity by Poiseuille method/ falling ball method | (i) Glass tubes (ii) Steel balls (iii) Retort stand and clamps (iv) Weighing balance (v) Screw gauge (vi) Stopwatch (vii) Sample liquids (castor oil and glycerin) (viii) Tweezers (ix) Vernier Caliper and (x) Magnets | Hands on experience |
| 5. | Determination of Metacentric height of a floating body | A Tank, Pontoon, weights | Hands on experience |
| 6. | Determination of pressure on a surface by using monometer | Monometer | Hands on experience |
| 7. | Verification of laws of vibration of a stretched string using sonometer. (demonstration only) | Visual demonstration | Identification |
| 8. | Newton's Laws of motion. (demonstration only) | Visual demonstration | Identification |
| 9 | Handling of different carpentry tools | Carpentry tools | Hands on experience |
| 10 | Study of various plumbing tools and fittings | Plumbing tools | Hands on experience |

**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


**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.


**Magazines:** Civil Engineering and Construction Review

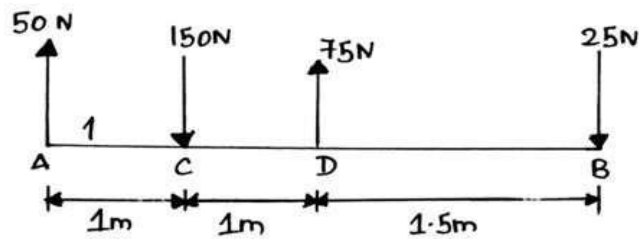
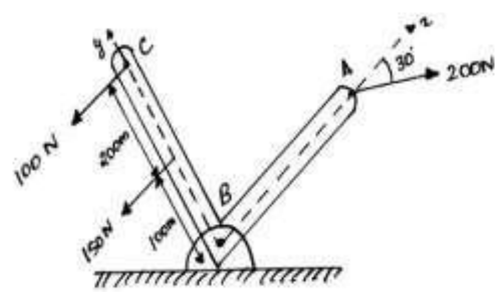
**SWAYAM/NPTEL/MOOCs:**

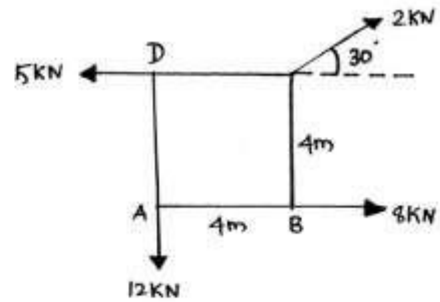
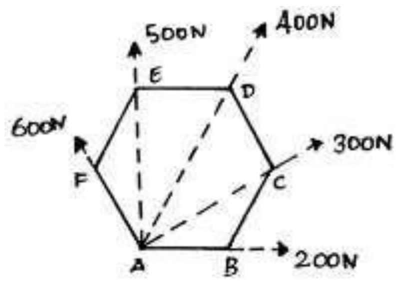
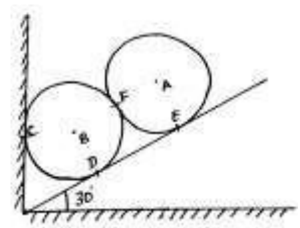
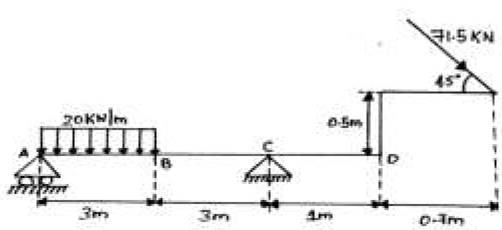
1. https://nptel.ac.in/courses/112/106/112106286/ (60%)
2. https://nptel.ac.in/courses/122/104/122104015/ (20%)

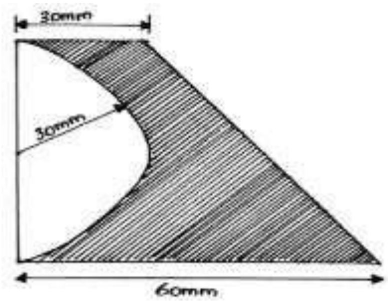
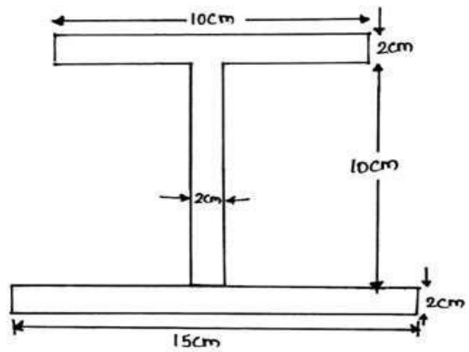
**Practice**

| PRACTICE # | Topics to be Covered |
|---|---|
| 1. | Determination of Young's Modulus by Uniform bending method. |
| 2. | Determination of Rigidity Modulus by Static Torsion Method. |
| 3. | Determination of Tensile strength of mild steel materials. |
| 4. | Determination of viscosity by Poiseuille method/ falling ball method. |
| 5. | Determination of Metacentric height of a floating body. |
| 6. | Determination of pressure on a surface by using monometer. |
| 7. | Verification of laws of vibration of a stretched string using sonometer. (Demonstration only). |
| 8. | Newton's Laws of motion. (Demonstration only). |
| 9. | Handling of different carpentry tools |
| 10 | Study of various plumbing tools and fittings |

**PROBLEM BASED LEARNING**

| No | Problem |
|---|---|
| 1 | A system of forces acting on a rigid bar as shown in figure below. Reduce this system to a<br>1. single force from A.<br>2. single force and a couple at A<br>3. single force and a couple at B<br> |
| 2 | Three external forces are acting on L shaped lever as shown in figure. Determine the equivalent system through B.<br> |

| | |
|---|---|
| 3 | Find the magnitude, direction, resultant and its distance from point A of the force system shown in figure.<br><br> |
| 4 | The force 200N, 300N, 400N, 500N and 600N are acting at the angular points as shown in figure. taken in order. Determine the magnitude and direction of the resultant.<br><br> |
| 5 | Two identical rollers A and B each of weight 700N are supported by an inclined plane and vertical wall as shown in figure. find the reaction exerted by the wall and the inclined plane at C, D, E and F.<br><br> |
| 6 | Compute the reactions at the supports of the beam ABCD which is loaded and supported as shown in figure.<br><br> |

| | | |
|---|---|---|
| 7 | Determine the moment of inertia of the shaded area about the centroidal axis as shown in figure.<br> |
| 8 | Determine the moment of inertia of the shaded area about the centroidal axis shown in figure.<br> |

**Project Based Learning – Integrated Course**

To Enhance The Skill Set In The Integrated Course, The Students Are Advised To Execute Course-Based **Design Projects**. Some Sample Projects Are Given Below:

| No. | Suggested Projects |
|---|---|
| 1. | Working models for force and friction. |
| 2. | Demo Model of different types of beams. |

**Practical /Term Work / Practice Sessions/Online /MOOC**

**COURSE PACK: ENTREPRENEURSHIP**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **ENTREPRENEURSHIP** | | | | **Course Type** | | **Theory** | |
| **Course Code** | **B20ME0104** | **Credits** | **3** | | **Class** | | **I semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | 13Hrs/ Semester | | Assessment in Weightage | |
| | Theory | 1 | 1 | 1 | | | | |
| | Practice | - | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | 1 | 1 | 1 | 13 | 0 | 50% | 50% |

**Course Overview**

Course Description: This is an *introductory course* is designed to provide the foundational concepts of *entrepreneurship*, including the definition of *entrepreneurship*, the profile of the *entrepreneur*, the role of venture creation in society. The course also provides a bird's eye view on the steps to start a venture, financing, marketing as well as support by various institutions towards entrepreneurship.

**Course Objective**

1. To understand the basic terms, concepts in Entrepreneurship Development
2. To apply for the supporting schemes towards entrepreneurship

COURSE OUTCOMES (COs)

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

| CO | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Define the keywords and concepts used in entrepreneurship development | 1 | |
| CO2 | Describe the characteristics and types of an entrepreneur | 1,6 | |
| CO3 | Explain the new generations of an entrepreneurship and skills of an entrepreneur | 1,2,6,7,10,12 | 1,3 |
| CO4 | Differentiate between the industrial park and special economic zone | 1,2,7 | 1,3 |
| CO5 | Classify the tender process and exemptions from income tax. | 1,2,5,8,10-12 | 1,3 |
| CO6 | Choose the suitable government agencies to support his/her idea to become an entrepreneur | 1-4,6-12 | 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 | 1 | | | | | | | | | | | | | | |
| CO2 | 1 | | | | | 1 | | | | | | | 2 | | 2 |
| CO3 | 1 | 1 | | | | 2 | 1 | | | 1 | | 2 | 2 | | 2 |
| CO4 | 1 | 1 | | | | | 2 | | | | | | 2 | | 2 |
| CO5 | 2 | 2 | | | 1 | | | 3 | | 3 | 3 | 1 | 2 | | 2 |
| CO6 | 1 | 3 | 3 | 1 | | 3 | 3 | 3 | 1 | 3 | 3 | 2 | 2 | | 2 |

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

**Course Content Theory**

**Practical /Term Work / Sessions**

Evolution of term 'Entrepreneurship', Factors influencing entrepreneurship', Psychological factors, Social factors, Economic factors, Environmental factors. Characteristics of an entrepreneur, Difference between Entrepreneur and Entrepreneurship, Types of entrepreneurs. 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

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) licence, 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.

**Text Book:**

1. Entrepreneurship Development, K. Ramachandran, Tata Mc. Graw Hill, 2008
2. Entrepreneurship Development, Sangeeta Sharma, PHI Publications, 2016

**Reference Books:**

1. Baringer and Ireland, Entrepreneurship, 11th Edition, Pearson, 2020.
2. P. Narayana Reddy, Entrepreneurship – Text and Cases, Cengage Learning India, I edition, 2010

3. "Corporate Entrepreneurship: Building The Entrepreneurial Organization" by Paul Burns published by Palgrave Macmillan.
4. Drucker F Peter,:"Innovation and Entrepreneurship", 1985.Heinemann, London.

**Journals/Magazines**

International Small Business Journal: https://journals.sagepub.com/home/isb
Journal of Development Entrepreneurship: https://www.worldscientific.com/worldscinet/jde

**SWAYAM/NPTEL/MOOCs:**

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

**Self-Learning Exercises:**

- Introverts participate. If you have a few vocal students asking questions and little participation from others, anonymous questions lower student anxiety, which makes it easier for everyone to participate.
- You learn what students are thinking about. Anonymity provides cover for students to ask questions they may be too afraid to ask but are curious about.
- Discussions start. Anonymity means you can invite students to pose "challenging" questions. If you encourage your students to question what they're learning, why it's important, or why they should have to do the work you're assigning, you spark discussions about how entrepreneurship is relevant, which can often be the key to increasing engagement.

**Lesson Plan**

| Lecture # | Topics to be Covered |
|---|---|
| 1. | Introduction to Entrepreneurship, Evolution of term 'Entrepreneurship' |
| 2. | Factors influencing entrepreneurship', Psychological factors, Social factors, Economic factors, Environmental factors. |
| 3. | Characteristics of an entrepreneur, Difference between Entrepreneur and Entrepreneurship, Types of entrepreneurs. |
| 4. | New generations of entrepreneurship viz. social entrepreneurship, Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship etc |
| 5. | Barriers to entrepreneurship, Creativity and entrepreneurship |
| 6. | Innovation and inventions, Skills of an entrepreneur, Decision making and Problem Solving |
| 7. | Organization Assistance to an entrepreneur, New Ventures |
| 8. | Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), |
| 9. | Financial assistance by different agencies, MSME Act Small Scale Industries |
| 10. | Carry on Business (COB) licence, Environmental Clearance, National Small Industries Corporation (NSIC), |
| 11. | e-tender process, Excise exemptions and concession, |

| | |
|---|---|
| 12. | Exemption from income tax, The Small Industries Development Bank of India(SIDBI) |
| 13. | Incentives for entrepreneurs, Conclusion of the Course |

**Problem Based Learning**

| No. | |
|---|---|
| 1 | How to write a Business Plan |
| 2 | Creating Marketing, Financial and Organizational Plans. |
| 3 | How to apply for financial assistance via various schemes |
| 4 | How to file taxes as a Small Business and understand the importance of GST |

**COURSE PACK FOR: IOT and Applications**

| **Course Title** | **IoT and Applications** | | | | **Course Type** | | **Integrated** | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **B20EC0101** | **Credits** | **2** | | **Class** | | **I Semester** | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 1 | 1 | 1 | | | | |
| | Practice | 1 | 2 | 2 | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | Total | 2 | 3 | 3 | 13 | 26 | 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 the course are to**

1. Explain the architecture of Internet of things
2. Include 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 application of IoT

**Course Outcomes (Cos)**

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

| **CO#** | **Course Outcomes** | **POs** | **PSOs** |
|---|---|---|---|
| 1 | Describe the architecture of IoT eco-system | 1 | 1,2 |
| 2 | Identify IoT devices, architecture, sensors and Communication protocols | 1 | 1,2 |
| 3 | Demonstrate the interface of sensors to IoT boards | 1 | 1,2 |
| 4 | Realize various Applications of IoT through case studies | 1,5, 12 | 1,2 |
| 5 | Develop simple IoT projects and modules | 1,5, 12 | 1,2 |
| 6 | Identify technologies used to develop IoT based applications | 1,5,9,10, 11, 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) |
| 1 | √ | √ | | | | |
| 2 | | √ | | | | |
| 3 | | | √ | | | |
| 4 | | | | √ | √ | |
| 5 | | | | | | √ |
| 6 | | | | | | √ |

**Course Articulation Matrix**

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 3 | | | | | | | | | | | | 3 | 3 | | |
| **2** | 3 | | | | | | | | | | | | 3 | 3 | | |
| **3** | 3 | | | | 3 | | | | | | | 3 | 2 | 2 | | |
| **4** | 3 | | | | 3 | | | | | | | 3 | 1 | 1 | | |
| **5** | 3 | | | | 3 | | | | 2 | | | 3 | 3 | 3 | | |
| **6** | 3 | | | | 3 | | | | | 3 | 3 | 3 | 3 | 3 | | |

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

**Course Content Theory**

| **Contents** |
|---|
| UNIT – 1<br>IoT Basics: Introduction to IoT, How does Internet of Things Works, Features of IoT, Advantages and Disadvantages of IoT, Embedded Devices in IoT, IoT eco-system, IoT Architecture and IoT Devices: Components of IoT architecture, Stages of IoT solution architecture, Smart Objects, IoT Devices. |
| UNIT – 2<br>IoT boards in Market: Arduino, Arduino UNO, ESP8266 ,Raspberry Pi<br>IoT Platform: Amazon Web Services (AWS) IoT platform, Microsoft Azure IoT platform, Google Cloud Platform IoT, IBM Watson IoT platform, ThingWork IoT platform<br>Technologies Used in IoT: Bluetooth, Wi-Fi, Li-Fi, RFID ,Cellular ,Z-Wave |

Practice:

| SL. No | Title of the Experiment | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1. | Introduction to IoT Board<br>a) Arduino UNO<br>b) Arduino Nano<br>c) Node MCU<br>d) Ethernet Shield | Hardware | • Identifications of various parts of Arduino and Node MCU boards<br>• Study of Ethernet shield and connection to the board |
| 2. | Working with Arduino IDE (Integrated Development Environment) | Open source Arduino IDE | • Download specified software<br>• Modify code as per the application<br>• Upload the code to IoT board |
| 3. | a) Demonstration of Multimeter usage<br>b) Demonstration of Breadboard connection for Voltage, Ground, series and parallel connections<br>c) Exercise to read the value of resistor using Colour code chart | Multimeter<br>Breadboard<br>Resistor packs | • Measurement of voltage at various points in IoT boards<br>• Choose the value of Resistor for an application |
| 4 | Reading photo resistor sensor value connected to Arduino Board | Arduino UNO<br>Arduino IDE<br>LDR , Multimeter, Resistor | Interface of photo sensor to IoT board for light measurement applications |
| 5 | Reading temperature sensor value connected to Arduino Board | Arduino UNO , Arduino IDE, Temperature sensor, Multimeter | Interface of Temperature sensor to IoT board for temperature measurement application |
| 6. | Reading motion detector sensor value connected to IoT board | Arduino UNO , Arduino IDE, pyro-dielectric sensor, Multimeter | Interface of Motion detector sensor to IoT board for motion detection applications |
| 7 | Reading distance measurement using Ultrasonic sensor Connected to IoT board | Arduino UNO , Arduino IDE, Ultrasonic sensor, Multimeter | Interface of Motion detector sensor to IoT board for motion detection |

| | | | |
|---|---|---|---|
| 8 | Interface relay to IoT board | Arduino UNO , Arduino IDE, relay Multimeter | Interface relay to IoT board for Switching Applications |
| 9 | Connect Wifi-ESP8266 to Arduino UNO board , Send and receive data through smart phone. | Arduino UNO<br>ESP8266, Arduino IDE<br>Smart phone | Connect IoT board to<br>Wi-Fi network |
| **Part-B (Case Study projects)** | | | |
| Automated lighting system, Intelligent Traffic system, Smart Parking, Smart water management ,Smart healthcare ,IoT for smart cities, IoT and Cloud Server Based Wearable Health Sensor's Monitoring System, IoT - Industrial Internet of Things Monitoring Of Sensor's Data on Android App, Remote Patient Monitoring ,E Agriculture Monitoring on Webpage Motor Controlling with Android App. Integrated Smart Health Care Monitoring System .,Air Pollution & Water Quality Monitoring System, A Smart System connecting E-Health Sensor's and the Cloud ,Smart E-Agriculture Monitoring Using Internet Of Things, IoT based Garbage Management System ,IoT projects \| Smart Home Automation using IOT ,IoT based submersible motor pumps on/off ,IoT Based Electronic Door Opener, IoT Based Garbage Monitoring ,Monitoring of Highway Hybrid Parameter & Controlling Highway Light Through Iot Based Smart Agriculture Monitoring System,IoT Based Agriculture Crop - Field Monitoring System and Irrigation Automation ,An IoT Based Patient Monitoring System using Raspberry Pi ,Underground Cable Fault Detection Over Internet Of Things (Iot) Google Map ,IoT Air & Water Quality Monitoring System,IoT Based Automatic Vehicle Accident Detection and Rescue System ,Patient Health Status Observing Based On IoT and Email Alert ,IoT Based Vehicle Accident Detection and Tracking System on google map webpage ,Data Logger System for weather monitoring using WSN ,Smart intelligent security system for women ,Building Automation System Using GRPS IoT, Implementation of Industrial Data Acquisition, management and Guiding using IoT Distance based Accident Avoidance System using CAN protocol & Tracking through IoT ,Multiple Garbage Box Monitoring & Collection system, IoT Based Garbage Monitoring System ,Swachh Bharat Waste Collection Management System using IOT | | | |
| **PART C (Mini Project)** | | | |
| 1 | **Arduino Controlled Light intensity**: design and build a simple , effective circuit called Auto Intensity Control of Street Lights using Arduino | ArduinoUNO,DS3231 RTC Module, LDR 16×2 LCD Display ,LED,10KΩ Potentiometer,10KΩ Resistor, Push Button, Connecting Wires, | Design and Implementation of IoT project to solve Engineering Problems. |
| 2 | **Thermometer**: build an LCD thermometer with an Arduino UNO and a LM35/36 analog | Arduino Uno, Temperature Sensor, LCD display, Breadboard and Connecting wires | Design and Implementation of IoT project for Engineering applications. |
| 3 | Motion activated light lamp: build an automated project that It switches on and off when there's | Arduino Uno, PIR Motion sensor, breadboard, connecting wires, LED generic. | Design and Implementation of IoT project for Engineering applications |
| 4 | Touchless motion sensor trash can: build touchless motion sensor trash can | Arduino UNO, Ultra sonic sensor, Micro servo motor, Breadboard, Connecting wires | Design and Implementation of IoT project for Engineering applications |

**Text Book:**

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

**Reference Books:**

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

**SWAYAM/NPTEL/MOOCs:**

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

**Lesson Plan**

| Lecture # | Topics to be Covered |
|---|---|
| 1. | Introduction to IoT, IoT ecosystem |
| 2. | IoT design frame, Advantages and disadvantages of IoT |
| 3. | IoT architecture and Domains |
| 4. | IoT devices and IoT platforms |
| 5. | Communication Protocols |
| 6. | Working with IoT and Cloud platforms |
| 7. | Case Study Projects: Lighting as a service<br>i) Lighting as a service ii) Intelligent Traffic systems iii) Smart Parking iv) Smart water management |
| 8. | Intelligent Traffic systems |
| 9. | Smart Parking |
| 10. | Smart water management |
| 11. | IoT for smart cities |

**COURSE PACK: Engineering Drawing (Manual)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **Engineering Drawing (Manual)** | | | | **Course Type** | | **Integrated** | |
| **Course Code** | **B20ED0102** | **Credits** | **3** | | **Class** | | **I semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 2 | 2 | 2 | | | | |
| | Practice | 1 | 2 | 2 | Theory | Practical | CIE | SEE |
| | Tutorial | 0 | - | - | | | | |
| | **Total** | **3** | **4** | **4** | **26** | **13** | **50%** | **50%** |

**Course Overview**

This course introduces the language of drawings to students. Students will be exploring usage of basic drawings tools. For Civil Engineers, drawings are predominant requirements for visualizing and efficiently communicate the ideas graphically technical information without any ambiguity to various stakeholders. Concepts of the course will be utilized in mapping, contour platting, building drawing and structural designs. Students will be understanding concepts like orthographic projections and isometric projections, which are very much essential for visualizing structures different planes. Development of solid concepts will be useful for quantity estimation of surfaces.

**Course Objective**

This course enables graduating students

1. To comprehend general projection theory, with emphasis on orthographic projection to represent in two-dimensional views (principal, auxiliary, sections).
2. To dimension and annotate two-dimensional engineering drawings with projection of solids.
3. To dimension and annotate two-dimensional engineering drawings with development of solids.
4. To understand the application of industry standards and best practices applied in engineering with respect to isometric concepts for spherical objects.
5. To emphasize freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically through conversion or transformation concepts using orthographic and isometric views.
6. To draw the perspective views using visual ray method.

**Course Outcomes (Cos)**

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

| **CO#** | **Course Outcomes** | **POs** | **PSOs** |
|---|---|---|---|
| CO1 | Apply independent thinking and problem solving capabilities in tool usage, projection, and dimensioning, 2D views. | PO1, PO2, PO3, PO5, PO9, PO10 | PSO2, PSO3 |
| CO2 | Express component descriptions as per the commonly practiced standards in dimensioning, annotating in development of solids | PO1,PO2, PO4,PO5, PO10 | PSO3, PSO4 |

| | | | |
|---|---|---|---|
| CO3 | Express component descriptions as per the commonly practiced standards in dimensioning, annotating in projection of solids | PO1,PO2, PO4,PO5, PO10 | PSO3, PSO4 |
| C04 | Executing drawings with isometric views for spherical objects | PO1,PO2, PO4,PO5, PO10 | PSO2, PSO3 |
| CO5 | Preparing industry specific drawings aligning the transformation of views using isometric and orthographic views. | PO1,PO2, PO4,PO5, PO10 | PSO3, PSO4 |
| C06 | Enable to draw perspective views by visual ray method | PO1,PO2, PO4,PO5, PO10 | PSO2, PSO3 |

**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 | ✓ | | ✓ | | ✓ | ✓ |
| C06 | | | ✓ | ✓ | | ✓ |

**Course Articulation Matrix**

| **CO#/ POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | 2 | | | | 3 | 3 | | | | 3 | 3 | |
| CO2 | 3 | 2 | | 2 | 2 | | | | | 3 | | | | | 3 | 3 |
| CO3 | 3 | 2 | | 2 | 2 | | | | | 3 | | | | 3 | 3 | 2 |
| C04 | 3 | 2 | | 2 | 2 | | | | | 3 | | | | 3 | 3 | |
| CO5 | 3 | 2 | | 2 | 2 | | | | | 3 | | | | 3 | 3 | 2 |
| CO6 | 3 | 2 | | 2 | 2 | | | | | 3 | | | | 3 | 3 | |

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

**Course Content Theory**

| Contents |
|---|
| **UNIT 1: Introduction to Engineering Drawing:** Introduction, Drawing Instruments and their uses, BIS conventions, Drawing sheets, Lettering, Dimensioning, Scales, Methods of drawing simple figures- ellipse, parabola, hyperbola, regular polygons.<br>**Orthographic Projections:** Projection – Orthographic Projection – Planes of Projection – Four quadrants – First-angle projection – Third-angle projection.<br>**Projection of points and Straight Lines (First-angle Projection only):** Points in different quadrants. Lines inclined to both the planes, True Lengths, traces.<br>**Projection of Planes (First-angle Projection only)**: Projection of regular Planes- auxiliary planes and projections inclined to both planes. |
| **UNIT 2: Projection of Solids: Projection of regular solids inclined to both planes – auxiliary views, section and sectional views of right regular solids – prisms, cone – auxiliary views.**<br>**Development of Solids: Development of surfaces of right regular solids – prisms, cylinders, pyramid cone** |
| **UNIT 3: Isometric Projection :**Principles of Isometric projections - Lines and Planes – Isometric Scale – Isometric views – conventions – Isometric views of lines, plane figures, simple and compound solids – Isometric projection of objects having non-isometric lines. Isometric projection of spherical parts. |
| **UNIT 4: Transformation of projections: Conversion of Isometric Views to Orthographic views – conventions. Introduction to perspective views – Visual ray method simple drawings.** |

**Text Book:**

1. Engineering Drawing – N.D.Bhatt and V.M. Panchal, 48th Edition, 2005 – Charotar Publishing House, Gujarat.
2. Engineering Drawing – K.L.Narayan & P.Kannaih
3. Engineering Graphics - K.R. Gopalakrishna, 32nd Edition, 2005 – Subhas Publishers, Bangalore.

**Reference Books:**

1. Technical Drawing with Engineering Graphics by Frederick Giesecke, John Thomas Dygdon, Alva Mitchell,
2. A Textbook of Engineering Drawing by R. K. Dhawan

**Journals/Magazines**

1. Journal of engineering graphics (Journal: https://www.oriprobe.com/journals/gctxxb.html)
2. Journal of Graphic Engineering and Design (Journal: https://www.grid.uns.ac.rs/jged/)

**SWAYAM/NPTEL/MOOCs:**

1. Engineering Drawing :By IIT Kanpur, , Prof. Anupam Saxena
https://freevideolectures.com/course/3420/engineering-drawing/1 )

**Lesson Plan (Practice)**

| No | Title of the Experiment | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1. | BIS conventions & Scales | Drawing accessories | Conventions & scaling techniques |
| 2 | Methods of drawing simple figures- Regular polygons. | Drawing accessories | Conventions, scaling, shapes identification |
| 3. | Projection of lines: Lines parallel to both HP and VP , Lines parallel to HP and inclined to VP | Drawing accessories | Visualization of planes |
| 4. | Projection of lines: finding the true lengths of lines, Applications of traces in projection of lines | Drawing accessories | Visualization of planes |
| 5. | Projections of planes parallel to VP and inclined to HP, projections of planes inclined to both HP and VP | Drawing accessories | Visualization of planes |
| 6. | Projection of regular solids inclined to both HP and VP<br>Sectional view of right regular solid- prism (with auxiliary views) | Drawing accessories | Visualization of planes and sections |
| 7. | Development of surfaces of right regular solids-cone and its parts, Development of surfaces of right regular solids-Pyramid and its parts | Drawing accessories | Development of shapes |
| 8. | Isometric views of plane figures<br>Isometric views of simple solids | Drawing accessories | Isometric visualization |
| 9 | Isometric views of compound solids | Drawing accessories | Isometric visualization |
| 10 | Isometric projection of objects having non-isometric lines | Drawing accessories | Isometric visualization |
| 11 | Transformation of projections | Drawing accessories | Conversions, planes identification |

| | | | |
|---|---|---|---|
| 12 | Conversion of Isometric Views to Orthographic views | Drawing accessories | Conversions, planes identification |
| 13 | Visual ray method simple drawings | Drawing accessories | Conversions, planes identification |

**Problem Based Learning**

| No | Problem |
|---|---|
| 1 | A 60mm long line AB, has its end A at a distance of 20mm in front of the V.P. the line is perpendicular to V.P and 40mm above H.P, draw the projection of the line. |
| 2 | A line AB, 70mm long, has its end A 15mm above HP and 20mm in front of VP. It is inclined at 30° to HP and 45°to VP. Draw its projections and mark its traces |
| 3 | Square plane with a 40mm side has its surface parallel to and 20mm above the HP. Drawn its Projections, when (a) A side is parallel to VP (b) A side is inclined at 300 to VP and (c) All sides are equally inclined to VP. |
| 4 | A Hexagonal plane with a 30mm side has its surface parallel to and 20mm in front of the VP. Draw it's Projections, when (a) a side is perpendicular to HP (b) a side is parallel to the HP (c) Side is inclined at 450 to the HP |
| 5 | A Pentagonal plane with a 30mm side has an edge on the HP, the surface of the Plane is inclined at 450 to the HP. Draw it's Projections? |
| 6 | A Circular plane with a 60mm Diameter is resting on a point it's circumference on the VP. The center is 40 mm above the HP , and The surface is inclined at 450 to the VP. And perpendicular to the HP Draw It's Projections? |
| 7 | A Square Pyramid, having base with a 40 mm side and 60mm axis is resting on its base on the HP. Draw its Projections when (a) a side of the base is parallel to the VP. (b) A side of the base is inclined at 300 to the VP and (c) All the sides of base are equally inclined to the VP. |
| 8 | A pentagonal Prism having a base with 30 mm side and 60mm long Axis, has one of It's bases in the VP. Draw Its projections When (a)rectangular face is parallel to and 15 mm above the HP (b) A rectangular face perpendicular to HP and (c) a rectangular face is inclined at 450 to the HP |

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Build a model of different shape by using waste materials or recyclable materials, which are ecofriendly.<br>Prism<br>Rectangle<br>Cylinder<br>Cone |
| 2. | Build a model of Cylinder and cut a cylinder along a chord of the circular ends, from end to end.<br>To represents shapes such as Circle and ellipse |
| 3. | Build a model of cone and cut a section<br>To represents shapes such as Circle and ellipse, parabola and hyperbola |

**SEMESTER-II**

# COURSE PACK FOR CIVIL ENGINEERING

<table>
<tr><td>Course Title</td><td colspan="4">Vector Calculus and Partial Differential Equations</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AS0205</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</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>Theory</td><td>3</td><td>4</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>3</td><td>48</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

**Course Overview:**

This course is overview to applied mathematics, which is useful for Civil engineering students and it covers various techniques for solving partial derivatives, multiple integrals, vector calculus, vector differentiation to flow problems, vector integration, formation of partial differential equations and various methods to find the solution with applications to engineering problems.

Course Objective: Student shall be able to learn,

1. The impart knowledge of partial differentiation and its application
2. Multiple integrals and beta gamma functions
3. The impart knowledge of vector calculus in the field of engineering
4. Vector integration and curvilinear coordinate system
5. Homogeneous and non- homogeneous partial differential equations.
6. Various methods to solve partial differential equations

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Study the concept of partial differentiation and its application in engineering. | 1 | 1,3 |
| CO2 | Solve double and triple integrals over a region and improper integrals using Beta and Gamma function. | 1 | 1,3 |
| CO3 | Analyze vector functions and vector differential operators. | 1 | 1,3 |

| | | | |
|---|---|---|---|
| C04 | Evaluate line integrals, surface, and volume integrals and to study curvilinear coordinate systems. | 1 | 1,3 |
| CO5 | Evaluate the solution of homogeneous and non- homogeneous partial differential equations. | 1 | 1,3 |
| C06 | Study various methods to solve partial differential equations having one or more independent variables | 1 | 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

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

| **CO#/ POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 1 | | | | | | | | | | 1 | | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 1 | | | |
| CO3 | 3 | 1 | 1 | | | | | | | | | | 1 | | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 1 | | | |
| CO5 | 3 | 1 | 1 | | | | | | | | | | 1 | | 1 | |
| CO6 | 3 | 2 | 1 | | | | | | | | | | 1 | | 1 | |

COURSE CONTENT THEORY

Unit-1: Partial Derivatives and Multiple Integrals

Functions of several variables – Partial derivatives, Homogeneous Functions – Euler's theorem, Jacobians. Multiple Integrals – Double integrals – Change of order and change of variables. Triple integrals Illustrative examples for change of order and change of variables. Gamma and Beta functions with simple examples. Engineering applications.

Unit –2: Vector Calculus
Differentiation of Vectors, Curves in space, Velocity and Acceleration, Tangential and normal acceleration, Relative velocity and acceleration, Scalar and vector point functions- Vector operator del. Del applied to scalar point functions – Gradient, Del applied to Vector point function – Divergence and Curl. Engineering applications.

Unit -3: Vector integration
Line integral – Circulation – work, Surface integral – Flux, Green's Theorem in the Plane, Stokes Theorem, Volume Integral, Divergence Theorem, Green's Theorem, Irrotational and Solenoidal Fields, Orthogonal Curvilinear Coordinates. Engineering Applications.

Unit -4: Partial Differential Equations
Formation of partial differential equations, solutions of non-homogeneous PDE by direct integration, Solutions of homogeneous PDE involving derivatives with respect to one independent variable, solution of Lagrange's Linear PDE, Solutions of PDE by product method, Engineering Applications.

TEXTBOOK:
1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Reprint edition, 2013.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2013.

REFERENCE BOOKS:
1. P.V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning, 7th Edition, 2012.
2. Potter and Goldberg, "Mathematical Methods", Printice Hall of India Pvt. Ltd.

JOURNALS/MAGAZINES:
1. https://www.journals.elsevier.com/partial-differential-equations-in-applied-mathematics/
2. https://www.elsevier.com/books/vector-calculus/cox/978-0-08-057295-6

SWAYAM/NPTEL/MOOCs:
1. https://www.coursera.org/learn/calculus-and-optimization-for-machine-learning
2. https://www.coursera.org/learn/vector-calculus-engineers.
3. https://www.coursera.org/learn/differential-equations-engineers

**Problems Based Learning**

| | **Partial Derivatives and Multiple Integrals** |
|---|---|
| 1 | If $z = \log(x^2+y^2)$ find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ |
| 2 | If $x+y+z = \log z$ find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ |
| 3 | If $u = x^3 - 3xy^2 + x + e^x cosy + 1$, show that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ |
| 4 | If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ show that $xu_x + yu_y = 1$ |
| 5 | Verify $u_{xy} = u_{yx}$ for the following functions, i. $u = \sin^{-1}(y/x)$<br>ii. $u = x^y$<br>iii. $u = log\left(\frac{x^2+y^2}{x+y}\right)$ |
| 6 | If $u = \log\sqrt{x^2+y^2+z^2}$, show that $(x^2+y^2+z^2)\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right) = 1$ |
| 7 | State and prove Euler's theorem for Homogeneous functions. |
| 8 | If $u = \frac{x^3+y^3}{\sqrt{x+y}}$ show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{5}{2}u$ |
| 9 | If $u = \sin^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, show that $xu_x + yu_y = 2\tan u$ |
| 10 | Find the Jacobian of $u, v, w$ w.r.t $x, y, z$ given $u = x+y+z,\ v = y+z,\ w = z$ |
| 11 | If $x = r\sin\theta\cos\varphi,\ y = r\sin\theta\sin\varphi,\ z = r\cos\theta$ show that $\frac{\partial(x,y,z)}{\partial(r,\theta,\varphi)} = r^2\sin\theta$ |
| 12 | Evaluate $\int_0^1\int_x^{\sqrt{x}} xy\,dy\,dx$ |

| | |
|---|---|
| 13 | Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} x^3 y \, dx\, dy$ |
| 14 | Evaluate $\iint y$ dxdy over the region bounded by the first quadrant of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ |
| 15 | Evaluate $\iint xy\,(x+y)$dxdy taken over the area between $y = x^2 and\ y = x$ |
| 16 | Evaluate by change of order of integration $\int_0^1 \int_x^1 \frac{x}{\sqrt{x^2+y^2}}\, dy\, dx$ |
| 17 | Evaluate by change of order of integration $\int_0^\infty \int_x^\infty \frac{e^{-y}}{y}\, dx\, dy$ |
| 18 | Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\, dx\, dy$ by changing to polar coordinates. |
| 19 | Evaluate $\int_{-1}^1 \int_0^z \int_{x-z}^{x+z} (x+y+z)$ dx dy dz |
| 20 | Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} xyz$ dx dy dz |
| 21 | Express $\int_0^1 x^m (1-x^n)^p dx$ in terms of beta functions and evaluate $\int_0^1 x^5 (1-x^3)^{10} dx$ |
| 22 | Given that $\int_0^\infty \frac{x^{m-1}}{(1+x)}\, dx = \frac{\pi}{\sin m\pi}$ by data. $\Gamma(m)\Gamma(1-m) = \frac{\pi}{\sin m\pi}$ for $0 < m < 1$ |
| | **Vector Calculus** |
| 1 | If $x = t^2 + 1,\ = 4t - 3,\ z = 2t^2 - 6t$ represents the parametric equation of a curve, determine the following.<br>i. The unit tangent vector at any point on the curve<br>ii. The angle between the tangents at $t = 1\ and\ t = 2$ |
| 2 | A particle moves along a curve whose parametric equations are: $= e^{-t},\ y = 2\cos 3t,\ = 2\sin 3t$, where $t$ is the time. Find the velocity and acceleration at any time t and also their magnitudes at $t = 0$. |
| 3 | A particle moves along the curve $C: x = t^3 - 4t,\ y = t^2 + 4t,\ z = 8t^2 - 3t^3$ where t denotes time. Find the components of its acceleration $at\ t = 2$ along tangent and normal. |
| 4 | Given $\vec{A} = x^2yzi + y^2zxj + z^2xyk$ find $div\ \vec{A}\ and\ curl\ \vec{A}$ |
| 5 | Find the unit vector normal to the surfaces at the indicated points $x^2y - 2xz + 2y^2z^4 = 10$ at $(2, 1, -1)$ |
| 6 | Find the directional derivatives of the following<br>i. $\varphi = x^2yz + 4xz^2\ \ at\ (1, -2, -1)\ \ along\ 2i - j - 2k$<br>ii. $\varphi = 4xz^3 - 3x^2y^2z\ \ at\ (2, -1, 2)\ \ along\ 2i - 3j + 6k$ |
| 7 | Find the directional derivative of the function xyz along the direction of the normal to the surface $xy^2 + yz^2 + zx^2 = 3$ at the point$(1,1,1)$. Also find the equation of the tangent plane and the normal line to this surface. |
| 8 | If the directional derivative of $\varphi = axy^2 + byz + cz^2x^3$ at $(-1,1,2)$ has a maximum magnitude of 32 units in the direction parallel to $y - axis\ find\ a, b, c.$ |
| 9 | Find the angle between the normal to the surface $x^3 - y^3 + xz^2 = 4$ at the points (1,-1,2) and (1,1,2) |
| 10 | Find the value of the constants a and b such that the surfaces $ax^2 - byz = (a+2)x$ and $4x^2y + z^3 = 4$ are orthogonal at the point $(1, -1, 2)$ |
| 11 | If $\vec{A} = 2x^2i - 3yzj + xz^2k$ and $\varphi = 2z - x^3y$, compute $\vec{A} \cdot \nabla\varphi\ and\ \vec{A} \times \nabla\varphi$ at (1,-1,1) |
| 12 | Find $div\ \vec{F}$ and $curl\ \vec{F}$ where $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$ |
| 13 | If $\vec{F} = (3x^2y - z)i + (xz^3 + y^4)j - 2x^3z^2k$, find $grad\ (div\vec{F})$ at (2, -1, 0) |
| 14 | If $\vec{A} = xz^3i - 2x^2yz + 2yz^4k$ find $\nabla \cdot \vec{A},\ \ \nabla \times \vec{A}\ \ and\ \nabla \cdot (\nabla \times \vec{A})$ at the point (1,-1,1). |
| 15 | If $\vec{V} = \frac{xi+yj+zk}{\sqrt{x^2+y^2+z^2}}$ then show that $div\ \vec{V} = \frac{2}{\sqrt{x^2+y^2+z^2}}$ and $curl\ \vec{V} = \vec{0}$ |
| 16 | Prove that $\nabla.(r^n\vec{r}) = (n+3)r^n$ |
| 17 | Show that $\vec{F} = (2xy^2 + yz) + (2x^2y + xz + 2yz^2)j + (2y^2z + xy)k$ is conservative force field. Find its scalar potential. |

| | |
|---|---|
| 18 | Prove that curl ($\varphi\vec{A}$) = $\varphi$ curl$\vec{A}$ + $grad\varphi$ x $\vec{A}$ |
| 19 | Show that $\vec{F} = (y+z)i + (z+x)j + (x+y)k$ is irrotational. Also find a scalar function $\varphi$ such that $\vec{F} = \nabla\varphi$ |
| | |
| | **Vector Integration** |
| 1 | $If\ \vec{F} = xy\,i + yz\,j + zx\,k,$ evaluate $\int \vec{F}.d\vec{r}$ over a curve C represented by $x = t, y = t^2, z = t^3, -1 \le t \le 1.$ |
| 2 | Evaluate $\int \vec{F}.d\vec{r}$ where $\vec{F} = xy\,i + (x^2 + y^2)j\ along$<br>i) The path of the straight line from $(0,0)\ to\ (1,0)\ and\ then\ to\ (1,1)$<br>ii) The straight line joining the origin and $(1,2)$ |
| 3 | Find the total work done by the force represented by $\vec{F} = 3xy\,i - y\,j + 2zx\,k$ in moving a particle round the circle $x^2 + y^2 = 4$ |
| 4 | $If\ \vec{F} = x^2 i + xy\,j,\ evaluate\ \int \vec{F}\,d\vec{r}\ ,\ from\ (0,0)\ to\ (1,1)\ along$<br>i) the line y = x ii) the parabola $y = \sqrt{x}$ |
| 5 | If the acceleration of a particle at any time t is $\vec{a} = 18\cos 3t\,i - 8\sin 2t\,j + 6t\,k\ and\ \vec{v}$ represents its velocity and $\vec{r}$ represents displacement which are zero at $t = 0$, find $\vec{r}$ at time $t > 0.$ |
| 6 | If $\varphi\ \emptyset = 2xyz^2, \vec{F} = xy\,i - z\,j + x^2k$ and C is the curve $x = t^2, y = 2t, z = t^3,$ from $t = 0\ to\ t = 1$, evaluate $i) \int \emptyset\,d\vec{r}$ ii) $\int \vec{F} \times d\vec{r}$ |
| 7 | Verify Green's theorem in a plane for $\oint(3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the boundary of the region enclosed by $y = \sqrt{x}$ and $y = x^2$ |
| 8 | Evaluate $\int(xy - x^2)\,dx + x^2y\,dy$ where C is the closed curve formed by $y = 0, x = 1\ and\ y = x.$ |
| 9 | Using Green's theorem : $\int(\cos x \sin y - xy)dx + \sin x \cos y\,dy$ , where C is the circle with centre at origin and unit radius. |
| 10 | Find the area between the parabolas $y^2 = 4x\ and\ x^2 = 4y$ with the help of Green's theorem in a plane. |
| 11 | Verify Stoke's theorem for the vector $\vec{F} = (x^2 + y^2)i - 2xy\,j$ taken round the rectangle bounded by $x = 0, x = a, y = 0, y = b.$ |
| 12 | Evaluate $\int xy\,dx + xy^2dy$ , by Stoke's theorem where C is the square in the x-y plane with vertices $(1,0)(-1,0)(0,1)(0,-1)$ |
| 13 | Using divergence theorem evaluate $\iint \vec{A}.\hat{n}ds$ where $\vec{A} = x^3 i + y^3 j + z^3 k$ and S is the surface of sphere $x^2 + y^2 + z^2 = a^2$ |
| 14 | Using divergence theorem evaluate $\iint \vec{A}.\hat{n}ds$ where $\vec{A} = xi + yj + z\,k$ and S is the surface of sphere $x^2 + y^2 + z^2 = 1$ |
| 15 | If $\vec{F} = 2xy\,i + yz^2\,j + xz\,k$ and S is the rectangular parallelepiped bounded by $x = 0, y = 0, z = 0, x = 2, y = 1, z = 3\ \iint \vec{F}.\hat{n}ds$ |
| 16 | Express the vector $F = y^2 i - 2zj + xy\,k$ in cylindrical system |
| 17 | Express the vector $F = zi - 2xj + y\,k$ in cylindrical system |
| 18 | Express the vector $F = yi + xj - z^2\,k$ in to spherical co-ordinates. |
| 19 | Express the vector $F = 2yi - zj + 3xk$ in to spherical co-ordinates. |
| | |
| | **Partial Differential Equations** |
| 1 | Form the Partial differential equations by eliminating arbitrary constants in the following. i) $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ ii) $z = a\,log(x^2 + y^2) + b$ |

| | |
|---|---|
| 2 | Form the Partial differential equations by eliminating arbitrary functions in the following. i) $z = y^2 + 2f\left(\frac{1}{x} + \log y\right)$ ii) $z = e^{ax+by} f(ax - by)$ |
| 3 | Solve $\frac{\partial^3 z}{\partial x^2 \partial y} + 18xy^2 + si(2x - y) = 0$ by direct integration. |
| 4 | Solve $\frac{\partial^2 z}{\partial x \partial y} = \sin x \sin y$ for which $\frac{\partial z}{\partial y} = -2\sin y$ when $x = 0$, and $z = 0$ if y is odd multiple of $\frac{\pi}{2}$. |
| 5 | Solve $\frac{\partial^2 z}{\partial x \partial y} = \frac{x}{y}$ subject to the conditions that $\frac{\partial z}{\partial x} = \log_e x$ when $y = 1$ and $z = 0$ when $x = 1$. |
| 6 | Solve $\frac{\partial^2 z}{\partial x^2} = a^2 z$ given that when $x = 0$, $\frac{\partial z}{\partial x} = a \sin y$ and $\frac{\partial z}{\partial y} = 0$ |
| 7 | Solve $\frac{\partial^2 z}{\partial x^2} + 3\frac{\partial z}{\partial x} - 4z = 0$ subject to the conditions that $z = 1$ and $\frac{\partial z}{\partial x} = y$ when $x = 0$. |
| 8 | Solve $(y - z)p + (z - x)q = (x - y)$ |
| 9 | Solve $x^2 \frac{\partial z}{\partial x} + y^2 \frac{\partial z}{\partial y} = (x - y)z$ |
| 10 | Solve $y^2 zp = x^2(zq + y)$ |
| 11 | Solve $\frac{\partial^2 z}{\partial x^2} = a^2 z$ given that when $x = 0, z = 0$ and $\frac{\partial z}{\partial x} = a \sin y$ |
| 12 | Solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$ where $u(x, 0) = 6e^{-3x}$ by the method of separation of variables |
| 13 | Solve $4\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 3$ given that $u(0, y) = 2e^{5y}$ by product method. |
| 14 | Solve $\frac{\partial^2 z}{\partial x^2} = \frac{\partial z}{\partial y} + 2z$ Subject to the conditions $z(0, y) = 0$ and $z_x(0, y) = e^{2y}$ by product method. |
| 15 | Solve $\frac{\partial^2 u}{\partial x^2} - 2\frac{\partial u}{\partial x} + \frac{\partial^2 u}{\partial y^2} = 0$ by the method of separation of variables |
| 16 | Solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$ where $u(x, 0) = 6e^{-3x}$ by the method of separation of variables |

**COURSE PACK FOR: APPLIED CHEMISTRY**

| **Course Title** | **Applied Chemistry** | | | | **Course Type** | | **Theory** | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **B20AS0201** | **Credits** | **3** | | **Clas** | | **II semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | | | | Theory | Practical | CIE | SEE |
| | Tutorial | | | | | | | |
| | **Total** | **3** | **3** | **3** | **39** | **0** | 50% | 50% |

**Course Overview**

Applied chemistry covers very relevant topics compatible with Civil engineering students and make them aware of importance of various aspects of basic science in engineering. The subject of applied chemistry covers area of water technology, corrosion phenomenon, which is widely an interdisciplinary subject of discussion. Further the course focus on the corrosion phenomenon, and various methods to control it. This area of science is very much interdisciplinary in its nature and gives a platform for students to strengthen their engineering knowledge of corrosion in higher semester. The present applied chemistry course further enlightens 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**

The Applied chemistry course is designed to fulfill the following objective;

- To impart knowledge about the significance of water chemistry and various methods of water treatment.
- To provide information on electrochemical concepts of corrosion science and engineering.
- Highlights on energy storage devices and other renewable energy sources and their applications.
- Introduction to engineering materials, properties and their applications.

**COURSE OUTCOMES (Cos)**

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

| CO | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Describe properties of water and various methods employed in water treatment. | 1,2,3 | 1 |
| CO2 | Understand and analyse the metal stability (corrosion resistance) under different environmental conditions. | 1,2,3 | 1 |
| CO3 | Identify and compare the materials best suited materials for construction of Battery, fuel cells and Photovoltaic Cell. | 1,2,3 | 1 |
| CO4 | Understand common use of metals and alloys, ceramics, polymers, their composition, properties and engineering applications. | 1,2,3 | 1 |
| CO5 | Explore the modern materials and their composites for technological applications | 1,2,3 | 1 |
| CO6 | Importance of advanced materials for electrochemical energy storage, conversion, and environmental remedies. | 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** | **2** | **1** | | | | | | | | | | **1** | | |
| CO2 | **2** | **1** | **2** | | | | | | | | | | **1** | | |
| CO3 | **1** | **2** | **1** | | | | | | | | | | **1** | | |
| CO4 | **2** | **3** | **3** | | | | | | | | | | **1** | | |
| **CO5** | 2 | 2 | 2 | | | | | | | | | | **1** | | |
| **CO6** | 1 | 2 | 1 | | | | | | | | | | **1** | | |

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

**Course Content Theory**

| Content |
|---|
| **UNIT-I**<br>**Water Technology**: Sources of water, Impurities of water, Hardness & its determination (EDTA method), Boiler Troubles & their removal, water softening methods -Lime soda, Zeolite & Ion exchange, Desalination of water — Electro dialysis & Reverse osmosis method, Chemical analysis of water |
| **UNIT-II**<br>**Corrosion:** Definition, Examples, Types, Theory of corrosion, Dry corrosion (Direct chemical Attack), Wet corrosion (electrochemical attack), Mechanism of wet corrosion, Factors affecting corrosion, Corrosion Control methods, protective coatings — Metallic & organic type. |
| **UNIT-III**<br>**Energy devices:** Batteries & types, fuel cell, super capacitors, photo voltaic cell |
| **UNIT-IV**<br>**Modern materials:** Classification, properties, and compositions: polymers, biomaterials, glass, cement, ceramics, composite materials, nano materials, thin films, liquid crystals**. Metals & Alloys:** Classification and properties of iron, Steel, Nickel, Chromium, Tungsten & alloys. |

**Text Book:**

1. Engineering Chemistry by R.V.Gadag & Nithyanandashetty, Ik International Publishing house.
2. Text Book of Engineering Chemistry by S.S. Dara, S. Chand & Co.

**Reference Books:**

1. Physical Chemistry by P.W. Atkins, 5$^{th}$edition Oxford.
2. Callister W.D., Materials Science and Engineering, John Wiley & Sons.

**Journals/Magazines**

1. https://www.sciencedirect.com/journal/water-science-and-technology
2. https://iwaponline.com/wst
3. https://www.scitechnol.com/nanomaterials-molecular-nanotechnology.php
4. 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/

**Self –learning programme:**

Boiler corrosion and its treatment, Mechanism of scale formation in boilers, Anodic protection of corrosion control, Synthesis of Silicon and its purification, Role of stress and strain curve in understanding hardness/toughness of materials, mechanical properties of composite materials

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based **design projects**. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | **Chemical analysis of water for its toxic materials**: This can be done for all types of water sources available and can assess to test their drinkable condition |
| 2. | **Estimation of COD level of water**: To test its toxicity level, polluted by organic compounds |
| 3. | **Corrosion studies:** This can be done corrosion immunity of materials in different acids and bases. |
| 4. | **Analysis of scale and sludge:** Collect the scale and sludge samples for sample analysis by various analytical technical, following proper protocol |

**COURSE PACK FOR: INTRODUCTION TO PYTHON PROGRAMMING**

| **Course Title** | **Introduction to Python Programming** | | | | **Course Type** | | **Integrated** | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | B20CI0101 | **Credits** | **3** | | **Class** | | **II Semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 2 | 2 | 2 | | | | |
| | Practice | 1 | 2 | 2 | Theory | Practical | IA | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | **3** | **4** | **4** | **26** | **26** | **50** | **50** |

**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 objectoriented 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 | Make use of language constructs to solve real world problems using python programming. | 1- 4, 8, 9, 12 | 1 |
| CO2 | Develop programs for text processing and other application domains by making use of regular expressions. | 1-3, 5,9,12 | 2 |
| CO3 | Apply features of object oriented and NumPy package to develop computationally intensive programming to analyze and interpret the | 1- 5, 9, 12 | 3 |
| CO4 | Create data science solutions with the help of files, Pandas and Data Visualization. | 1,4,5,9,12 | 1-3 |
| CO5 | Learn new tools and technologies in the python and apply for suitable application development. | 12 | 1,2 |
| CO6 | Develop solutions in the python 1to the complex problems, either individually or as a part of the team and report the results with proper | 5, 9, 10 | 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 | 3 | 1 | 1 | 2 | | | | 1 | 1 | | | 1 | 3 | | |
| CO2 | 3 | 2 | 3 | | 2 | | | | 1 | | | 1 | | 3 | |
| CO3 | 3 | 1 | 2 | 1 | 2 | | | | 1 | | | 1 | | | |
| CO4 | 3 | | | 2 | 2 | | | | 1 | | | 1 | 3 | 3 | 3 |
| CO5 | | | | | | | | | | | | 1 | 2 | 2 | |
| CO6 | | | | | 2 | | | | 1 | 1 | | | | 2 | 2 |

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

**COURSE CONTENT**
**THEORY**

| **Contents** |
|---|
| **UNIT-1**<br>**Introduction to Computer Fundamentals:** Computer Components, accessories, specifications of computers and external devices. Flowchart symbols and guidelines, types and advantages, Algorithm design.<br>**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. Introduction to GitHub and applications. |
| **UNIT-2**<br>Strings: Unicode, 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 and Data Visualization.

**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, Jupiter | 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. | Windows/Linux OS, IDE, Jupiter | 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)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.<br>Convert all the strings to uppercase and display<br>Split the words of a string using space as the separation character and display. | | |
| 4. | a)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 $4^{th}$ Semester "A" Section who have scored more than 75%. | Windows/Linux OS, IDE, Jupyter | File Handling. |

| | | | |
|---|---|---|---|
| | b)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 TOTAL-DEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input() and compute the following:<br>TOTAL_DEDUCTIONS= (LIC+PF)<br>GROSS_SALARY= BASIC_SALARY+ DA<br>NET_SALARY= GROSS_SALARY – TOTAL_DEDUCTIONS.<br>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). 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:<br>Get the details of "CAR" object from user and store into Array of objects<br>Display the details of "CAR" object based on "COMPANY", "MODEL" and "PRICE". | Windows/Linux OS, IDE, Jupyter | Classes and objects usage. |
| | b). 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:<br>Get the details of "Airline" object from user and store into Array of objects<br>List details of all the passengers who travelled From "Bengaluru to London".<br>List details of all the passengers who travelled From "Chicago to Beijing" on $10^{th}$ of Feb, 2020. | | |
| 6. | a). "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<br>Diagonal elements of"Arr_1"<br>Elements of $m^{th}$ row (row no should be entered by user)<br>Elements of $n^{th}$column (column no should be entered by user) | Windows/Linux OS, IDE, Jupyter | NumPy arrays usability. |
| | b)The 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. | | Pandas Series usability. |
| | **Part-B (Mini Project: Library Management System)** | | |
| 1. | Develop a program to create the class "USER" with the attributes USER_NAME, USER_ID, SCHOOL_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 | Windows/Linux OS, IDE, Jupyter | Create a class user to read the attributes of user and store them in a file. |
| 2 | Develop 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" | Windows/Linux OS, IDE, Jupyter | Create a class user to read the attributes and |

| | | | |
|---|---|---|---|
| 3 | Develop 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_File.txt” and display the contents after | Windows/Linux OS, IDE, Jupyter | To create a class and edit the file. |
| 4 | Develop a program to create the class “BOOK” with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, SCHOOL_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 () | Windows/Linux OS, IDE, Jupyter | Create a class book to read the attributes of user and store them in a file. |
| 5 | Develop 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. | Windows/Linux OS, IDE, Jupyter | Create a class book to read the attributes and delete the object. |
| 6 | Develop 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. | Windows/Linux OS, IDE, Jupyter | To create a class and edit the file. |
| 7 | Develop 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 | Windows/Linux OS, IDE, Jupyter | Create class and perform string operations. |
| 8 | Develop 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 date are same and put zero | Windows/Linux OS, IDE, Jupyter | Create class and perform string operation. |
| 9 | Develop a program to search for a book using its “author”. Display the message “available” if search is successful otherwise display the message “not available”. | Windows/Linux OS, IDE, Jupyter | Create class and object, perform file operations and regular expressions. |
| 10 | Develop a program to get a list of users by referring to “User_File.txt” and “Transaction_File.txt”. | Windows/Linux OS, IDE, Jupyter | Create class and object, perform file operations and regular expressions. |
| 11 | Develop a program to get List of Books in stock by referring to “Book_File.txt” and “Transaction_File.txt”. | Windows/Linux OS, IDE, Jupyter | Create class and object, perform file operations and regular expressions. |
| 12 | Develop a program to get List of Books Issued by referring to “User File”, “Book File” and “Transaction File”. | Windows/Linux OS, IDE, Jupyter | Create class and object, perform file operations and |
| 13 | Develop a project by integrating User, Books, Transaction and Reports Modules. | Windows/Linux OS, IDE, Jupyter | Module integration and project |

**TEXTBOOKS:**


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

**REFERENCEBOOKS:**


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”, $3^{rd}$ Edition, CENAGE Learning.
5. Wesley J. Chun, “Core Python Programming”, $2^{nd}$ Edition, Prentice Hall.
6. Steve Holden and David Beazley, “Python Web Programming”, New Riders, 2002. Springer, Kent D. Lee, “Python Programming Fundamentals”, $2^{nd}$ Edition.
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

**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-LEARNINGEXERCISES:**

1. Explore PYTHON library for IOT programming
2. More exploration on GitHub
3. Data Visualization packages
4. C modules interface

**COURSE PACK FOR: BASIC ELECTRICAL & ELECTRONICS ENGINEERING**

<table>
<tr><td>Course Title</td><td colspan="4">BASIC ELECTRICAL & ELECTRONICS ENGINEERING</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EE0101</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>1</td><td rowspan="2">Theory Hours</td><td rowspan="2">Practical Hours</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>4</td><td>42</td><td>28</td><td>50</td><td>50</td></tr>
</table>

**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 Objective (S):**

1. Explain the basics of electrical and electronics engineering terminologies.
2. Distinguish the single and three phase systems.
3. Illustrate the different building blocks in digital electronics using logic gates and explain simple logic functions using basic universal gates.
4. Discuss the applications of diode in rectifiers, filter circuits and wave shaping.
5. To build a broad concept for hands on experience in various types of electrical apparatus, tools and instrumentation with electrical safety norms.
6. To analyze the schematics for making electrical connection and to interpret experimental data for Various electrical appliances.

**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. | 1-6 | 1,2 |
| CO-2 | Analyze the concepts and applications of DC & AC Machines. | 1-5 | 1,2 |

| | | | |
|---|---|---|---|
| CO-3 | Apply the concept of domestic wiring, importance of safety and sensing devices | 1-5,10 | 1,2 |
| CO-4 | Analyze the different building blocks in digital electronics using logic gates and applications of diode in rectifiers, filter circuits and wave shaping. . | 1-5 | 1,2 |
| CO-5 | Interpret, Identify and use appropriate electrical tools for electrical connections and to repair electrical equipment's. | 1,4 | 1,2 |
| CO-6 | Compare experimental results with theoretical analysis and the ability to critically evaluate the performance of electrical appliances. | 1,5 | 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) |
| 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** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 2 | 1 | 3 | 1 | 2 | 1 | | | | | | | 1 | |
| CO-2 | 1 | 3 | 2 | 2 | 1 | | | | | | | | 1 | |
| CO-3 | 2 | 2 | 2 | 2 | 1 | | | | | 2 | | | 1 | |
| CO-4 | 3 | 3 | 3 | 1 | 1 | | | | | | | | 1 | |
| CO-5 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | | 3 | 1 | | | 3 | 3 |
| CO-6 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | | 3 | 1 | | | 3 | 3 |

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

**Course Content Theory**

| Content |
|---|
| **UNIT-1:** Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, Kirchhoff's Laws, Resistive, Inductive, capacitive networks, Series, Parallel circuits and Star-delta and delta-star transformations, Network Theorems (Superposition, Thevenin's & Norton's) Generation of an alternating Emf–average and rms values of alternating quantity–representation of alternating quantities by phasors–single phase series and parallel circuits (simple problems), three phase systems and power calculations. |
| **UNIT-2:** DC-Machines: Construction and Principle of operation of DC Machines–Emf & Speed equations-types–applications. AC-Machines: Principle of operation of single phase transformers–Emf equation–losses– efficiency and regulation-Construction and working principle of induction motors–Slip–torque characteristics–applications-Construction and Principle of operation of alternators applications. |
| **UNIT-3:** Instruments: Basic Principle of indicating instruments–PMMC&MI instruments. Tariff, Protective Devices and Sensors: Tariff schemes, basic concepts of domestic wiring and types, Earthing, protective fuses, MCB, sensors: pressure sensors, strain gage, proximity sensors, displacement sensors, Rotatory encoder and ultrasonic sensors and civil engineering applications. |
| **UNIT-4:** Diodes: Introduction, Physical operation of p-n junction diodes, Characteristics of p-n junction diodes, Zener diode, Rectifier circuits (half-wave, full-wave, bridge and peak rectifiers),Light emitting diodes.<br>Digital Electronic Principles: Introduction, Binary digits, Logic levels and Digital waveforms, Introduction to basic logic operation, Number system, Decimal numbers, Binary numbers, Decimal-to-Binary conversion, Simple binary arithmetic.. |

**Practice:**

| No | Title of the Experiment | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1. | Electrical Safety Training.<br>a) To Study the importance of Earthing during accidental shorting of line wire and the body of equipment. | Trainer kit<br>Ohms Law<br>Fall of resistance | Importance & applications of Earthing, Fuse & MCB |
| | b) To conduct experiment and to know the Importance and mechanism of FUSE | | |
| | c) To study the Importance and mechanism of MCB. | | |

| | | | |
|---|---|---|---|
| 2. | Home Electrical Wiring Demonstration.<br>a) To study & verify the connection procedure for fluorescent lamp wiring. | Fluorescent Lamp wiring Panel<br>Fan with switch and regulator Kit | Connection & Trouble shooting of Fluorescent lamp wiring & Fan with switch and regulator |
| | b) To study the connection of Fan with switch and regulator. | | |
| 3. | Two-way switch/ staircase wiring.<br>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. | Behaviour of current and voltage in series and parallel circuits.<br>a)To study and verify the | Series and parallel circuits Kit | Connection & behaviour of current & voltage in series , parallel circuit |
| | b) To study and verify the behaviour of current and voltage in parallel circuit. | | |
| 5. | Polarity test on single phase transformer.<br>a)To determine the additive polarity of a single-phase transformer. | Transformer Kit | Polarities of single phase transformer |
| | b) To determine the subtractive polarity of a single-phase | | |
| 6. | Determination of VI characteristics of Zener Diode | VI characteristics of Zener Diode kit | VI characteristics of Zener Diode |
| 7. | Determination of VI characteristics of Silicon Diode | VI characteristics of Silicon Diode kit | VI characteristics of Silicon Diode |
| 8. | Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter | Rectifier kit | Determine the efficiency, Voltage regulation, ripple factor of rectifiers |

| | | | |
|---|---|---|---|
| 9. | Determine the Characteristics of BJT in Common Emitter Configuration | Characteristics of BJT in Common Emitter Configuration | Input & Output Characteristics of BJT |
| 10. | Determine the Characteristics of JFET in Common Source Configuration | Characteristics of JFET in Common Source Configuration | Input & Output Characteristics of JFET |
| 11. | Realization of Universal gates using basic logic gates. | Trainer kit | Universal gates will be realized using basic gates |

**Text Book:**


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.
5. Hughes, E., "Electrical Technology", Pearson, 2005.
6. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
7. D.P. Kothari, I. J. Nagrath, "Basic Electronics", McGraw Hill Education (India) Private Limited, 2014


**Reference Books:**


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


**Journals/Magazines**

1. International Journal of Electrical Power and Energy Systems (https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems)
2. Journal of Electrical Engineering (https://link.springer.com/journal/202)

**SWAYAM/NPTEL/MOOCs:**

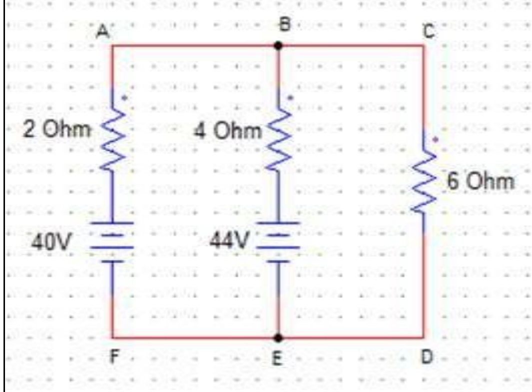
1. https://nptel.ac.in/courses/108/108/108108076/

**Self-Learning Exercises:**

a) Build a electrical circuit using BJT as a switch
b) Identifying the practical application of Electromagnetic Induction

**Problem Based Learning**

| No | Problems |
|---|---|
| 1 | A current of 20A flows through two ammeter A and B in series. Potential difference across A is 0.2V and across B is 0.8 V. Find how the same current will divide between A and B when they are joined in parallel |

| | |
|---|---|
| 2 | For the given circuit calculate the current supplied by each battery and current in 6 ohm resistor.<br><br> |
| 3 | Two 12V batteries with internal resistances 0.2 ohm and 0.25 ohm respectively are joined in parallel and a resistance of 1 ohm is placed across the terminals. Find the current supplied by each battery. |
| 4 | A 6 pole induction motor is connected to a 50 Hz supply. It is running at a speed of 970 R.P.M. Find the synchronous speed and the slip |
| 5 | If A= $(1011)_2$ and B = $(1110)_2$, perform the following arithmetic operations.<br>i)Addition ii) subtraction ii) Multiplication |
| 6 | Simplify the given Boolean expression and implement using logic gates. i)Y=AB+ABC+AB(D+E) ii) Y=ABCD+ABD iii) Y=AB+A(B+C)+B(B+C) |
| 7 | Simplify the given Boolean Expression: i) Y= XY+XYZ+XY$\bar{Z}$+$\bar{X}Z$<br>ii) $Y$ = $\bar{A}BC$+$\bar{A}$B$\bar{C}$+$\bar{A}$BC iii) Y= AC+C(A+$\bar{A}$B) |
| 8 | a) Perform the following operations:<br>(i)Convert $(01110111)_2$ to decimal<br>(ii) Convert $(21)_{10}$ to binary<br>(iii) Add: $(1010)_2$ and $(0011)_2$<br>(iv) Subtract: $(111.111)_2$ from $(1010.01)_2$<br>(v) Divide: $(101101)_2$ by $(110)_2$ |

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based **design projects**. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Design & Development of a rectifier circuit |
| 2. | Identify the types of wiring |
| 3. | Electricity bill calculation |
| 4. | Identify the types of motors used in domestic & industrial application with nameplate details. |
| 5. | Identification of different transformer based on their rating used for various applications. |

## COURSE PACK FOR: BUILDNING MATERIALS AND CONSTRUCTION

| Course Title | BUILDNING MATERIALS AND CONSTRUCTION | | | | Course Type | | Integrated | |
|---|---|---|---|---|---|---|---|---|
| Course Code | B20ED0201 | Credits | 3 | | Class | | II semester | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 1 | 2 | 2 | Theory | Practical | CIE | SEE |
| | Tutorial | 0 | - | - | | | | |
| | **Total** | **4** | **5** | **5** | **39** | **26** | **50%** | **50%** |

**Course Overview**

This course introduces the students to various building materials and classification. Students will also understand physical & chemical properties of materials like bricks, stones, steel, timber, cement. The course will make students to be able to understand construction procedure like foundations, masonry, plastering and flooring.

**Course Objective**

This course enables graduating students

1. To understand the different types, and Properties of Bricks, stones and cement.
2. To summarize the different types, and Properties of Steel and timber.
3. To study different types and process of painting.
4. To articulate the different types of foundations provided for civil engineering structures.
5. To examine the different types of materials and joints in brick masonry and stone masonry.
6. To understand the process of plastering and defects in it.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Identify the types, origin, classification, manufacturing process, qualities, and uses of building elements, of bricks, stones and cement. | 1,2,12 | 1,2,4 |
| CO2 | Explain about manufacturing process, various tests, types, Uses and storage of steel and timber. | 1,2,12 | 1,2,4 |
| CO3 | Identify different types and process of painting. | 1,2,3,5, 12 | 1,2,3,4 |
| C04 | Identify different types of foundations provided for civil engineering structures. | 2,4,12 | 1,2,3,4 |
| CO5 | Identify the materials, and explain the types of joints in brick and stone masonry. | 1,2,3,5, 12 | 1,2,3,4 |
| C06 | Explain the purpose and process of plastering. | 2,4,12 | 1,2,3,4 |

**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 | | ✓ | | | | |
| C06 | | | ✓ | | | |

**Course Articulation Matrix**
**Note:** 1-Low, 2-Medium, 3-High

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO3 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C04 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C06 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1 Bricks:** Introduction, types of bricks, material suitable for manufacture of bricks, methods of brick manufacture, quality of good brick, testing of brick, uses of bricks.<br>**Stones:** Introduction, classification, composition and characteristics, different types of stones, method of quarrying and dressing.<br>**Cement:** Physical properties of cement, manufacturing of cement, tests for cement, uses of cement, types of cement. |

| |
|---|
| **UNIT:2 Steel:** Manufacturing of steel, uses of steel, factors affecting physical properties of steel, defects in steels. **Timber:** Introduction, classification of timber, structure of a timber (microstructure and macrostructure), defects in timber, qualities of good timber, factors affecting strength of timber. **Painting:** Ingredients of paints, Types of Paints, Defects in Painting, Application of Paints to new and old surface (wood and steel). |
| **UNIT:3 Foundations:** Function and requirements of a good foundation, Types of foundations, Preliminary investigation of soil, Safe Bearing Capacity of Soil, Introduction to spread, combined, strap, mat, pier and pile foundations. (Basic Concepts and Sketches only) excavation of foundation. Simple Problems on design of foundations. |
| **UNIT:4 Brick masonry:** Introduction, Definition of terms used in Masonry, materials used, types of bonds, joints in brickwork, joint between old and new masonry, maintenance of brickwork. **Stone masonry:** Introduction, Definition of terms used in Masonry, cutting and dressing of stones, types of stone masonry (rubber and ashlar), joints of stones, maintenance of stone works, cavity walls, purpose and method of construction of cavity walls. **Plastering:** Definition, materials used for plastering, types of plastering, Purpose of plastering, Methods of plastering, Defects and remedial measures in plastering. |

**Practice**

| No | Title of the Experiment | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1. | TESTS ON TIMBER: Determination of moisture content by Oven dry testing. | Oven | Hands on training |
| 2 | TESTS ON TIMBER: Determination of moisture content by moisture meter | Moisture meter | Hands on training |
| 3. | TESTS ON BRICKS: Determination of Compressive strength of brick | Compression testing machine | Hands on training |
| 4. | Water absorption test on brick. | Oven | Hands on training |
| 5. | Efflorescence test on brick. | Bricks | Creative thinking |
| 6. | TESTS ON SAND: Bulking test | Measuring cylinder | Hands on training |
| 7. | Silt test on sand | Measuring cylinder | Hands on training |
| 8. | TESTS ON STONES: **Acid Test** | Hydrochloric acid and oven | Hands on training |
| 9. | Impact test on stones. | Impact testing machine | Hands on training |
| 10. | Determination of Crushing Strength of stones. | Universal testing machine | Hands on training |
| 11 | Determination of Water Absorption Test | Ventilated oven | Hands on training |
| 12 | Determination of Crystallization Test | Sodium Sulfate and oven | Hands on training |

**Text Book:**

1. Engineering Materials by Rangawala P.C. Charter Publishing House, Anand, India.
2. Engineering Materials by Sushil Kumar, Standard Publication and Distributors, New Delhi.
3. Text Book of Building Materials, by P.G. Varghese, Prentice-Hall of India Pvt. Ltd., Publication.

**Reference Books:**

1. Building Materials" by S K Duggal
2. Building Construction" by B C Punmia and Ashok Kumar Jain

**Journals/Magazines**

1. Journal of Construction Engineering and Management
2. Journal of Construction and building materials

**SWAYAM/NPTEL/MOOCs:**

1. http://www.nptelvideos.in/2012/11/building-materials-and-construction.html
2. https://nptel.ac.in/courses/105/102/105102088/
3. https://www.coursera.org/specializations/construction-management

**Problem Based Learning**

| No | Problem |
|---|---|
| 1 | A Load Test Was Made With A 35 Cm Square Plate At A Depth Of One Meter Below The Ground Level In Soil With □□= 0. The Water Table Was Located At A Depth Of 5m Below The Ground Level. Failure Occurred At A Load Of 5200 Kg. What Would Be The Ultimate Bearing Capacity Per Unit Area For A 1.6m Wide Continuous Footing With Its Base Loaded At The Same Depth In The Same Soil. Unit Weight Of Soil Was 1.9 G/Cc Above Water Table. For □□= 0, • Nc = 5.7, Nq = 1 , N□□= 0. Assume General Shear Failure. |
| 2 | A Square Footing 2.5 M By 2.5 M Is Built In A Homogenous Bed Of Sand Density 2.0 T/M3 And Having An Angle Of Shearing 38 Degree. The Depth Of A Base Of The Footing Is 1.5 M Below The Ground Surface. Calculate The Safe Load That Can Be Carried By A Footing With A Factor Of Safety 3 Against Complete Shear Failure. Use Terzaghi's Analysis. |

**Project Based Learning**
To enhance the skill set in the integrated course, the students are advised to execute course-based
**Design projects**. Some sample projects are given below:

| **No.** | **Suggested Projects** |
|---|---|
| 1. | Fire resistance in cross laminated timber |
| 2. | Impact of using crushed rocks in concrete |
| 3. | Utilization of waste plastic in manufacturing of bricks along with quarry dust and M-sand |
| 4. | A study of the possibilities of sustainable Buildings |

**Practical /Term Work / Practice Sessions/Online/MOOC**

**COURSE PACK FOR: BIOLOGY FOR ENGINEERS**

<table>
<tr><td>Course Title</td><td colspan="3">BIOLOGY FOR ENGINEERS</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AS0109</td><td>Credits</td><td>3</td><td colspan="2">Class</td><td colspan="2">II semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td>13</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

**COURSE OVERVIEW**

**Course Description:** Understanding biological systems, principles and concepts in order to create usable, tangible, economically viable product or process has become need of the hour. Hence irrespective of the parent engineering discipline, knowledge and expertise from pure and applied sciences is necessary to create product or process related to healthcare, agriculture, environmental issues and many more. Any engineer will have a high probability of using biology related skills and concepts to create products and processes beneficial to the mankind and as well for the sustainable environmental friendly approach. For example, the knowledge can be used to create medical devices, diagnostic equipment's, bioreactor designing, agriculture related equipment/instruments or anything related to surface science, fluid mechanism and polymer science. This course is designed to lay foundation in the field of Cell biology, Molecular biology and Genetics, so that anyone who is interested can design better product/process to enhance the overall quality of life.

**Course Objective**

1. To inculcate the basic concepts of biology from engineering perspective among students
2. To understand the interplay between biology and engineering disciplines
3. To conceptualize the engineering design/process/product for life science challenges

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | To understand and explain the concepts regarding origin and evolution of life. | 1 | 1 |
| CO2 | To understand the structure and functions of various biomolecules in living system. | 1 | 1 |
| CO3 | To comprehend the organization of cell structure in prokaryotes and eukaryotes. | 1 | 1 |
| CO4 | To describe the process of cell division involving mitosis and meiosis | 1 | 1 |
| CO5 | To predict the inheritance pattern of genes from parents to offspring | 1 | 1 |
| CO6 | Apply the principles of Biology either for the process/product development from the engineering perspective. | 1 | 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 | L1 | **L2** | | | | |
| CO2 | L1 | L2 | **L3** | | | |
| CO3 | L1 | L2 | | | | |
| CO4 | L1 | L2 | | | | |
| CO5 | | L2 | **L3** | | | |
| CO6 | | L2 | **L3** | | | |

**Course Articulation Matrix**

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

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

**Course Content Theory**

| | |
|---|---|
| | Experiments/Practice session/ Workshop session<br>1. Introduction to Biology<br>2. Evolution and Origin of Life<br>3. Biomolecules-Lipids<br>4. Biomolecules: Carbohydrates, Water<br>5. Biomolecules: Amino acids, Proteins<br>6. Biomolecules: Enzymes<br>7. Biomolecules: Nucleotides<br>8. Cell structure and function – Prokaryotes<br>9. Cell structure and function – Eukaryotes<br>10. Cell cycle-Mitosis and Meiosis<br>11. Mendelian genetics: Mendelian inheritance Lesson 13. Genetic diseases and Mendelian inheritance<br>12. Central Dogma - Replication<br>13. Transcription and Translation |

**Text Book:**

1. Biology for Engineers, G.K. Suraishkumar, Oxford University Press, 2019
2. Biology for Engineers, As per AICTE curriculum, Wiley publication,
3. Biology for Engineers, Dr.Sohini Singh, Dr.Tanu Allen, Vayu Education of India.

**Reference Books:**

1. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P.S.Verma and V.K. Agarwal, 2018
2. Handbook of Genetics, Sambamurthy, Friends Publisher, 2010

**Journals/Magazines :** Current Sciences

**SWAYAM/NPTEL/MOOCs:**
https://onlinecourses.nptel.ac.in/noc19_ge31/preview
Coursera: Biology everywhere

**Self-Learning Exercises:**
Case study: Biobased Civil engineering for sustainable society.
Biological process for soil improvement in civil engineering

**Lesson Plan**

| Lecture # | Topics to be Covered |
|---|---|
| 1. | Introduction to Biology |
| 2. | Evolution and Origin of Life |
| 3. | Biomolecules-Lipids |
| 4. | Biomolecules: Carbohydrates, Water |
| 5. | Biomolecules: Amino acids, Proteins |
| 6. | Biomolecules: Enzymes |
| 7. | Biomolecules: Nucleotides |
| 8. | Cell structure and function – Prokaryotes |
| 9. | Cell structure and function – Eukaryotes |
| 10. | Cell cycle-Mitosis and Meiosis |
| 11. | Mendelian genetics: Mendelian inheritance Lesson 13. Genetic diseases and Mendelian |
| 12. | Central Dogma – Replication |
| 13. | Transcription and Translation |

**Problem Based Learning**

| No. | |
|---|---|
| 1 | Case study: Biobased Civil engineering for sustainable society. |
| 2 | Case Study: Biological process for soil improvement in civil engineering |

**COURSE PACK FOR: DESIGN THINKING**

<table>
<tr><td>Course Title</td><td colspan="4">DESIGN THINKING</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ME0102</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Design Thinking</td><td>TLP</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>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>3</td><td>3</td><td>13</td><td>26</td><td>50%</td><td>50 %</td></tr>
</table>

**Course Overview**

Today, innovation is everyone's business. At every level, in every kind of organization, design thinking provides the tools that one needs to become an innovative thinker and uncover creative opportunities. For example, companies like Procter, Gamble and GE have incorporated Design Thinking into their strategy and marketing. The course draws on methods from engineering and design, and combines them with ideas from the arts, tools from the social sciences, and insights from the business world.

In this course, students start in the field, where they discover the needs of the target audience. They then iterate ideas on teams to develop a range of promising possible solutions, create rough prototypes to take back out into the field, and learn to test with real people in the target audience.

**Course Objectives:**

1. To impart knowledge on design thinking process for understanding designs.
2. To provide design skills to analyze design thinking issues and apply the tools and techniques of design.
3. To inculcate attitude to solve societal problems using design thinking tools.

**Course Outcomes (CO's):**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Identify the problems that fall under the purview of human centered design process for creative problem solving. | 1,2 , 9,10,12 | 2 |
| **CO2** | Develop empathy maps to visualize user needs and to get insights of the problem. | 1,2,9,10,12 | 2 |
| **CO3** | Define the problem from user's perception. | 1,2,9,10,12 | 1,2 |

| | | | |
|---|---|---|---|
| **CO4** | Apply Ideation techniques to ideate innovative ideas for the problem | 1,2,9,10,12 | 1,2 |
| **CO5** | Develop simple prototypes for problems using feasible idea. | 1,3, 5,9,10,12 | 1,2 |
| **CO6** | Improve prototype by testing it with a specific set of users for making it sustainable by following ethics. | 1,4,8,9,10,12 | 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 | 2 | | | | | | | 2 | 2 | | 2 | 3 | 2 | |
| **CO2** | 1 | 3 | | | | | | | 2 | 3 | | 2 | | 2 | |
| **CO3** | 1 | 2 | | | | | | | 3 | 2 | | 3 | 1 | 2 | |
| **CO4** | 1 | 2 | | | | | | | 3 | 2 | | 2 | 1 | 2 | |
| **CO5** | 2 | | 3 | | 2 | | | | 3 | 3 | | 2 | 2 | 3 | |
| **CO6** | 2 | | | 2 | | | | 1 | 3 | 2 | | 2 | 2 | 3 | |

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

**Course Contents:**

**Unit-1 :**

Design Thinking Process: Types of the thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking. Problem Exploration, Case Studies from Embrace-Stanford Innovation Challenge, IDEO, GE Healthcare, The Good Kitchen- Denmark Program etc, identifying the target users for the problem selected, Survey on existing solutions for the problem identified.

Empathizing: Powerful Visualizing tool – a method to connect to the user, Creating Empathy maps – Case studies.

**Unit-2 :**

Defining the problems: POV statements from User perspective. Idea generation: Methods to spark the innovative ideas – Brainstorming, Mind map, Story board, Provocation etc.

What is a prototype? - Prototyping as a mindset, prototype examples, prototyping for products; Why we prototype? Fidelity for prototypes, Process of prototyping- Minimum Viable prototype

Prototyping for digital products: What's unique for digital, Preparation; Prototyping for physical products: What's unique for physical products, Preparation; Testing prototypes with users.

**Practice Session:**

| Sl.No | Name of the Practice Session | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1 | Identifying the problem that can be solved using Design Thinking approach | Observation and survey | Develop identifying human centered problems |
| 2 | Build the empathy maps for simple problems like single user | Visualization | Develop ability to understand other's emotions |
| 3 | Build the detailed empathy maps for problem identified in the teams formed | Visualization | Develop ability to understand other's emotions |
| 4 | Presentation by student teams | PPT | Develop ability to express their views |
| 5 | Obtain the insights into user's problems and make PoV statement | Understanding | Develop making problem statements from user perception |
| 6 | Presentation by student teams | PPT | Develop ability to express their views |

| | | | |
|---|---|---|---|
| 7 | Carry out Brain storming between the groups and generate as many as ideas possible | Ideation tools | Develop innovative mind set |
| 8 | Prototype for best 3 ideas selected | Sketching, simple model making etc | Develop prototyping techniques |
| 9 | Presentation by student teams | PPT | Develop ability to express their plan |
| 10 | Test the developed prototype with set of identified users | Google forms , cold calls, social media etc. | Develop understanding of various testing methods |
| 11 | Pitching final solution | PPT | Develop ability to express their views |

**Text Books:**


1. Gavin Ambrose, Paul Harris, Basics Design-Design Thinking, AVA Publishing, 2010
2. Kathryn McElroy, "Prototyping for Designers: Developing the best Digital and Physical Products", O'Reilly,2017.


**Reference Books:**


1. Michael G. Luchs, Scott Swan , Abbie Griffin,"Design Thinking – New Product Essentials from PDMA", Wiley, 2015.
2. Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", 2012.


**Journals/Magazines/Additional Sources**


1. Leonard, D., and Rayport, J. F. 1997. Spark Innovation through Empathic Design. In Harvard Business Review, November-December 1997,102-113.
2. https://www.ideo.com
3. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process
4. https://www.ibm.com/design/thinking/page/toolkit
5. https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge-by-creating-your-point-of-view-and-ask-how-might-we
6. https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking
7. https://youtu.be/M66ZU2PCIcM
8. https://thisisdesignthinking.net/2017/07/innogy_energy_ecarsharing/


**SWAYAM/NPTEL/MOOCs:**


1. https://nptel.ac.in/courses/109/104/109104109/
2. https://nptel.ac.in/courses/110106124/

## SEMESTER III

## COURSE PACK FOR: Laplace Transforms, Fourier series and Numerical methods (B20AS0301)

<table>
<tr><td>Course Title</td><td colspan="4">Laplace Transforms and Fourier Series</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20AS0301</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes<br>Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>4</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview:** In this course students will study the Laplace Transforms, inverse Laplace Transforms, Fourier Series, Fourier transforms and Numerical Methods. The purpose of this course is to provide students with skills and knowledge required to perform mathematical procedures and processes for solution of engineering problems. This course is widely used in all streams of Engineering particularly in the field of civil Engineering.

**Course Objective: Student shall be able to learn,**

1. To impart the Knowledge of Laplace transforms and its applications in the field of engineering.
2. To impart the Knowledge of Inverse Laplace transforms and its applications in the field of engineering.
3. To study and understand the application approach of the concepts of Fourier series and transforms.
4. To study and understand the application approach of the concepts of Numerical methods.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Apply the knowledge of Laplace transformation from the time domain to the frequency domain. | 1,2,3,5 | 1,2,3 |
| CO2 | Study the periodic function, unit step function and unit impulse function by using Laplace transform. | 1,2,3,5 | 1,2,3 |
| CO3 | Compute Inverse Laplace transform and apply them to ODEs arising in engineering | 1,2,3,5 | 1,2,3 |
| C04 | Find the Fourier series and half range series expansion of different functions in different intervals | 1,2,3,5 | 1,2,3 |
| CO5 | Find the Fourier & inverse Fourier transforms of different functions and apply this knowledge in solving different civil engineering problems. | 1,2,3,5 | 1,2,3 |
| C06 | Apply the numerical methods to solve various engineering problems. | 1,2,3,5 | 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 Note: 1-Low, 2-Medium, 3-High**

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | | | 1 | | | | | | | | 2 | 2 | 3 | |
| CO2 | 3 | 2 | 2 | | 1 | | | | | | | | 2 | 2 | 3 | |
| CO3 | 3 | 2 | 2 | | 1 | | | | | | | | 3 | 2 | 3 | |
| CO4 | 3 | 2 | 2 | | 1 | | | | | | | | 2 | 2 | 3 | |
| CO5 | 3 | 2 | 2 | | 1 | | | | | | | | 2 | 2 | 3 | |
| CO6 | 3 | 3 | 2 | | 1 | | | | | | | | 3 | 2 | 2 | |

**Course Content Theory**

| **Contents** |
|---|
| UNIT:1<br>**Laplace Transforms:** Definition, transforms of elementary functions, Properties-transform of $e^{at}f(t)$, $t^n f(t)$ and $\frac{f(t)}{t}$. Laplace transform of derivatives, integrals, periodic functions, unit step function and unit impulse function. |
| **UNIT: 2**<br>**Inverse Laplace Transforms:** Inverse Laplace Transforms, Inverse Laplace transform of standard functions, convolution theorem (without proof), Solution of linear differential equations using Laplace Transforms.<br>Applications: Applications of Laplace transforms to civil engineering problems. |

| |
|---|
| **UNIT:3**<br>**Fourier Series:** Periodic functions, Dirichlet's condition, Fourier Series of periodic functions with period 2π and with arbitrary period 2l. Fourier series of even and odd functions. Half range Fourier Series, practical harmonic analysis-Illustrative examples from engineering field.<br>Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Applications to civil engineering problems. |
| **UNIT:4**<br>**Numerical Methods:** Numerical solution of algebraic and transcendental equations by Regula- Falsi Method and Newton-Raphson method.<br>Finite Differences: Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences- Newton's divided difference formula. Lagrange's interpolation formula and inverse interpolation formula (all formulae without proof)-Problems. |

**Textbook:**

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 48th edition.
2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 1stedition.

**Reference Books:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 13th edition.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition.

**SWAYAM/NPTEL/MOOCs:**

**https://nptel.ac.in/courses/111/106/111106139/**
**https://nptel.ac.in/courses/111/106/111106111/**
**https://nptel.ac.in/courses/111/102/111102129/**
**https://nptel.ac.in/courses/111/107/111107105/**

**Problem Based Learning**

| No | Problem |
|---|---|
| 1. | Find the Laplace transform of saw-tooth wave function of period $T$, given by $f(t) = \frac{kt}{T}\ for$ $0 < t < T: f(t+T) = f(t)$. |
| 2. | A sinusoidal voltage $E \sin \omega t$ is passes through a half wave rectifier which clips the negative portion of the wave. Develop the resulting periodic function $u(t) = \begin{cases} 0 & in\ -\frac{T}{2} < t < 0 \\ \sin t & in\ 0 < t < \frac{T}{2} \end{cases}$ and $T = \frac{2\pi}{w}$ in a Fourier series. |

**COURSE PACK FOR: FLUID MECHANICS (B20ED0301)**

<table>
<tr><th>Course Title</th><th colspan="4">FLUID MECHANICS</th><th colspan="2">Course Type</th><th colspan="2">HC</th></tr>
<tr><th>Course Code</th><th>B20ED0301</th><th>Credits</th><th colspan="2">3</th><th colspan="2">Class</th><th colspan="2">III semester</th></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes<br>Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>4</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

The course familiarizes students with basic facts relating to working principles of Fluid Mechanics, and principles used in day today life. It deals with dynamics, kinematics, pipe flow, losses in pipe flow, open channel flow, and economical sections.

## Course Objective

This course enables graduating students

1. Understand kinematics and dynamics of fluid flow, continuity equation, Bernoulli's equation and its application.
2. Learn about pipe flow, Energy losses - major losses, minor losses and its measurement.
3. Learn about Analyze and solve problems related to losses in pipe flow, network problems.
4. Will be able to know the basic principles, procedures and calculation of different types of notches and weirs.
5. Learn about uniform flow in open channels of different sections.
6. Learn about Design of most economical open channel sections and related problems.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Define and explain the kinematic and dynamics of flow, continuity equation, stream function and velocity potential function. | 1,2,3 | 1,2,3 |
| CO2 | Make use of the Bernoulli's equation and its application, Momentum equation and solve the problems on pipe bends. | 2,3,6 | 1,2,3 |
| CO3 | Analyze and solve problems related to losses in pipe flow, network problems. | 1,2,3,4 | 2,3 |
| C04 | Analyze and finding the discharges using notches and weirs | 2,3,4,5 | 1,2,3,4 |
| CO5 | Understand geometric properties of different channel sections. | 1,2,3,4,5 | 1,2,3 |

| | | | |
|---|---|---|---|
| C06 | Understand and Design of most economical open channels with problems. | 2,3,4,5,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | | | | | | | 2 | 2 | 2 | 2 | 3 |
| **CO2** | 3 | 2 | 2 | 2 | | | 2 | | | | | 2 | 3 | 3 | 2 | 3 |
| **CO3** | 3 | 2 | 2 | 2 | | | 2 | | | | | 2 | 2 | 2 | 2 | 3 |
| **CO4** | 3 | 2 | 2 | 2 | | | | | | | | 2 | 3 | 3 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 | | 2 | | | | | 2 | 3 | 2 | 3 | 3 |
| **CO6** | | 3 | 2 | 2 | 3 | | 2 | | | | | 3 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| **Contents** |
|---|
| **UNIT:1**<br>**KINEMATICS OF FLOW** – Introduction, methods of describing fluid motion, definitions of types of fluid flow, streamline. Three-dimensional continuity equation in Cartesian Coordinates (derivation only). General Continuity equation (problems). Velocity potential function, Stream function, Equipotential line, Stream line - problems.<br>**DYNAMICS OF FLUID FLOW**<br>Introduction, Energy possessed by a fluid body. Euler's equation of motion along a streamline and Bernoulli's equation – Assumptions, Limitations and practical applications - problems, Venturimeter and its significance – problems. |

| |
|---|
| **UNIT: 2**<br>**Pipe Flow:** Introduction, losses in pipe flow, Darcy-Weisbach equation for head loss due to friction in a pipe. Pipes in series and parallel, equivalent pipe, pipe networks-problems.<br>Minor losses in pipe flow, Derivation for head loss due to sudden expansion only- problems. Momentum equation, problems on pipe bends |
| **UNIT:3**<br>**Flow Through Notches, Weirs and Orifices:** Introduction, Triangular notch, Rectangular notch,<br>Trapezoidal notch, Cipolletti notch, Ogee weir and broad crested weir, Flow through Orifices, Problems. |
| **UNIT:4**<br>**Uniform Flow in Open Channels:** Introduction, Geometric properties of Rectangular, Trapezoidal channels. Chezy's equation, Manning's equation-problems. Most economical open channels-Rectangular, Trapezoidal channels- problems. |

## Text Book:

1. Text Book of Fluid Mechanics& Hydraulic Machines'-R.K.Bansal, Laxmi Publications, New Delhi, 2008 Edition.
2. A Textbook of Fluid mechanics & Hydraulic Machines'- R.K.Rajput, S.Chand&Co, New Delhi,2006 Edition.
3. Principles of Fluid Mechanics and Fluid Machines'-N.NarayanaPillai, Universities Press (India), Hyderabad, 2009 Edition.
4. Fluid Mechanics and Turbo machines'- Madan Mohan Das, PHI Learning Pvt. Limited, New Delhi. 2009 Edition.

## Reference Books :

1. Fundamentals of Fluid Mechanics' – Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, Wiley India, New Delhi, 2009 Edition.

2. 'Fluid Mechanics' – Streeter, Wylie, Bedford New Delhi, 2008(Ed)

**Journals/Magazines**

1. Journal of Fluid Mechanics
2. Journal of Hydraulic Engineering

**SWAYAM/NPTEL/MOOCs:**
**http://www.nptel.iitm.ac.in**
**https://nptel.ac.in/courses/105/103/105103192**

**Problem Based Learning**

| No | Problem |
|---|---|
| 1. | A rectangular channel of width 4m is having a bed slope of 1 in 1500. Find the maximum discharge through the channel. Take value of C = 50. Discharge will be max. when the channel is most economical. |
| 2. | |

| | |
|---|---|
| | A trapezoidal channel has side slopes 1H : 2V and bed slope 1 in 1500. The area of the section is 40m². Find the dimension of the section if it is most economical. Determine the discharge of the most economical section if C = 50. |

**Project Based Learning**

- **Flow Measurements using weirs and notches**
- **Flow Visualization of Hydraulics Structures.**

**COURSE PACK FOR: STRENGTH OF MATERIALS**

| **Course Title** | **STRENGTH OF MATERIALS** | | | | **Course Type** | | **Integrated** | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **B20ED0302** | **Credits** | **3** | | **Class** | | **IV semester** | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weight age | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 1 | 2 | 2 | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | Total | 2 | 5 | 5 | 48 | 26 | 50% | 50% |

## Course Overview:

Strength of Materials focuses on the strength of materials and structural components subjected to different types of force and thermal loadings, the limiting strength criteria of structures, theory of strength of structures and calculations of the stress-strain state of structural components

## Course Objective

1. This course enables graduating students to learn
2. The basic concepts of simple stresses, strains and elastic constants, composite bars and temperature stresses in simple and compound bars.
3. Bending moment and Shear force of various beams.
4. Bending and shear stresses in beams subjected to simple bending and deflections in loaded statically determinate beams.
5. Torsional stress induced in circular members and critical buckling load of prismatic columns with different end conditions.
6. Ability to apply knowledge of mathematics and engineering in calculating the mechanical properties of structural materials
7. To study the behavior of mild steel under impact load, torsion, tension, compression and shear.

## COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|

| | | | |
|---|---|---|---|
| CO1 | Be familiar with the concepts of Simple Stresses, Strains and Elastic constants and Analyze stresses in composite bars and temperature stresses in simple and compound bars | 2,5,7 | 1 |
| CO2 | Compute Shear force and Bending Moment of different types of loadings of Various Beams. | 1,2,3,6,9,12 | 1,2,4 |
| CO3 | Compute Bending and shear stresses in beams subjected to simple bending slope | 1,2,3, ,6,8,9,11 | 1,2,4 |
| C04 | Compute deflection in loaded statically determinate beams | 1,2,3,4,5,6,7,8,10,12 | 1,2,3,4 |
| C05 | Reproduce the basic knowledge of mathematics and engineering in finding the strength in tension, compression, shear and torsion. | 1,2,3,6,9,12 | 1,2,3,4 |
| C06 | Analyze the behavior of steel and wood under compression and bending test. | 1,2,3,4,6,7,8,10,12 | 1,2,3,4 |

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

| CO#/ POs | PO | PO | PO | PO | PO | PO | PO | PO | PO | PO1 | PO1 | PO1 | PSO | PSO | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | | 2 | | 2 | | | | | 3 | | | | |
| CO2 | 3 | 2 | 3 | | | 3 | | 2 | 2 | | | | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | | | 2 | | 2 | 2 | | 2 | | 2 | 2 | 3 | 3 |
| C04 | 3 | 3 | 2 | | | 2 | | | | | | | 2 | 2 | 3 | 3 |
| C05 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | | 3 | 2 | 2 | 3 | 3 |
| C06 | | | | | | 2 | 2 | 2 | | 2 | 2 | 3 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| Contents |
|---|
| **UNIT: 1 Simple Stresses and Strains:** Introduction- Principle of Superposition (Bars of uniform and varying sections), Total Elongation of Tapering bars of Circular and Rectangular cross sections, Volumetric strain, Expression for volumetric strain, Elastic constants, Relationships among elastic constants, Theories of failure, Composite bars-Thermal stresses in simple and compound bars. With Numerical Examples. Strain (Concept only). |
| **UNIT: 2 Shear Force and Bending Moment:,** Concept of shear force and bending moment, Relation between S.F, B.M and rate of loading at a section of a beam. S.F and B.M diagrams for cantilever simply supported and overhanging beams subjected to point loads, UDL, moment, Couple and combination of these loads, Point of contra flexure. With numerical examples. |
| **UNIT: 3 Bending and Shear Stresses in Beams**<br>Bending and Shear Stresses: Theory of simple bending, Assumptions, Definition of Flexural rigidity and Modulus of rupture. Derivation of bending equation, Expression for horizontal shear stress in beam Bending – Stress Distribution due to bending moment and shearing force , Design of Simple beam sections, (rectangular and T) Section modulus of rectangular and circular sections (Solid).<br>**Slope and Deflection of Beams:**<br>Introduction – Definition of slope, deflection and elastic curve, Derivation of differential equation of flexure (Euler-Bernoulli equation), Elastic curve – Governing differential equation – Macaulay's method. Moment area method- Cantilever Beams. Conjugate Beam Method- Simply Supported |
| **UNIT:4 Elastic Stability of Columns:**<br>Introduction – Short and long columns, Euler's theory on columns, Effective length, slenderness ratio, buckling load, Assumptions and derivation of Euler's Buckling load for different end conditions, Limitations of Euler's theory. With numerical examples.<br>Introduction to Indeterminate Structures: SI and KI for different Types of Structures. Analysis of Propped Cantilever Beams and Fixed Beams by Consistent deformation method and simple continuous beams by consistent deformation method. |

**PRACTICE**

| No | Title of the Experiment | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1. | Impact Test on Mild Steel | Izod and Charpy test | Hands on training |
| 2. | Hardness Test | Brinells Hardness<br>Rockwells Hardness<br>Vickers's hardness Test | Hands on training |
| 3. | Torsion test on Mild Steel- With Pure Torsion Equation Derivation | Torsion equipment | Hands on training |
| 4. | Tension Test on Mild Steel | Universal Testing Machine | Hands on training/ Understanding mechanism of working |
| 5. | Compression Test on Mild Steel | Universal Testing Machine | Hands on training/ Understanding mechanism of working |
| 6. | Bending test on wood under one and two point loading | Universal Testing Machine | Hands on training |
| 7. | Shear test on Mild Steel- Single and double shear | Universal Testing Machine | Hands on training |

| | | | |
|---|---|---|---|
| 8. | Deflection of Beams - Demo | Universal Testing Machine | Hands on training |

**TEXT BOOKS:**

1. Strength of Materials by R. K Rajput, S. Chand & Company Ltd.
2. Mechanics of Materials by Dr. B.C Punmia, Dr. Ashok Kumar Jain and Dr. Arun Kumar Jain.
3. Strength of Materials by R. Subramanian, Oxford University Press
4. S.S.Bhavikatti “Strength of materials”, 4th Edition, Vikas Publishing House

**REFERENCE BOOKS:**

1. Ferdinand P. Beer, E. Russell Johnston and Jr.John T. DeWolf “Mechanics of Materials”, Third Edition, Tata McGraw-Hill publications.
2. James M. Gere, “Mechanics of Materials”, 5th Edition, Thomson Learning.
3. R C Hibbler, “Mechanics of Materials”, 9th Edition, Pearson publications.
4. D.H. Young, S.P. Timoshenko “ Elements of Strength of Materials” East West Press Pvt. Ltd., 5th Edition (Reprint 2014)
5. S Ramamrutham and R Narayanan, “Strength of Materials”, 18th Edition, Dhanpat Rai Publishers 2016.
6. Vazirani, V N, Ratwani M M. and S K Duggal "Analysis of Structures Vol. I", 17th Edition, Khanna Publishers, New Delhi.

**Journals/Magazines**

1. Strength of Materials Journal, India
2. Mechanics of Material, Elsevier

SWAYAM/NPTEL/MOOCs:

**http://www.nptel.iitm.ac.in**

**COURSE PACK FOR: SURVEYING AND GEOMATICS**

<table>
<tr><td>Course Title</td><td colspan="4">SURVEYING AND GEOMATICS</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0303</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes<br>Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>4</td><td>2</td></tr>
<tr><td>Practice</td><td>1</td><td>1</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>4</td><td>60</td><td>16</td><td>50%</td><td>50%</td></tr>
</table>

**COURSE OVERVIEW:** This course is an overview of engineering approaches to collection of the ground details with an emphasis on fundamental principles. Theory and conceptual study on classifications of survey, instruments of chain surveying, levelling surveying, Theodolite surveying, Total station surveying, curves setting and knowledge of geomatics subject will help to prepare the details of maps and plans for civil Engineering projects.

**COURSE OBJECTIVE (S):**

The objectives of this course are to:

1. To provide basic knowledge about principle of surveying for location, design and construction of engineering projects and also study about chain.
2. To develop skills for using surveying instrument of levelling instruments.
3. To develop skills for using theodolite instruments
4. To find horizontal and vertical angles and setting of curves
5. To make students to develop skills using of Total station.
6. To make students to aware of geomatics area knowledg

**COURSE OUTCOMES (COs)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Gain the basic surveying and application of chain and compass surveying for various different conditions. | 1, 2, 3, 4, 5 | 1,2,3 |
| **CO2** | Gained the ability to use plane table and | 1, 2, 3, 4, 5 | 1,2,3 |
| **CO3** | Gain the knowledge of levelling equipment with their accessories and to meet various requirements. | 1, 2, 3, 4, 5 | 1, 2, 3 |
| **C04** | Gain the ability to use of theodolite to measure angles, and horizontal curves. | 1, 2, 3, 4, 5, | 1, 2, 3 |
| **CO5** | Gain the knowledge of Total station instrument using | 1, 2, 3, 4, 5 | 1, 2, 3 |
| **CO6** | Gain the knowledge of remote sensing, GIS and GPS in geomatics area. | 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** | ✓ | ✓ | ✓ | ✓ | | ✓ |
| **C04** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **CO5** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **CO6** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**COURSE ARTICULATION MATRIX**

| CO#/ POs | **PO** | **PO** | **PO** | **PO** | **PO** | **PO** | **PO** | **PO** | **PO** | **PO1** | **PO1** | **PO1** | **PSO** | **PSO** | **PSO** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | **3** | **2** | **2** | **2** | | | | | | | | **3** | **3** | **3** |
| **CO2** | **2** | **2** | **2** | **2** | **2** | | | | | | | | **3** | **3** | **3** |
| **CO3** | **3** | **3** | **2** | **2** | **2** | | | | | | | | **3** | **3** | **3** |
| **C04** | **3** | **3** | **3** | **2** | **2** | | | | | | | | **3** | **3** | **3** |
| **CO5** | **3** | **3** | **3** | **2** | **2** | | | | | | | | **3** | **3** | **3** |
| **CO6** | **3** | **3** | **3** | **2** | **2** | | | | | | | | **3** | **3** | **3** |

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

## Course Content

| Contents |
|---|
| **Unit-I : Introduction to Surveying**<br>Chain Surveying: importance of surveying- classification of surveying- principles of surveying- units of measurements, concepts of plane and geodetic surveying (angular and linear measurements) and maps-surveying equipment's- Types chains ,Tapes and its accessories, Cross staff and types open cross staff, optical square, Prism square . Numerical problems |
| **UNIT – II : Levelling & Theodolite survey**<br>Levelling-Principles and basic definitions- Types of levels- – Types of levelling, Simple, Differential, Fly, Reciprocal, Profile, Cross sectioning – Booking of levels- Rise and Fall and H.I methods. Contours and their characteristics – Methods of contour plotting- Interpolation<br>Theodolite – Terminologies ,Horizontal angle by repetition and reiteration methods, vertical angle measurements,<br>Computation of distances and elevations using Tachometric methods (concepts only) |
| **Unit-III : Total station & Curve setting**<br>Total station, Automatic total station, Adjustments of total station, Operation of total station, Applications of Total Station.<br>Curves: Simple curve- elements of simple curves, Designation of a curve, setting out simple curve by offsets from long chord d, setting out simple curve by Rankin's method. Compound curve, (numerical problems), Reverse curve, transition curve, and vertical curves. |
| **Unit-IV : Introduction to Remote sensing and Geo Information System**<br>Necessity and importance of Remote sensing (RS), methods of remote sensing, Applications of remote sensing. . Introduction to Geographic Information System (GIS), GIS terminology, objectives of GIS, GIS software packages, applications of GIS. Introduction to Global Positioning System (GPS), Components of GPS, Types of GPS and accuracy, Applications of GPS. |

**PRACTICE:.**

| No | Title of the Experiment | Tools and Techniques | Expected Skill/Ability |
|---|---|---|---|
| 1. | To measure distance between two points using direct ranging, to set out perpendiculars at various points on given line | Instrumental | Conduction of Experiments |
| 2. | Determination of reduced levels of points using dumpy level/ auto level (differential levelling and inverted levelling) | Instrumental | Conduction of Experiments |
| 3. | To conduct profile levelling, cross sectioning using dumpy level. | Instrumental | Conduction of Experiments |
| 4. | To determine the tachometric constants and to determine distance and elevation of an object using tachometric methods. | Instrumental | Conduction of Experiments |
| 5. | Measurement of horizontal angle by repetition and reiteration methods and measurement of vertical angles using theodolite | Instrumental | Conduction of Experiments |
| 6. | Measurement of horizontal angle and measurement of vertical angles using Total station. | Instrumental | Conduction of Experiments |
| 7. | Measurement of horizontal and measurement of vertical Distances using Total station. | Instrumental | Conduction of Experiments |

| | | | |
|---|---|---|---|
| 8. | Setting out a simple curve by Rankine's deflection method | Instrumental | Conduction of Experiments |
| 9. | Setting out a compound curve by Rankine's deflection method. | Instrumental | Conduction of Experiments |
| 10. | Demo on conventional instruments (Compass surveying & Plane Table surveying) | | |

**REFERENCES BOOKS:**


1. B. C Punmia, Surveying Vol. 1, Laxmi publications pvt ltd, New Delhi
2. S. K Duggal, Surveying Vol. Tata McGraw Hill Publishing Co. Ltd. New Delhi-2009
3. K. R Arora, Surveying Vol. 1 Standard Book House, New Delhi-2010
4. Kanetkar T P and S V Kulkarni, Surveying and Levelling Part I, Pune VidyarthiGrihaPrakashan, 1988.
5. R Subramanian, Surveying and Levelling, Second edition, Oxford University Press, New Delhi.
   A. Bannister, S. Raymond , R. Baker, "Surveying", Pearson, 7th ed., NewDelhi
6. Textbook of Surveying Venkatramaiah, C Universities Press, Hyderabad


**Reference Books:**


S K Roy, "Fundamentals of Surveying", Prentice Hall of India, New Delhi. 2009

S K Duggal, "Surveying", Vol. 1, Tata McGraw Hill Publishing Co. Ltd., New Delhi. 2008.

A. M. Chandra, "Plane Surveying"– New age international ( P) Ltd.

A. M. Chandra, "Higher Surveying" - New age international (P) Ltd.


**Journals/Magazines**

https://guides.libraries.psu.edu/c.php?g=378978&p=2568678
https://researchguides.austincc.edu/c.php?g=434679&p=2964469
https://www.engineeringcivil.com/journals-and-magazines

**SWAYAM/NPTEL/MOOCs:**

1. https://www.classcentral.com/course/swayam-higher-surveying-17632
2. https://onlinecourses.nptel.ac.in/noc20_ce51/preview

**Self-Learning Exercises:**

1. Advanced Surveying
2. IOT in Surveyi

## COURSE PACK FOR: WATER AND WASTE WATER ENGINEERING

<table>
<tr><td>Course Title</td><td colspan="4">WATER AND WASTEWATER ENGINEERING</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0305</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>TLP</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>Theory</td><td>3</td><td>4</td><td>2</td></tr>
<tr><td>Practice</td><td>1</td><td>1</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td></td><td>4</td><td>4</td><td>26</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

**COURSE OVERVIEW:** This course is an overview of engineering approaches to protecting water quality with an emphasis on fundamental principles. Theory and conceptual design of systems for treating municipal wastewater and drinking water are discussed, as well as reactor theory, process kinetics, and models. Physical, chemical, and biological processes are presented, including sedimentation, filtration, biological treatment, disinfection, and sludge processing.

**COURSE OBJECTIVE (S):**

**The objectives of this course are to:**

1. To introduce the fundamental scientific concepts of water supply and various sources of water
2. To discuss the Water quality parameter analysis and its conveyance.
3. To describe the objectives and methods of water treatment and the principles involved in the design and selection of appropriate unit processes
4. To introduce to the types of sewerage system, sewer materials and sewer appurtenances used in sanitary engineering.
5. To analysis wastewater quality analysis and select appropriate Waste water treatment unit processes
6. To demonstrate the objectives of used water reuse and recycle.

## COURSE OUTCOMES (COs)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Understand the concepts of water supply and various sources of water | 1, 2, 3, 4, 5 | 1,2,3 |
| CO2 | Explain the Water quality parameter analysis and its conveyance. | 1, 2, 3, 4, 5 | 1,2,3 |
| CO3 | Identify the various methods of water treatment and the principals involved in the design and selection of appropriate unit processes. | 1, 2, 3, 4, 5 | 1, 2, 3 |
| C04 | Explain the necessity of sanitation, types of sewerage system, sewer materials and analyse the various sewer appurtenances. | 1, 2, 3, 4, 5 | 1, 2, 3 |
| C05 | Analysis wastewater quality and select appropriate wastewater treatment unit processes | 1, 2, 3, 4, 5 | 1, 2, 3 |
| C06 | Understand the objectives of wastewater reuse and recycle. | 1, 2, 3, 4, 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 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | | 1 | | | | | | | | | 3 | 3 | 3 | |
| **CO2** | 3 | 2 | 1 | | | | | | | | | | 3 | 3 | 3 | |
| **CO3** | 3 | 2 | | | | | | | | | | | 3 | 3 | 3 | |
| **C04** | 3 | 2 | | | | | 3 | | | | | | 3 | 3 | 3 | |
| **CO5** | 3 | 2 | | | | | | | | | | | 3 | 3 | 3 | |
| **CO6** | 3 | 2 | | | | | 3 | | | | | | 3 | 3 | 3 | |

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

**Course Content**

| **Contents** |
|---|
| **Unit-I : Introduction to Water supply engineering**<br>Water Supply: Need for protected water supply, water demands, design period, population forecasting, Numerical on population forecast, variations in demand of water, Source of water, Intake structures and types, Water quality parameters – Physical, chemical and biological ( BIS & WHO )<br>Conveyance of Water: Pipe materials (No Design examples), Pipe appurtenances, various valves, systems of water supply. |
| **UNIT – II : Water Treatment**<br>Water Treatment: Objectives of treatment, Sedimentation- types (design example), Coagulation and Flocculation, clariflocculator; Filtration-theory, types, construction, operation and maintenance of filters, Numericals on Design, Disinfection- methods, Miscellaneous treatments -Softening- lime soda process, zeolite process, RO and membrane techniques, Fluoridation and Defluoridation. Methods of layout of distribution systems and using of software's |
| **Unit-III Introduction to Waste Water Engineering**<br>Sanitation: Necessity for sanitation, types of sewerage systems and their suitability. Estimating Peak Run-off by Rational formula, self-cleansing and non-scouring velocities, Physical, Chemical and Biological characteristics of waste water; Sewer materials and shapes (No design examples), laying of sewers, joints and testing of sewers, Sewer appurtenances: Catch basins, manholes, flushing tanks, oil and grease traps, Drainage traps. |
| **Unit-IV : Waste Water Treatment**<br>Waste Water Treatment: Screening, grit chambers, skimming tanks, primary sedimentation tanks, secondary treatment- Trickling filter – theory and operation, Activated sludge process- Principle and flow diagram, , Septic tank, Oxidation Pond(No design examples), Disposal of effluents: methods, Sewage farming, Use of Sewage Effluents for Groundwater recharge. |

## PRACTICE:.

| No | Title of the Experiment | Tools and Techniques | Expected Skill/Ability |
|---|---|---|---|
| 1. | Determination of Alkalinity | Volumetric | Conduction of Experiments |
| 2. | Determination of Acidity | Volumetric | Conduction of Experiments |
| 3. | Determination of pH & Electrical Conductivity | Instrumental | Conduction of Experiments |
| 4. | Determination of Turbidity | Instrumental | Conduction of Experiments |
| 5. | Jar test for Optimum Dosage of Alum | Volumetric | Conduction of Experiments |
| 6. | Determination of Chlorides | Volumetric | Conduction of Experiments |
| 7. | Determination of Hardness | Volumetric | Conduction of Experiments |
| 8. | Determination of Residual Chlorine | Volumetric | Conduction of Experiments |
| 9. | Determination of Dissolved Oxygen (DO) | Volumetric | Conduction of Experiments |
| 10. | Biochemical Oxygen Demand (BOD) of Wastewater | Volumetric | Conduction of Experiments |
| 11. | Chemical Oxygen Demand (COD) of Wastewater | Volumetric | Conduction of Experiments |
| 12. | Determination of Total Solids, Suspended Solids, Dissolved Solids, and Settleable Solids. | Gravimetric | Conduction of Experiments |
| 13. | Determination of Sulphates | Gravimetric | Conduction of Experiments |
| 14. | MPN determination | Instrumental | Conduction of Experiments |
| 15. | Demo on UV-Spectro Photometer | Instrumental | Demo |

## Text Book:


1. Water supply Engineering –S.K.Garg, Khanna Publishers
2. Environmental Engineering I –B C Punima and Ashok Jain
3. Environmental Engineering -Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), McGraw Hill Book Co.
4. Sewage Disposal and Air Pollution Engineering –S.K.Garg, Khanna Publishers
5. Wastewater Engineering –B C Punima and Ashok Jain, Lakshmi Publishers
6. Environmental Engineering -Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), McGraw Hill Book Co.
7. Manual on Water supply and treatment –CPHEEO, Ministry of Urban Development, New Delhi
8. Hammer, M.J., (1986), Water and Wastewater Technology –SI Version, 2nd Edition, John Wiley and Sons.
9. Karia, G.L., and Christian, R.A., (2006), Wastewater Treatment – Concepts and Design Approach, Prentice Hall of India Pvt. Ltd., New Delhi.

10. Sincero, A.P., and Sincero, G.A., (1999), Environmental Engineering – A Design Approach–Prentice Hall of India Pvt. Ltd., New Delhi.
11. E.W.Steel,Mc Ghee, Terence -'Water Supply Engineering and Sewerage; Mc.Graw Hill
12. Fair, Geyer and Okun-'Water and Wastewater Engineering: Water Supply and Wastewater Removal, 3rd Edition, John Wiley and Sons.

Reference Books:

1. Manual on Wastewater Treatment –CPHEEO, Ministry of Urban Development, New Delhi
2. E.W.Steel,Mc Ghee, Terence -'Water Supply Engineering and Sewerage; Mc.Graw Hill
3. Fair, Geyer and Okun-'Water and Wastewater Engineering: Water Supply and Wastewater Removal, 3rd Edition, John Wiley and Sons.
4. Metcalf and Eddy: 'Waste Water Treatment, Disposal and Reuse'; Tata McGraw Hill Publications.
5. Manual of Water and Wastewater Analysis – NEERI Publication.
6. Standard Methods for Examination of Water and Wastewater (1995), American Publication – Association, Water Pollution Control Federation, American Water Works Association, Washington DC.
7. IS Standards: 2490-1974, 3360-1974, 3307-1974.
8. Chemistry for Environmental Engineering, Sayer and Mccarthy
9. Environmental Engineering Laboratory Manual- Dr.BKotaiah, N Kumara Swamy

## Journals/Magazines

1. https://www.environmental-expert.com/water-wastewater/water-treatment/magazines
2. https://www.sciforschenonline.org/journals/water-and-waste/index.php
3. https://www.springer.com/journal/11962

## SWAYAM/NPTEL/MOOCs:

1. Water and waste water treatment (https://onlinecourses.nptel.ac.in/noc21_ce25/preview)
2. Wastewater Treatment and Recycling (https://onlinecourses.nptel.ac.in/noc19_ce32/preview)

## Self-Learning Exercises:

1. Advanced wastewater treatment
2. IOT in wastewater treatment.

## COURSE PACK FOR: COMMUNICATION SKILLS

<table>
<tr><td>Course Title</td><td colspan="4">Communication Skills</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AH0301</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes<br>Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>2</td><td>2</td><td>2</td><td>26</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

### COURSE OVERVIEW

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 objectives of this course are to:

1. Develop basic communication skills in English.
2. Emphasize on the development of speaking skills amongst learners of Engineering and Technology
3. Impart the knowledge about use of electronic media such as 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 and communicate with one or many listeners using appropriate communicative strategies (Speaking Skills). | 1 to 3, 12 | 1,3 |
| **CO2** | Build inferences from the text. | 1 to 4 ,12 | 2 |
| **CO3** | Make use of accurate writing skills using different components of academic writing. | 1 to 5,12 | 2 |
| **CO4** | Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic | 1 to 5,12 | 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 | | | √ | | | |

## 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 | 3 | | 1 |
| **CO2** | 3 | 3 | 3 | 3 | | | | | | | | 1 | | 3 | |
| **CO3** | 3 | 3 | 3 | 3 | 3 | | | | | | | 1 | | 2 | |
| **CO4** | 3 | 3 | 3 | 3 | 3 | | | | | | | 1 | | 3 | 3 |

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

## COURSE CONTENT

**THEORY:**

**Unit – 1**

**Functional English: Grammar:** Prepositions; Modal Auxiliaries, Reading Comprehension, Active and passive voice, Giving Instructions.

**Unit – 2**

**Interpersonal Skills: Grammar:** Tenses; Wh-questions, Compound words; Phrasal verbs, Recommendations

**Unit – 3**

**Multitasking Skills Grammar:** Conditional Sentences, Homonyms; homophones, Subject-verb agreement.

**Unit – 4**

**Communication Skills Grammar:** Direct and indirect speech, Interpreting visual materials (line graphs, pie charts etc.), Single word substitutes.

## TEXT BOOKS:

1. Green, David, "Contemporary English Grammar Structures and Composition", New Delhi: MacMillan Publishers, 20l0.
2. Thorpe, Edgar and Showick Thorpe, "Basic Vocabulary", Pearson Education India, 20l2.
3. Leech, Geoffrey and Jan Svartvik, "A Communicative Grammar of English", Longman, 2003.

## REFERENCE BOOKS:

Murphy, Raymond, "Murphy's English Grammar with CD", Cambridge University Press, 2004.

Rizvi, M. Ashraf, "Effective Technical Communication", Tata McGraw-Hill, New Delhi, 2005.

Riordan, Daniel, "Technical Communication", Cengage Publications, New Delhi, 2011.

Sen, "Communication and Language Skills", Cambridge University Press, 2015.

| COURSE PACK FOR: INDIAN CONSTITUTION AND PROFESSIONAL ETHICS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **Indian Constitution and Professional Ethics** | | | | **Course Type** | | **Theory** | |
| **Course** | **B20LS0301** | **Credits** | **2** | | **Class** | | **III Semester** | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 2 | 2 | 2 | | | | |
| | Practice | 0 | 0 | 0 | Theory | Practical | IA | SEE |
| | Tutorial | 0 | 0 | 0 | | | | |
| | Total | 2 | 2 | 2 | 26 | 0 | 50 % | 50 % |

## COURSE OVERVIEW

The Constitution of India lays down in defining fundamental political principles, establishes the structure, procedures, powers and duties of government institutions and sets out fundamental rights, directive principles and duties of citizen. It helps to know and understand the human rights and human values. It also helps to know the meaning of ethics and need of ethics in personal and professional life.

**COURSE OBJECTIVE (S):**

The objectives of this course are to:

1. Explain basic knowledge required to understand Constitution of India.
2. Describe the Fundamental Rights, Duties and other Rights.
3. Discuss different types of ethics.
4. Explore ethical standards followed by different companies.

## COURSE OUTCOMES (COs)

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

| CO | Course Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Analyze the Fundamental Rights, Duties and other Rights protected under Indian Constitution. | 1 ,6,7,8,9, 12 | 1,3 |
| **CO2** | Demonstrate the practicality of Constitution perspective and make them face the world as a bonafide citizen. | 1 to 4,7,8 ,12 | 2 |
| **CO3** | Illustrate the professional ethics and human values. | 1 to 5, 7,8 ,12 | 2 |
| **CO4** | Summarize ethical standards followed by different companies. | 1 to 5,7,8,12 | 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** | | | √ | | | |

## 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 | | 1 |
| CO2 | 3 | 3 | 3 | 3 | | | 3 | 3 | | | | 1 | | 3 | |
| CO3 | 3 | 3 | 3 | 3 | [illegible] | | 3 | 3 | | | | 1 | | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | | 3 | 3 | | | | 1 | | 3 | [illegible] |

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

**COURSE CONTENT**

**THEORY:**

**Unit – 1**

**Indian constitution:** Sailent features, fundamental rights and duties (Directive principle and state policy), Legislature (Loka Sabha & Rajya Sabha), Executive ( President& Governor) and Judiciary (Supreme court & high court), Composition and function of parliament, Council of ministers, prime minister, Speaker, Passing of bills.

**Unit – 2**

**Human Rights:** Nature and Scope of human rights, Universal protection of human rights (UDHR),Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups (children, women & old-age).

Human Values: Truth, Honesty, Loyalty, Love, Peace with examples, Difference between ethics, beliefs and morals.

**Unit – 3**

**Ethics:** Meaning, Definition, Evolution, Need of ethics, Aristotlean Ethics, Utilitarianism, Katianism, human values(Good conduct, respect for elders), ethical human conduct (Gender equality), Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

**Unit – 4**

**Engineering Ethics:** Definition Scope and needs, Ethics in Consumer Protection, Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence

## TEXT BOOKS:


1. Kapoor, S.K., “Human rights under International Law and Indian Law”, Prentice Hall of India, New Delhi, 2002.
2. Basu, D.D., “Indian Constitution”, Oxford University Press, New Delhi, 2002.
3. Chakraborty, S.K., “Values and ethics for Organizations and Theory Practice”, Oxford University Press, New Delhi, 2001.


## REFERENCES BOOKS:


1. Meron Theodor, “Human Rights and International Law Legal Policy Issues”, Vol. 1 and 2, Oxford University, Press, New Delhi, 2000.
2. M V Pylee, “An Introduction to Constitution of India”, S Chand & Company, 5th Edition
3. Durga Das Basu, “Introduction to constitution of India”, LexisNexis, 23rd Edition.


Self-Learning Exercises: Abuse of Technologies: Hacking and other crimes, addiction to mobile phone usage, video games and social networking websites

**SEMESTER IV**
**COURSE PACK FOR: PROBABILITY AND SAMPLING THEORY (B20AS0401)**

<table>
<tr><th>Course Title</th><th colspan="4">Probability and Sampling Theory</th><th colspan="2">Course Type</th><th colspan="2">HC</th></tr>
<tr><th>Course Code</th><th>B20AS0401</th><th>Credits</th><th colspan="2">3</th><th colspan="2">Class</th><th colspan="2">IV semester</th></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</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>Theory</td><td>3</td><td>4</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

## Course Overview:

Axiomatic probability theory, independence, conditional probability. Discrete and continuous random variables, special distributions of importance to Civil Engineering. And expectation. Simulation of random variables and Curve fitting, basic statistical inference, parameter estimation, hypothesis testing, and linear regression and correlation. Introduction to stochastic processes and Sampling theory.

**Course Objective: Student will be able to learn,**

1. The concept of curve fitting and few statistical methods.
2. Fundamentals of probability- Random variables.
3. Joint probability and regarding stochastic process.
4. Concept of Test of Hypothesis and able to apply in the various fields of Civil engineering.

## COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Approximate a linear and non-linear equation to the given data by the method of least squares. | 1,2,3,5 | 1,2,3 |
| **CO2** | Apply the concept of correlation and regression lines for distinct civil engineering problems. | 1,2,3,5 | 1,2,3 |
| **CO3** | Define concepts of probability space, random variable, discrete & continuous distribution and use to solve various Civil engineering problems | 1,2,3,5 | 1,2,3 |
| **C04** | Calculate Joint probabilities and derive the marginal and conditional distributions of bivariate random variables. | 1,2,3,5 | 1,2,3 |
| **CO5** | Define and use Stochastic processes and Markov chains in discrete and continuous time. | 1,2,3,5 | 1,2,3 |
| **C06** | Apply Sampling Theory concepts to solve various Civil engineering problems. | 1,2,3,5 | 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 Note: 1-Low, 2-Medium, 3-High**

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | 2 | | | | | | | | 2 | 2 | 3 | |
| CO2 | 3 | 2 | 2 | | 2 | | | | | | | | 2 | 2 | 3 | |
| CO3 | 3 | 2 | 2 | | 2 | | | | | | | | 3 | 2 | 3 | |
| CO4 | 3 | 2 | 2 | | 2 | | | | | | | | 2 | 2 | 3 | |
| CO5 | 3 | 2 | 2 | | 2 | | | | | | | | 3 | 2 | 3 | |
| CO6 | 3 | 2 | 2 | | 2 | | | | | | | | 2 | 2 | 3 | |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1**<br>**Curve Fitting:** Curve fitting by the method of least squares and fitting of the curves of the form,<br>y = ax + b, y = ax2 + bx + c, y = aebx and y = axb<br>Statistical Methods: Measures of central tendency and dispersion. Correlation-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression (without proof) –problems. |
| **UNIT: 2**<br>**Probability Theory:** Recap of Probability theory (definition, addition theorem, multiplication theorem and conditional probability and Baye's theorem).<br>Probability Distributions: Random variables (discrete and continuous), probability mass/density functions, mean, variance and moments. Binomial distribution, Poisson distribution. Exponential and normal distributions, problems. |
| **UNIT:3**<br>**Joint Probability Distribution:** Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.<br>Stochastic Process: Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability-simple problems. |

**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.

## Textbook:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 48th edition.
2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 1stedition.
3. Reference Books:
4. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 13th edition.
5. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition.

## SWAYAM/NPTEL/MOOCs:

https://www.digimat.in/nptel/courses/video/111105042/L01.html
https://nptel.ac.in/courses/111/104/111104079/
http://www.nptelvideos.in/2012/12/probability-random-variables.html

**Problem Based Learning**

<table>
<tr><th>No</th><th>Problem</th></tr>
<tr><td>1.</td><td>A simply supported beam carries a concentrated load P at its mid-point. Corresponding to various values of P the maximum deflection Y is measured and is given in the following table.<br><table><tr><td>$P$</td><td>100</td><td>120</td><td>140</td><td>160</td><td>180</td><td>200</td></tr><tr><td>$Y$</td><td>0.45</td><td>0.55</td><td>0.60</td><td>0.70</td><td>0.80</td><td>0.85</td></tr></table>Find a low of the form $Y = a + bP$ and hence estimate $Y$ when $P\ is\ 150$.</td></tr>
<tr><td>2.</td><td>In an examination given to students at a large number of different schools the mean grade was 74.5 and S.D grade was 8. At one particular school where 200 students took the examination the mean grade was 75.9. Discus the significance of this result from the view point of (a) one tailed test (b) two tailed test at both 5% and 1% level of significance.</td></tr>
</table>

## COURSE PACK FOR: BUILDING PLANNING AND DRAWING WITH AUTO CAD

| **Course Title** | **BUILDING PLANNING AND DRAWING WITH AUTO CAD** | | | | **Course Type** | | **Integrated** | |
|---|---|---|---|---|---|---|---|---|
| Course Code | B20ED0401 | Credits | 2 | | Class | | IV semester | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 1 | 1 | 1 | | | | |
| | Practice | 1 | 2 | 2 | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | Total | 2 | 3 | 3 | 16 | 32 | 50% | 50% |

### Course Overview
This course provides the concepts related to building planning and drawing which involves understanding the standards, bye laws of construction. It emphasizes on the drawings of different building components, further it also provides exposure for the planning and drawing of residential and commercial buildings using auto cad.

### Course Objective
**This course enables graduating students**

1. To introduce building planning, types of buildings, regulations
2. To apply AUTO CAD commands in layout and plans
3. To understand the National Building Code regulations, bye laws of construction
4. To identify the requirements for various building components
5. To understand and draw the individual components of building
6. To categorize the different types of building and draw the necessary diagrams

### COURSE OUTCOMES (Cos)
**After the completion of the course, the student will be able to:**

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Identify types of buildings and follow the regulations | 1,2,5,12 | 1,2,4 |
| CO2 | Apply the auto cad commands, examine the dimensions and draw the diagrams | 1,2,5,12 | 1,2,4 |
| CO3 | Follow the National Building Code standards, bye laws for planning | 1,2,5,12 | 1,2,4 |
| C04 | Represent the requirements for various building components | 1,2,5,12 | 1,2,4 |
| C05 | Understand and prepare working drawings for individual components like doors, windows etc. with standard sizes | 1,2,3,5, 12 | 1,2,3,4 |
| C06 | Develop the skills of drawing plans, sections and elevations of different houses and various buildings with the given data | 1,2,3,5, 12 | 1,2,3,4 |

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

| CO#/ POs | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | | | 3 | | | | | | | 2 | 3 | 3 | | 3 |
| CO2 | 3 | 1 | | | 3 | | | | | | | 2 | 3 | 3 | | 3 |
| CO3 | 3 | 1 | | | 3 | | | | | | | 2 | 3 | 3 | | 3 |
| C04 | 3 | 1 | | | 3 | | | | | | | 2 | 3 | 3 | | 3 |
| C05 | 3 | 3 | 2 | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| C06 | 3 | 3 | 2 | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| Contents |
|---|
| **UNIT: 1 Introduction to Building planning and Drawing:** Types of Buildings - Building Regulations as per Indian Standards - Drawing Tools - Standard Paper Size - BIS, ISO, Architecture and ANSI Specifications and Notations.<br>AutoCAD: Basic Commands - 2D Drafting and Annotation - Sheets and Layouts - Blocks and Customizing AutoCAD. Introduction to Building Information Modeling. |
| **UNIT:2 Building Planning: Provisions of National Building Code** - Building bye-laws - open area - setbacks - FAR terminology - Principles of planning - orientation - ventilation and lighting. Provisions for differently abled persons. |
| **UNIT:3 Building Elements :** Description for preparation of geometrical drawing of components of buildings, Calculation of number of steps for dog legged and open well stairs, Types of doors and windows, sizes<br>Roof Types: Flat and Pitched roofs. |
| **UNIT:4 Planning of Residential and Hospital buildings:** Plan, elevation and sectional elevation of Single bed room - double bed-room – two storeyed building, Hospitals buildings<br>Institutional, Commercial and Industrial buildings: School Building , Workshop and Factory buildings |

| No | Title of the Experiment | Tools | Expected Skill /Ability |
|---|---|---|---|
| 1. | Building Components | Drawings using Auto-CAD<br>Stepped wall footing and isolated RCC column footing<br>Fully panelled and flush doors<br>Half-panelled and half-glazed window<br>RCC dog legged and open well stairs<br>Steel truss | Hands on training |
| 2 | Residential and Hospital buildings<br><br>Institutional, Commercial and Industrial buildings | Drawings using Auto-CAD<br>Single bed room<br>Double bed-room<br>Two storeyed building<br>Pharmacy and Dispensaries<br>School Building with Hostel –<br>Workshop and Factory buildings with steel truss. | Hands on training |

**Text Book:**

1. Shah M.H and Kale C.M, “Building Drawing”, Tata Mc-Graw Hill Publishing co. Ltd., New Delhi.
2. N.Kumarswamy and A. KameswaraRao, “Building Planning and Drawing”, Chartor Publishing House Pvt. Ltd.

**Reference Books**

1 Dr.Balagopal and T.S.Prabhu, Building Drawing and Detailing - Spades Publishers, Calicut.

2. Randy Shih “Autocad 2016 Tutorial First Level - 2D fundamentals” Schroff Development Corp, 2015
3. Building byelaws by state and Central Governments and Municipal corporations, 2011.

**Journals/Magazines**

1. National Building Code, BIS, New Delhi.
2. Model building bye-laws 2016.

**SWAYAM/NPTEL/MOOCs:**

http://nptel.ac.in/courses/php

http://jntuk-coeerd.in

**Problem Based Learning**

| No | Problem |
|---|---|
| 1. | Draw plan and sectional elevation of RCC dog legged staircase for an office building which measures 3m x 5.5m. The vertical distance between the floors is 3.3m (including landing). Thickness of the floor slab is 150mm. Provide steps with tread of 300mm and rise of 150mm. Thickness of waist slab and landing slab is 150mm. Width of stair is 1.5m. Reinforcement details: main steel: 10φ @125 c/c spacing and distribution: 8φ @ 250 c/c spacing. |

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | To draw a school building with R.C.C. flat roof using basic AutoCAD commands as bubble diagrams |
| 2. | To draw a two storey residential building using basic AutoCAD commands for different plans |

**COURSE PACK FOR: CONCRETE TECHNOLOGY**

<table>
<tr><td>Course Title</td><td colspan="4">CONCRETE TECHNOLOGY</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0402</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes<br>Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>2</td><td>2</td><td>48</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

## Course Overview

The concept related to concrete technology which involves types and properties of concrete and different adhesive materials and its vital use for the safe, economic developments of the buildings

## Course Objective

**This course enables graduating students**

1. To learn about properties of aggregates, manufacture and tests on concrete
2. To understand about properties of hardened , various admixtures used in concrete
3. To know the properties of hardened and concept of durability of concrete.
4. To understand the principles of Concrete mix design.
5. To understand the characteristics and behavior of civil engineering materials used in buildings and infrastructure
6. Students will have exposure to practical applications including writing of a technical report related to each experiment

## COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Will gain an experience in the implementation of Concrete Materials on engineering concepts which are applied in field Construction Fields. | 1,2,12 | 1,2,4 |
| CO2 | will be able to practically understand the properties of fresh concrete and Get a confidence in selecting the admixture required for the concrete | 1,2,12 | 1,2,4 |
| CO3 | Get a confidence in deciding the hardened properties of concrete required for a particular work by testing the specimens after 28 days curing and l gain the confidence to manufacture durable concrete | 2,4,12 | 1,2,3,4 |
| CO4 | Decide the mix proportions by carrying out Mix design by knowing the properties of materials to be used at the site | 1,2,3,5, 12 | 1,2,3,4 |
| CO5 | Demonstrate ability to make selection of materials based on their properties, behavior and intended use in design and construction | 2,12 | 1,2,3,4 |
| C06 | Understand ethical issues associated with Engineering experiments and professional practice | 2,4,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO3 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C04 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | | | 3 | | | | | | | | 3 | 2 | 3 | 3 |
| CO6 | 3 | 3 | | | 3 | | | | | | | | 3 | 2 | 3 | 3 |

Course Content Theory

## Contents

**UNIT:1 Introduction**

**Basics:** Historical background, composition of concrete, general note on strength mechanism, recent practice and future trends.

Constituent of Concrete:

Cement - Chemical composition, hydration, heat of hydration, hydrated structure, Transition zone

Aggregates - classification, texture, strength, mechanical properties, moisture content

Water - General Requirements & limiting values of impurities.

**UNIT: 2 Fresh concreate and admixtures-**

Fresh concrete: Manufacturing of concrete Methods of Mixing, Transporting, handling and Placing of concrete). Workability – Definition and requirement, factors affecting workability, various Tests as per IS. Segregation and bleeding, Curing: Necessity and Methods.

Admixtures – Chemical Admixtures - Accelerator, Retarder, Plasticizer and Super-plasticizer, their functions and dosage. Mineral admixture - Fly ash, Silica fume, blast furnace slag- Properties.

| UNIT: 3 Hardened Concrete |
|---|
| Hardened Concrete: Mechanical Properties of hardened concrete and factors effecting – gel space ratio, aggregate cement ratio, effect of age, maturity, aggregate cement-paste inter-face. Introduction to aspects of elasticity, shrinkage and creep. Tests for strength of concrete:<br>Durability: definition, significance, permeability, alkali aggregate reaction, sulphate attack, chloride attack, carbonation, freezing and thawing, factors contributing to cracks in concrete. |
| **UNIT:4 Mix design of Concrete** |
| Concept of concrete mix design, variables in proportioning, exposure conditions, selection criteria of materials for mix design, factors affecting mix design, BIS method of mix design, ACI method, numerical examples of concrete mix design with and without admixtures<br>Advances in Concrete- Self Compacting Concrete, Bacterial Concrete, High density Concrete. |

**Text Book:**

1. M S Shetty; Concrete Technology, S. Chand Publication New Delhi
2. P Kumar Mehta, Monteiro; Concrete Technology, Indian Concrete Institute
3. M L Gambhir; Concrete Technology, Tata McGraw Hill
4. ”Laboratory Manual on Concrete Technology" Sood, Hemant, Mittal L N and Kulkarni P D, CBS Publishers, New Delhi, 2002.
5. Gambhir M L “Concrete Manual Laboratory testing for quality control” of concrete 4th edition DhanpatRai and Sons Delhi 1992.

**Reference Books**

1. A R Santhakumar; Concrete Technology, Oxford University Press
2. A.M. Neville; Properties of Concrete, Pearson Education

Journals/Magazines

1. Indian Concrete Journal, Mumbai, India
2. Jounal of Advanced Concrete Technology, Japan Concrete Institute, Tokyo

**PRACTICE :**

| No | Title of the Experiment | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1 | Tests on Aggregate | Sieve Analysis of FA and CA | Hands on training |
| 2 | Tests on Cement : | Normal Consistency<br>Setting time<br>compressive strength<br>Fineness and soundness of Cement.<br>Specific gravity | Hands on training |
| 3 | Tests on Concrete: | 1.-Tests on fresh concrete:-<br>Workability Tests<br><br>2.Tests on hardened concrete:<br>i. Compressive strength test,<br>ii. Split tensile strength test, | Hands on training |

| | | | |
|---|---|---|---|
| | | iii. Flexural strength test | |
| | | 3.Demonstration of NDT-Limitations<br>4. Demo on SCC Testing | DEMO |

**SWAYAM/NPTEL/MOOCs:**
**http://www.nptel.iitm.ac.in**

**Problem Based Learning**

| No | Problem |
|---|---|
| | Mix design: It is required to have characteristic compressive strength 40 N/mm2. The compaction factor for the design mix is taken as 0.9. The maximum size of aggregate is 20 mm (angular). Type of exposure moderate and degree of quality control as very good.<br><br>Test data for materials: Cement used of 43 grade of OPC<br>Specific gravity of cement - 2.975<br>Specific gravity of aggregates:-<br>Coarse - 2.63<br>Fine - 2.62<br>Water absorption<br>Coarse aggregate - 0.5 percent<br>Fine aggregate - 1.0 percent<br>Free surface moisture<br>Coarse aggregate - nil<br>Fine aggregate- nil<br>For any other required data, IS: 10261-2019 and IS: 383-1970 may be referred |

**Project Based Learning**
To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| Highway Engineering | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Course Code*** | **B18CE401** | **Credits** | 3 | | **Class** | | **IV sem** | |
| | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 1 | 2 | 2 | | | | |
| | Tutorial | 0 | - | - | | | | |
| | **Total** | 3 | 5 | 5 | 42 | 26 | 50% | 50% |

## COURSE PACK FOR: HIGHWAY ENGINEERING

| No. | Suggested Projects |
|---|---|
| 1. | Fresh concrete properties can be explored in the laboratory for various mix proportions |
| 2. | Hardened concrete properties can be explored by testing the specimens cured for 7 days, 14 days and 28 days |

### COURSE OVERVIEW

Course Description: This subject provides overall basic knowledge to the students about Highway Engineering. This includes study on Highway Materials and Highway Drainage.

### COURSE OBJECTIVE

1. To educate students about the importance of transportation, various modes of transportation with emphasis on road transportation
2. To know the scope of Highway Engineering and Rural road development projects in India
3. To learn Requirements and properties of Highway materials.
4. To discuss about various challenges faced during construction.
5. To know the importance and Requirements of Highway drainage system
6. To discuss the various issues in highway development.

### COURSE OUTCOMES (COs)

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

| CO | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Compare the various modes of transportation and learn the importance of road developments in India and study about the current road development in India | PO1, PO2, PO3, PO5 | PSO1, PSO3 |
| CO2 | Describe the various objectives of planning and classify the roads. | PO2, PO3, PO5 | PSO2, PSO3 |

| | | | |
|---|---|---|---|
| CO3 | Outline the importance and desirable properties of soil in the construction of highways. | PO1, PO2, PO3, PO5 | PSO2, PSO3 |
| CO4 | Describe the various soil challenges faced during the construction and properties of bitumen. | PO1, PO2, PO3, PO5 | PSO2, PSO3 |
| CO5 | To align the highway drainage and learn the requirements and importance of highway drainage. | PO2, PO3, PO5 | PSO3, PSO4 |
| CO6 | Describes the various Environmental and Social issues in Highway development. | PO2, PO3, PO5 | PSO3, PSO4 |

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

**COURSE ARTICULATION MATRIX**

| **Course Code** | **POS/ COs** | **PO 1** | **P0 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PS O1** | **PS O2** | **PS O3** | **PS O4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **B18CE 4050** | CO1 | 3 | 2 | | | | 2 | 3 | 3 | | 3 | | 1 | 3 | | 2 | 3 |
| | CO2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | | | 3 | 2 | 3 | 3 |
| | CO3 | 3 | 3 | 3 | 2 | | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 2 |
| | CO4 | 3 | | | 3 | 3 | 3 | 3 | 2 | 3 | 3 | | 2 | 3 | 2 | | |
| | CO5 | 3 | 2 | 3 | 2 | | 3 | 2 | 3 | | 3 | | 3 | 3 | | 3 | 2 |
| | CO6 | 3 | | 3 | | 2 | 2 | 3 | 3 | | 2 | | 3 | 3 | | 2 | 3 |

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

**COURSE ASSESSMENT**

| **S No** | **Component** | | **Duration in Hours** | **Component Wise Marks** | **Total Marks** | **Weightage** | **Marks** |
|---|---|---|---|---|---|---|---|
| 1 | Continuous Internal Evaluation (CIE) | Theory: Test-1 | 1.5 | 30 | 100 | 0.5 | 50 |
| 2 | | Theory: Test-2 | 1.5 | 30 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3<br>4 | | Alternate Assessment* | - | 40 | | | |
| 4 | Semester End Exam (SEE) | | 3 | 100 | 100 | 0.5 | 50 |
| Total Marks | | | | | | | 100 |

*** Assignment, Quiz, Class test, SWAYAM/NPTEL/MOOCs and etc.**

**COURSE CONTENT**
**THEORY**

| Contents |
|---|
| **UNIT-I** **12 HOURS** |
| **Introduction:** Importance of transportation, Different modes of transportation, Importance of roads in India, Role of transportation for the Development of Rural Areas in India, Current road development programmes in India, Scope of Highway Engineering, recent numerical examples |
| **UNIT II** **12 HOURS** |
| **Highway planning, location and alignment-** Objectives of highway planning, classification of roads based on types and Nagpur Road Plan, Planning Surveys and Interpretation, Basic requirements of an ideal alignment and factors controlling, engineering survey for highway alignment, steps in new alignment, necessity of realignment and steps, drawings and report |
| **UNIT III** **12 HOURS** |
| **Highway Materials:-**Soil: Importance and desirable properties of subgrade soil, HRB method of soil classification, – numerical examples.<br>Aggregates: Requirements, properties and tests on road aggregates.<br>Bitumen and Modified Bitumen: Requirements, properties and tests, criterion for selection of different binders.<br>Emulsions and Cutbacks: Preparation, characteristics, uses and tests. |
| **UNIT IV** |
| **Highway Drainage:** Requirements, Surface and Sub-surface drainage system, road construction in water-logged areas. Road-Side Development: Environmental and Social issues in Highway development, Hydraulic Design elements of drains, numericals, Control of soil Erosion |

**Practice:**

| No | Title of the Experiment | Tools and Techniques | Expected Skill |
|---|---|---|---|
| 1. | Determination of Specific gravity &Water Absorption of Coarse Aggregates | Hot air Oven, Wire basket, Weighing balance. | Hands on experience |
| 2. | Aggregates Impact test | Impact testing Machine, Moulds, Rammer, Weighing balance. | Hands on experience |
| 3. | Aggregates Crushing strength Test | Crushing testing Machine, | Hands on |

| | | | |
|---|---|---|---|
| | | Moulds, Rammer, Weighing balance | Experience |
| 4. | Determination of Flakiness index and Elongation Index of Coarse Aggregates | Flakiness and Elongation Scale, Weighing balance | Hands on Experience |
| 5. | Determination of Abrasion Value of Coarse Aggregates. | Los Angeles Abrasion testing Machine, Steel balls, Weighing balance | Hands on experience |
| 6. | Determination of Specific Gravity of Bitumen. | Density Bottle, Weighing Balance, Kerosene | Hands on experience |
| 7. | Determination of Penetration value of Bitumen | Penetrometer, Bitumen Heater, Water bath | Hands on experience |
| 8. | Determination of Softening point of Bitumen | Bitumen Heater, Water bath, Ring and Ball Apparatus | Hands on experience |
| 9. | Viscosity of Bitumen. | Bitumen Heater, Water bath, Viscometer, Thermometer. | Hands on experience |
| 10. | Only demonstration- Determination of Marshall Stability of Bitumen Mix | Bitumen Heater, Water bath, Ductility Testing machine, Mould. | Hands on experience |

**REFERENCE BOOKS**


1. Khanna S K, Justo C E G and Veereragavan A, **"Highway Engineering",** Nemchand and Bros, Roorkee.
2. Saxena S C and Arora S P, "**A Text Book of Railway Engineering",** DhanpatRai Publications Pvt. Ltd. New Delhi.
3. Khanna S K, Arora M G and Jain S S, **"Airport Planning and Design",** Nemchand and Bros. Roorkee.
4. Srinivasan R, **"Harbour Dock and Tunnel Engineering",** Charotar Publishing House, Anand.
5. William W. Hay, **"An Introduction to Transportation Engineering",** Toppan Company Ltd., Tokyo.
6. Relevant IRC codes


**JOURNALS/MAGAZINES**

International Journal of Highway Engineeringhttp://www.ijhe.or.kr/AboutUs/

Indian journal of Applied Research: https://www.worldwidejournals.com/indian-journal-of-applied-research-(IJAR)/article/design-of-road-side-drainage/NTk4

**SWAYAM/NPTEL/MOOCs**

1. http://www.nptelvideos.in
2. https://nptel.ac.in
3. https://www.coursera.org

## Practice

| PRACTICE # | Topics to be Covered |
|---|---|
| 1. | Determination of Specific gravity &Water Absorption of Coarse Aggregates |
| 2. | Determination of Impact value of Coarse Aggregates |
| 3. | Determination of Crushing value of Coarse Aggregates |
| 4. | Determination of Flakiness and Elongation Index of Coarse Aggregates |
| 5. | Determination of Abrasion value of Coarse Aggregates( Los Angles Abrasion Test) |
| 6. | Determination of Specific Gravity of Bitumen. |
| 7. | Determination of Penetration value of Bitumen. |
| 8. | Determination of Viscosity of Bitumen. |

| | |
|---|---|
| 9. | Determination of Softening point of Bitumen. |
| 10 | Only Demonstration - Determination of Marshall Stability of Bitumen Mix. |

**Assignment Questions**

| | |
|---|---|
| 1 | List and explain the current Road Development projects in India |
| 2 | What are the basic requirements to be considered while planning a Highway |
| 3 | Name any new materials that can replaced for conventional materials for construction of Highways |
| 4 | The maximum quantity of water expected in one of the open longitudinal drain on clayey sol 0.9 m3/sec. Design the cross section and longitudinal slope of trapezoidal drain assuming the bottom width of drain to be 1.00 and cross slope to be 1.0 V to 1.5 H. The allowable velocity of flow in drain is 1.2 m/sec and manning roughness co efficient is 0.02. |

**Project Based Learning – Integrated Course**

To Enhance the Skill Set in The Integrated Course, The Students Are Advised to Execute Course-Based
Design Projects. Some Sample Projects Are Given Below:

| No. | Suggested Projects |
|---|---|
| 1. | Determination of Engineering properties of given sample of Aggregates |
| 2. | Determination of Engineering properties of given sample of Bitumen. |

## COURSE PACK FOR: HYDROLOGY AND IRRIGATION ENGINEERING

<table>
<tr><td>Course Title</td><td colspan="3">Hydrology and Irrigation Engineering</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0404</td><td>Credits</td><td colspan="2">4</td><td>Class</td><td colspan="2">IV semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

This course introduces the students to various concepts of Hydrology and Irrigation engineering necessary to understand irrigation practice. Students will also learn the concepts of flow measuring techniques by pipe and channels necessary for irrigation practice.

### Course Objective

**This course enables graduating students**

1. To impart the knowledge of hydrology that deals with the occurrence, distribution and movement of water on the earth & learnt about the Precipitation and related losses of water.
2. To educate the students, concepts of Runoff and rainfall- runoff relationship
3. To educate the students, concepts of Runoff & Hydrograph for applications like Flood etc.
4. To impart knowledge of various irrigation techniques and water requirements of crops along with assessment of irrigation water.
5. To learn the canal irrigation distribution system .

### COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Outline the important process involved in the water cycle, identify methods for determining Precipitation & Components of Water Losses. | 1,3,5,6,7, | 1,2,3,4 |
| **CO2** | Classification of the runoff , influencing factors & Rainfall-Runoff relationship. | 1,2,3,4,6, 8,9,11 | 1,2,3,4 |
| **CO5** | Components of hydrograph and predict the surface runoff based on hydrograph theory. | 1,2,3,4,6, 8,9,11 | 1,2,3,4 |
| **CO3** | Summarize various irrigation techniques &estimate water requirements of the crops. | 1,2,3,4,5, 6,7,8,10, 11 | 1,2,3,4 |

| | | | |
|---|---|---|---|
| **C05** | Classify the distribution system for canal irrigation. And describe the design procedure of canal systems. | 1,2,3,4,7, 8,10,11 | 1,2,3,4 |
| **CO6** | Knowledge for additional sources of water and challenges in irrigation practice | 1,2,3,4,6, 7,8,10,11 | 1,2,3,4 |

**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** | **PSO4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | 2 | | 2 | 2 | 3 | | | | | 1 | 3 | 2 | 1 | 1 |
| **CO2** | 2 | 3 | 1 | 2 | | 2 | | 2 | 1 | | 1 | | 2 | 3 | 3 | 2 |
| **CO3** | 2 | 3 | 1 | 2 | | 2 | | 2 | 1 | | 1 | | 2 | 3 | 3 | 2 |
| **CO4** | 1 | 1 | 3 | 2 | 3 | 3 | 3 | | | 1 | 2 | 2 | 3 | 2 | 2 | 1 |
| **C05** | 3 | 2 | 2 | 1 | | 2 | | 1 | | 2 | 3 | | 2 | 3 | 3 | 2 |
| **CO6** | 3 | 2 | 2 | 1 | | 2 | 2 | 1 | | 2 | 3 | | 2 | 3 | 3 | 2 |

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

**Course Content Theory**

| **Contents** |
|---|
| **UNIT: Introduction to Hydrology**<br>**Precipitation & Abstraction:** Hydrologic cycle, Water budget equation, Applications - Precipitation: Forms & Types, Measurement of precipitation(Rain gauges), Rain gauge density, Adequacy of rain gauges, Computations of mean rainfall, Estimation of missing data, Presentation of rainfall data(hyetograph and mass curve)<br>Evaporation, Transpiration and Infiltration –Process & influencing factors, Field Measurement (IS Class A Pan, Lysimeter, Double ring Infiltrometer) – Horton's infiltration equations, Infiltration Indices-Numerical problems. |

| |
|---|
| **UNIT:2 Runoff & Hydrographs**<br>Runoff: Definition, Components, influencing factors, concept of catchment, Rainfall-Runoff relationship–Simple regression, Peak runoff and methods-numerical problems<br>Hydrograph: Definition, Components, Hydrograph separation, Unit hydrograph theory & its Derivation from simple storm hydrograph, Prepositions of unit hydrograph- Numerical problems |
| **UNIT: 3 Introduction to Irrigation Engineering**<br>Necessity, Benefits & ill effects of Irrigation, Systems of Irrigation: Flow & Lift irrigation, Infiltration galleries, Sewage & Supplemental Irrigation, - Methods of irrigation: Surface methods, Sprinkler & Drip Irrigation, Soil-water-plant relationship, soil moisture, Irrigation relationship, frequency of irrigation-Numerical problems. |
| **UNIT:4 Canal Irrigation**<br>Crop Water Requirement & Canal Irrigation: Crop seasons of India, Crop rotation, Duty, Delta, Base period (relationship & numerical problems on reservoir capacity), Types of Irrigation Canals, Alignment of canal, Design of canal, Kennedy's & Lacey's theory-Numerical problems |

**Practice:**

| No | Title of the Experiment | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1. | Calibration of Notches: Triangular (V-Notch), Notch | Notch equipment | Hands on training |
| 2 | Calibration of Rectangular Notch | Notch equipment | Hands on training |
| 3. | Calibration Cipolletti Notch | Notch equipment | Hands on training |
| 4. | Calibration of Broad crested weir | Weir Equipment | Hands on training |
| 5. | Calibration of Ogee weir. | Weir Equipment | Hands on training |
| 6. | Determination of Darcy's friction factor for a straight pipe. | Weir Equipment | Hands on training |
| 7. | Determination of vane coefficients for a flat vane, inclined and semi-circular vane. | Impact test equipment | Hands on training |
| 8. | Plotting of hydrograph by measurement of flow across v-notch/weir by variation of discharge over the time. | Notch / weir equipment | Creative thinking |
| 9. | Working of non-recording (Symon's Rain gauge) gauge and recording (Syphon Gauge) rain gauge. | Rain gauges | Understanding mechanism of working |
| 10. | Performance characteristics of a Centrifugal pump (Demo only) | Centrifugal pump | Understanding mechanism of working |

**REFERENCE BOOKS:**


1. Engineering Hydrology – Subramanya.K; Tata McgrawHill NewDelhi-4th Edition.
2. Hydrology- Madan Mohan Das, Mim Mohan Das-PHI Learning private Ltd. New Delhi-2009 (Ed)
3. A Text Book Of Hydrology- Jayarami Reddy, Laksmi Publications, New Delhi-2007 (Ed)

4. Irrigation, water Resources and water power Engineering- P.N.Modi- standard book house, New Delhi.
5. Irrigation and Water Power Engineering- Punmia B C-Laxmi Publication, 16th Edition
6. Hydrology & Water Resources Engineering- PatraK.C.Narosa Book Distributors Pvt. Ltd. New Delhi-2008 (Ed)
7. Hydrology & Water Resources Engineering- R.K.Sharma& Sharma, Oxford and Ibh, New Delhi
8. Irrigation engineering & Hydraulic structures – S.K.Garg,Khanna Publication, New Delhi
9. Fluid Mechanics & Machinery Laboratory Manual Prepared by School of Civil Engineering, REVA University, Bengaluru.
10. Fluid Mechanics & Hydraulic Machines; .R.K.Bansal (2004), Laxmi Publication (P) Ltd, New Delhi.
11. Hydraulics and Hydraulic Machines Laboratory Manual –R.V.Raikar, PHI Learning Pvt.Ltd.
12. Irrigation Engineering and Hydraulic structures - S.K.Garg, Khanna Publication, New Delhi

**Journals/Magazines**

Journal of Hydrology, Elsevier
Journal of Hydrology, Science Direct
Journal of Irrigation and Drainage Engineering, ASCE
International Journal Water Resources Management & Irrigation Engineering Research, European American Journal

**SWAYAM/NPTEL/MOOCs:**

https://mooc.es/course/irrigation-and-drainage/
https://mooc.es/course/water-resources-and-watershed-management/
https://www.swayamprabha.gov.in/index.php/program/current_he/12
https://onlinecourses.nptel.ac.in/noc20_ag04/preview
https://nptel.ac.in/courses/105/101/105101002/
https://nptel.ac.in/courses/105/108/105108079/

**Problem Based Learning**

| No | Problem |
|---|---|
| 1 | In a typical 2 hour storm produces 5 cm runoff from a basin. The flow in the stream at every two hour intervals are: 0, 1.25, 4.25, 6.75, 5.60, 3.50, 1.35, 1.00 ,0 cumecs.<br>(i)Find & plot 2 hour unit hydrograph.<br>(ii)From 2 hour unit hydrograph, find the 6 hour unit hydrograph using Method of superposition & S-Curve Techniques. |
| 2 | The slope of channel in alluvium soil is S= 1/5000; Lacey's silt factor, f= 0.9, Side slope of the channel is = 0.5H: 1V.<br>(i)Find the channel section and maximum discharge which can be allowed to flow in it.<br>(ii)For the discharge calculated, find the area of wheat crop with base period of 120 days that can be put to irrigation with it's Duty at the field as 1800 hectares/ cumec.<br>(iii)If the irrigated area is of clay loam, find the frequency of irrigation with field capacity of soil=27%, Permanent wilting point=14%, Specific gravity of soil= 1.5, effective depth of root zone = 0.75m and daily consumptive use of water for the given crop is 11mm? |

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based projects.

| No. | Suggested Projects |
|---|---|
| 1. | Rainfall & Runoff modeling of a catchment |
| 2. | Climate change & its impact on hydrological parameters |
| 3. | Design of embankment dam for a catchment area |
| 4. | Design of irrigation canal |

## COURSE PACK FOR: STRUCTURAL ANALYSIS

<table>
<tr><td>Course Title</td><td colspan="4">STRUCTURAL ANALYSIS</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20ED04 05</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>TLP</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>Theory</td><td>3</td><td>5</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>5</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

Structural analysis is the determination of the effects of loads on physical structures and their components. Structures subject to this type of analysis include all that must withstand loads, such as buildings, bridges, aircraft and ships. ... Structural analysis is thus a key part of the engineering design of structures.

**Course Objective**

**This course enables graduating students**

1. Present systematic approach for analyzing three hinged and two hinged arches.
2. To analyze continuous beams and frames by slope deflection method.
3. To analyze continuous beams and frames by moment distribution method.
4. To understand the concept of Kani’s method and analyze continuous beams and frames.
5. Explain the concept involved in strain energy method and analyze continuous beam problems.
6. To analyze beams and plane truss by flexibility and stiffness methods using system approach.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Describe arches and explain the various parameters involved in analyzing three hinged and two hinged arches | 1,2,12 | 1,2,4 |
| **CO2** | Analyze continuous beams and frames by slope deflection method | 1,2,3,5, 12 | 1,2,3,4 |
| **CO3** | Analyze continuous beams and frames by moment distribution method | 1,2,3,5, 12 | 1,2,3,4 |
| **CO4** | Represent the concept involved in Kani’s method and able to solve numerical problems | 1,2,3,5, 12 | 1,2,3,4 |

| | | | |
|---|---|---|---|
| **CO5** | Enumerate the concept involved in strain energy method and analyze continuous beam problems | 1,2,3,5, 12 | 1,2,3,4 |
| **CO6** | Analyze beams and plane truss by flexibility and stiffness methods using system approach | 1,2,3,5, 12 | 1,2,3,4 |

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

| **CO# / POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO2 | 3 | 2 | 2 | | 3 | | | | | | | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C04 | 3 | 3 | 2 | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 2 | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO6 | 3 | 3 | 2 | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| Contents |
|---|
| **UNIT1: Analysis of Arches**<br>Three Hinged Arches: Analysis of three hinged parabolic and circular arches, settlement. Determination of normal thrust, radial shear and bending moment. Numerical problems.<br>Two Hinged Arches: Analysis of two hinged parabolic and circular arches. Determination of normal thrust, radial shear and bending moment. Numerical problems. |
| **UNIT2: Slope Deflection and Moment Distribution Methods:**<br>Slope Deflection Method: Analysis of continuous beams and rigid-jointed plane frames with and without side sway. Numerical problems. (Indeterminacy ≤3).<br>Moment Distribution Method: Analysis of continuous beams and rigid jointed plane frames with and |

| |
|---|
| without side sway. Numerical problems (Indeterminacy ≤3). |
| **UNIT3: Kani's and Strain Energy Method**<br>Kani's Method: Analysis of continuous beams and rigid jointed plane frames with symmetry. Numerical problems. (Indeterminacy ≤3).<br>Strain Energy Method: Analysis of continuous beams (Indeterminacy ≤3). |
| **UNIT4: Matrix method of analysis**<br>**Stiffness method: Analysis of continuous beams and plane truss (3x3 matrix) using system approach**<br>**Flexibility method: Analysis of continuous beams and plane truss (3x3 matrix) using system approach** |

**Text Book:**

1. Structural Analysis by Devdas Menon, Narosa Book Distributors Pvt Ltd. (2009).
2. Basic Structural Analysis by Reddy C. S., Tata McGraw Hill, New Delhi.
3. Theory of Structures, Pandit and Gupta, Vol. – I, Tata McGraw Hill, New Delhi.
4. Structural Analysis-II -S. S. Bhavikatti – Vikas Publishers, New Delhi
5. S. Rajasekaran, "Computational Structural Mechanics", PHI, New Dehi 2001.

**Reference Books**

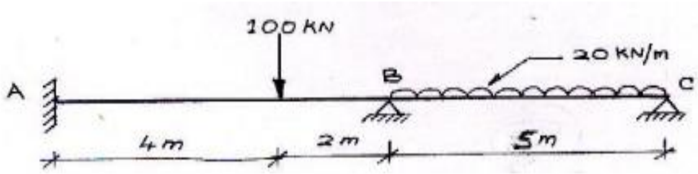
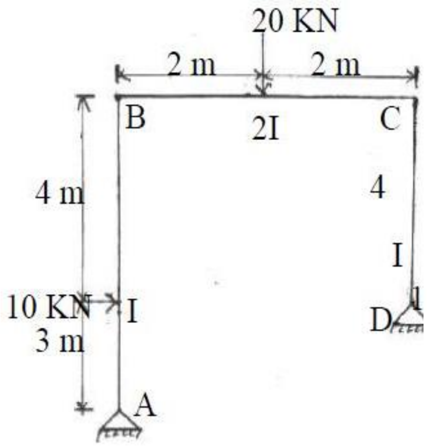
1. Structural Analysis- D.S. PrakashRao, a Unified Approach, University Press.
2. Elementary Structural Analysis, Norris and Wilbur, International Student Edition, McGraw Hill Book Co., New York.
3. Structural Analysis by R C Hibbeler, Prentice Hall, New Jersey.
4. Strength of Materials and theory of structures Vol I & II, B.C. Punmia, R.K. Jain Laxmi Publication New Delhi.
5. M.F.Rubinstein "Matrix Computer Methods of Structural Analysis "Prentice - Hall.

**Journals/Magazines**

1. Journal of Structural Engineering, American Society of Civil Engineers, USA
2. Journal of Structural Engineering, Chennai, India

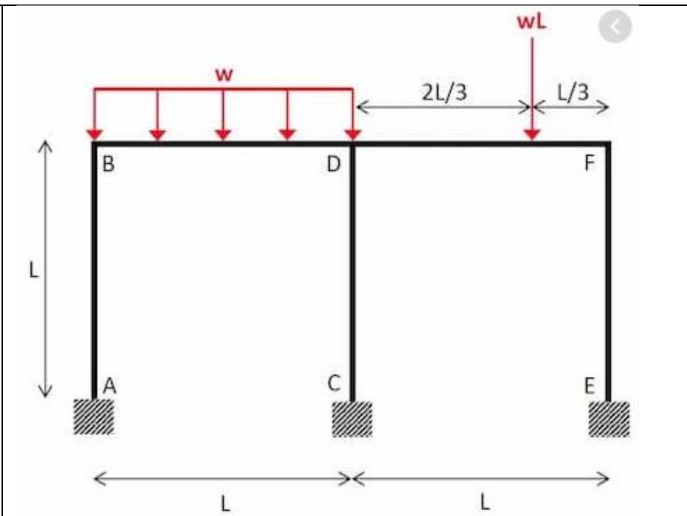
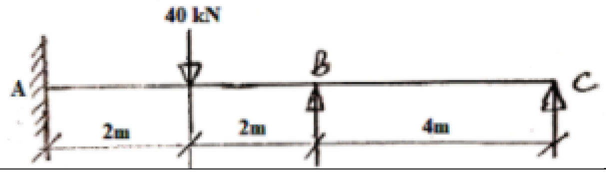
**SWAYAM/NPTEL/MOOCs:**

http://www.nptel.iitm.ac.in

| No | Problem |
|---|---|
| 1 | Analyze two span continuous beam ABC by slope deflection method. Then draw Bending moment & Shear force diagram. Take EI constant.<br> |
| 2 | Analysis the frame shown in figure by Kani's method and draw BMD assume EI is constant.<br> |

Project Based Learning
To enhance the skill set in the integrated course, the students are advised to execute course-based
Design projects. Some sample projects are given below:

| No | Suggested Project |
|---|---|
| 1 | Such framed structures are to be analyzed by different methods such as Slope Deflection Method, Moment Distribution Method and Kani's Method for different loading and different support conditions. |

| | |
|---|---|
| |  |
| 2 | Analyze the continuous beam by stiffness method. Take EI constant. Draw SFD, BMD and elastic curve.<br>Analysis can also be carried out by using suitable software.<br> |

**COURSE PACK FOR: MANAGEMENT SCIENCE**

<table>
<tr><td>Course Title</td><td colspan="3">Management Science</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20MG0301</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work</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>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>2</td><td>2</td><td>2</td><td>26</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

**COURSE OVERVIEW**

The course intends to familiarize students to understand the management principles and applications, which lays a strong foundation for managers and leaders in critical thinking and decisions making process. The course emphasizes on giving an overview of the functional area of management

**COURSE OBJECTIVE (S):**

1. To help the students gain understanding of the functions and responsibilities of managers.
2. To provide them tools and techniques to be used in the performance of the managerial job.
3. To enable them to analyze and understand the environment of the organization.
4. To help the students to develop cognizance of the importance of management principles.

## COURSE OUTCOMES (COs)

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

| CO | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Make use of Plan organizational structure for a given context in the organization carry out production operations through Work-study. | 1-5 | 2 |
| CO2 | Analyze production operations through Work-study. | 1-5 | 3 |
| CO3 | Understand the markets, customers and competition better and price the given products Appropriately. | 1-5 | 2 |
| CO4 | Summarize the HR function better. | 1-5 | 2,3 |

## BLOOM'S LEVEL OF THE COURSE OUTCOMES

| CO | Bloom's Level | | | | | |
|---|---|---|---|---|---|---|
| | Remember (L1) | Understand | Apply (L3) | Analyze (L4) | Evaluate (L5) | Create (L6) |
| 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 | 2 | 2 | 3 | | | | | | | | | 3 | |
| CO2 | 1 | 1 | 3 | 3 | 3 | | | | | | | | | | 3 |
| CO3 | 1 | 3 | 2 | 3 | 1 | | | | | | | | | 3 | |
| CO4 | 1 | 1 | 3 | 2 | 5 | | | | | | | | | 3 | 3 |

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

**COURSE CONTENT**

**THEORY:**

**Unit – 1**

**Introduction to Management and Organization:** Concepts of Management and organization- nature, importance and Functions of Management. Systems Approach to Management - Taylor's Scientific Management Theory- Taylor's Principles of Management, Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's Theory X and Theory - Hertzberg Two Factor Theory of Motivation - Leadership Styles, Social responsibilities of Management. Designing Organizational Structures: Basic concepts related to Organization Depart mentation and Decentralization.

**Unit – 2**

**Operations and Marketing Management:** Principles and Types of Plant Layout-Methods of

Production( Job, batch and Mass Production), Work Study --Basic procedure involved in Method Study and Work Measurement - Business Process Reengineering(BPR) Statistical
Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Deming's contribution to quality. Objectives of Inventory control, EOQ, ABC Analysis. Purchase Procedure, Stores Management and Store Records - JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix. And Marketing Strategies based on Product Life Cycle. Channels of distribution.

**Unit – 3**

**Human Resources Management (HRM):** Concepts of HRM. HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR. Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development. Placement, Wage and Salary Administration, Promotion. Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating -Capability Maturity Model (CMM) Levels - Performance Management System.

**Unit – 4**

**Strategic Management and Contemporary strategic Issues:** Mission, Goals, Objectives, Policy, Strategy. Programmes, Elements of Corporate Planning Process, Environmental Scanning. Value Chain Analysis, SWOT Analysis. Steps in Strategy Formulation and implementation, Generic. Strategy alternatives. Bench Marking and Balanced Score and as Contemporary Business Strategies.

**TEXT BOOKS:**

1. Kotler Philip and Keller Kevin Lane, "Marketing Management", Pearson, New York, 15th Edition, 2012.
2. Koontz and Weihrich, "Essentials of management", McGraw Hill, New Delhi, 11th Edition, 2012.

**REFERENCE BOOKS:**

1. Thomas N. Duening and John M. Ivancevich, "Management - Principles and Guidelines", Dreamtech Press; 1st Edition, 2012.
2. Samuel C. Certo, "Modern Management", Prentice Hall, New York, 9th Edition, 2012.
3. Schermerhorn, Capling, Poole and Wiesner, "Management", Wiley, New York, 6th Edition, 2012.
4. John A. Parnell, "Strategic Management – Theory and Practice", Cengage Publications, 2018.
5. Lawrence R Jauch, R. Gupta and William F. Glucek, "Business Policy and Strategic Management Science", McGraw Hill, New York, 5th Edition, 2012.

## COURSE PACK FOR: ENVIRONMENTAL SCIENCE

<table>
<tr><td>Course Title</td><td colspan="4">Environmental Science</td><td>Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AS0303</td><td>Credits</td><td colspan="2">2</td><td>Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work</td><td rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>2</td><td>2</td><td>2</td><td>26</td><td>50 %</td><td>50 %</td></tr>
</table>

**COURSE OVERVIEW**

This introductory course is designed to introduce you to the foundational concepts of environmental engineering, types of resources, biodiversity, threats and methods of conservation, sources and control measures of environmental pollution and ways to protect the environment.

**COURSE OBJECTIVE(S):**

1. Graduates will be familiar with current and emerging environmental engineering and global issues, and have an understanding of ethical and societal responsibilities.
2. Graduates will have the ability to obtain the knowledge, and will recognize the need for engaging in life-long learning.
3. Will find the need of 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. Acquire knowledge 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, analyze and execute favorable environmental conditions and the role of individual, government and NGO in environmental protection | 2,7,8,10,12 | |
| CO2 | List the causes, effects & remedial measures and find ways to overcome them by suggesting the pollution-controlled products | 2,3, 7,8,10,12 | 3 |
| CO3 | Classify different wastes, sources of waste and their effect on population. | 2,3, 7,8,10,12 | |
| CO4 | Get motivation to find new renewable energy resources with high efficiency through active research and innovation. | 2,3, 7,8,9,10,12 | 3 |
| CO5 | Critically analyze the ecological imbalances and provide recommendations to protect the environment. | 2,3, 7,8,9,10,12 | |

**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 | | √ | | | | |

**COURSE ARTICULATION MATRIX**

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

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

**COURSE CONTENTS**

**THEORY**

**Unit – 1**

**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:** Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil 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.

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

**Unit-3**

**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 - Importance, Deforestation-Causes, effects and controlling measures

**Unit-4**

**Ecology-**Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Characteristics of an Ecosystem - Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity. Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

**TEXT 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, New Delhi, 2nd Edition, 2008.


**REFERENCE BOOKS:**


1. Dr.S.M.Prakash, "Environmental Studies", Elite Publishers, Mangalore, 2nd Edition, 2009.
2. Rajagopalan R, "Environmental Studies – from Crisis to cure", Oxford University Press, New Delhi, 3rd Edition, 2016
3. Anil Kumar Dey and Arnab Kumar Dey, "Environmental Studies", New age international private limited publishers, New Delhi, 2nd Edition, 2007.
4. Michael Allaby, "Basics of environmental Science", Routledge-Tayler & Francis e-library, New York, 2nd Edition, 2002.
5. Dr.Y.K Singh, "Environmental Science", New age international private limited publishers, New Delhi, 1st Edition, 2006


JOURNALS/MAGAZINES

International Journal of Environmental Science and Technology, https://www.springer.com/journal/13762/.

Journal of Environmental Sciences, https://www.journals.elsevier.com/journal-of-environmental-sciences.

**SWAYAM/NPTEL/MOOCs:**

Environmental Studies: https://onlinecourses.swayam2.ac.in/cec19_bt03/preview

Environmental Studies: https://nptel.ac.in/courses/120/108/120108004/

**SELF-LEARNING EXERCISES:**

Discussion on the need for public awareness on the environment, Gaia Hypothesis

Case studies of London smog, Bhopal gas tragedy, marine pollutions and study of different waste water treatment processes, Disaster management, early warning systems-bio indicators for Tsunami and other natural disasters.

Hydrology & modern methods adopted for mining activities, Remote sensing and its applications, Chernobyl (USSR) nuclear disaster and Fukushima (Japan) nuclear disaster.
Discussion on the need for balanced ecosystem and restoration of degraded ecosystems.

**COURSE PACK FOR: UNIVERSAL HUMAN VALUES**

| **Course Title** | **Universal Human Values** | | | | **Course Type** | | **Theory** | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **B20AHM401** | **Credits** | **0** | | **Class** | | **III Semester** | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 0 | 2 | 2 | | | | |
| | Practice | 0 | 0 | 0 | Theory | Practical | IA | SEE |
| | Tutorial | 0 | 0 | 0 | | | | |
| | Total | 0 | 2 | 2 | 26 | 0 | 50 % | 50 % |

**COURSE OVERVIEW**
Basic human values refer to those values which are at the core of being human. The values which are considered basic inherent values in humans include truth, honesty, loyalty, love, peace, etc. because they bring out the fundamental goodness of human beings and society at large. Tis subject focuses on developing holistic perspective and harmony on self-exploration among individuals, family and society.

**COURSE OBJECTIVE(S)**
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 | PSO |
|---|---|---|---|
| CO1 | Understand the significance of value inputs in a classroom and start applying them in their life and profession. | 3,6,7,8, 9, | |
| CO2 | Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc. | 3,6,7,8, 9,10 | |
| CO3 | Understand the role of a human being in ensuring harmony in society and nature. | 3,6,7,8 | |
| CO4 | Demonstrate the role of human being in the abetment of pollution | 3,6,7,9 | |
| CO5 | Describe appropriate technologies for the safety and security of the society as responsible human being. | 9,10,11, 12 | |
| CO6 | Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work. | 9,10,11, 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 | | | 1 | | | 3 | 3 | 3 | 3 | 3 | | | | | |
| CO2 | | | 1 | | | 3 | 3 | 3 | 3 | 3 | | | | | |
| CO3 | | | 1 | | | 3 | 3 | 3 | | | | | | | |
| CO4 | | | 1 | | | 3 | 3 | | 3 | | | | | | |
| CO5 | | | | | | | | | 3 | 3 | 3 | 2 | | | |
| CO6 | | | | | | | | | 2 | 3 | 3 | 2 | | | |

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

**COURSE CONTENT**

**THEORY**

**Unit- 1**

**Happiness and Prosperity:** A look at basic Human Aspirations. Right understanding, Relationship, basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly, Method to fulfil human aspirations: understanding and living in harmony at various levels, Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seeker and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

**Unit- 2**

**Understanding values in human-human relationship:** meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family

**Unit- 3**

**Understanding the harmony in the Nature:** Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

**Unit- 4**

**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, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 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. R.R. Gaur, R. Sangal and G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, 2010

4. 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 Julundhar, 1970

3. Mohandas Karamchand Gandhi, “The Story of My Experiments with Truth”, Navajivan Mudranalaya, Ahmadabad, 1993
4. William Lilly, “Introduction to Ethics”, Allied Publisher, London, 1955

**JOURNALS/MAGAZINES/ONLINE COURSES:**

1. Value Education websites, http://uhv.ac.in, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story
6. Gandhi A., Right Here Right Now, Cyclewala Production

**SELF-LEARNING EXERCISES:**

Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect? ii) What is Naturally Acceptable to you – to nurture or to exploit others? Is our living the same as your natural acceptance or different?

Out of the three basic requirements for fulfilment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.

Choose any two current problems of different kind in the society and suggest how they can be solved on the basis of natural acceptance of human values. Suggest steps you will take in present conditions.

# SEMESTER V

## COURSE PACK FOR: BASIC GEOTECHNICAL ENGINEERING

| Course Title | Basic Geotechnical Engineering | | | | Course Type | | Integrated | |
|---|---|---|---|---|---|---|---|---|
| Course Code | B20ED0501 | Credits | 4 | | Class | | V semester | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 1 | 2 | 2 | Theory | Practical | CIE | SEE |
| | Tutorial | 0 | - | - | | | | |
| | Total | 4 | 5 | 5 | 48 | 26 | 50% | 50% |

**COURSE OVERVIEW**

This course introduces the students to Geotechnical engineering is an art form that requires both judgment and experience to arrive at a satisfactory solution. Unlike steel or concrete for instance, soil is quite different. The ground below us ultimately supports all structures and to be successful, the ground must not fail under the applied structural load.

**COURSE OBJECTIVE**

This course enables graduating students

1. To create an ability to apply knowledge of geotechnical engineering.
2. To conduct experiments, as well as to analyses and interpret data related to the geotechnical engineering.
3. To accentuate the understanding of the basic principles.
4. To identify the type and characteristics of soil.
5. To understand the compaction and consolidation characteristics of soil.
6. To understand effect of stresses on shear strength of soil.

**COURSE OUT COMES (COs)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Understand basic concepts of soil and they will be knowing the classification of soil. | 1, 2, 3 | 2, 3 |
| **CO2** | Evaluate the permeability of soil and its importance. | 1, 2, 3 | 2, 3 |
| **CO3** | Analyze water - soil interaction and the seepage flow through soils. | 1, 2, 3 | 2, 3 |
| **CO4** | Understand principle of compaction and consolidation of soil in field and Laboratory. | 1, 2, 3 | 1, 3 |
| **C05** | Understand the strength characteristic of soil in construction. | 1, 2, 3 | 2, 3 |
| **C06** | Understand the Total, neutral and effective stresses in soils. | 1, 2, 3 | 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 | | ✓ | ✓ | ✓ | ✓ | |
| C05 | | ✓ | ✓ | ✓ | ✓ | |
| 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 | 3 | 2 | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |
| **CO2** | 3 | 2 | 1 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |
| **CO3** | 3 | 2 | 1 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |
| **CO4** | 3 | 2 | 3 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 1 |
| **C05** | 3 | 2 | 3 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |
| **C06** | 3 | 2 | 3 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |

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

**COURSE CONTENT THEORY**

**Contents :**

**UNIT – I : INTRODUCTION**

Formation of soil, Understanding the earth, interior of the earth, composition and density of crust, mantle and core layers. Basic Terminology - Clay Mineralogy and Soil Structure: Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite – Soil Problems in Civil Engineering Field – Phase Diagrams and Mass- volume relationship – Relative density.

INDEX PROPERTIES OF SOILS and Classification of Soil: Moisture Content, Specific Gravity, Particle Size Distribution (Sieve analysis and Hydrometer analysis), Consistency of Soils- Atterberg Limits, Field Density and Density Index.

Soil Classification Purpose, Unified Soil Classification System, Indian Standard Soil Classification System

**UNIT:2 : Permeability and Seepage**

One dimensional flow through soil – Permeability, Darcy's law- assumptions and validity, field and laboratory permeability tests, flow through stratified soils, factors affecting permeability. Introduction to flow nets- assumptions and limitations only, estimating quantity of seepage and exit gradient.

| |
|---|
| **UNIT:3 Compaction & Consolidation**<br>Principle of compaction, Standard and Modified proctor’s compaction tests, factors affecting compaction - effect of compaction on soil properties - types of field compaction, Field compaction control – Proctor’s needle, principles of dynamic compaction & vibro-flotation.<br>Terzaghi’s theory of one-dimensional consolidation partial differential equations (no analytical solutions), Mass spring analogy, Laboratory test – Determination of co-efficient of consolidation, Pre-consolidation pressure and its determination by Casagrande's method. |
| **UNIT:4 Effective Stress, Principal Stress and Shear Strength:**<br>Total, neutral and effective stresses –quick sand condition.<br>shear strength of cohesive and cohesion less soils – Principal Stress determination, Mohr coulomb’s theory –Direct shear, Triaxial, unconfined shear strength – Lab and field vane shear test - factors affecting the shear strength. |

**Practice:**

| No | Title of the Experiment | Tools and Techniques | Expected Skill |
|---|---|---|---|
| 1. | Water content determination (Oven drying method), Determination of Specific gravity by Pycnometer and density bottle method. | Hot air Oven, Air tight containers, Weighing balance. | Hands on experience |
| 2. | Grain size distribution (Sieve analysis Only) | Set of sieves (4.75mm to 75µm), Weighing balance | Hands on experience |
| 3. | Determination of Liquid (Casagrande method) and Plastic limit. | Casagrande’s apparatus, 425µm sieve | Hands on Experience |
| 4. | Determination of Shrinkage limit of soil. | Shrinkage dish, mercury and porcelain dish | Hands on Experience |
| 5. | Determination of moisture-density relationship (Standard Proctor's test or modified proctor test) | Proctor Mould and accessories | Hands on experience |
| 6. | Determination of Permeability by Constant and Variable head method. | Permeameter and accessories | Hands on experience |
| 7. | Determination of in-situ density by sand replacement and core cutter method. | Core-cutter and sand replacement accessories | Hands on experience |
| 8. | Unconfined compression test for fine grained soils. | UCC Mould | Hands on experience |
| 9. | Triaxial Compression Test. | Tri-axial test set-up | Hands on experience |
| 10. | Direct shear test. | Shear box and weights | Hands on experience |
| 11. | Determination of Swell, determination of CBR value. | CBR Mould | Hands on experience |
| 12. | Demonstration on - Determination of Relative density – Sand, Vane shear test. Odometer test (Consolidation).<br>Identification of minerals and rocks, Bore hole problems. | Oedometer, Vane shear apparatus | Hands on experience |

Text Books:

1. Murthy V.N.S, Principles of Soil Mechanics and Foundation Engineering, 4th Edition, UBS Publishers and Distributors, New Delhi, 1996
2. Punima. B.C, “Soil Mechanics and Foundations”, Laxmi Publications Pvt. Ltd., 2005.

3. Gopal Ranjan and Rao. A.S.R, “Basic and Applied Soil Mechanics”, New age international (p) Ltd., 2007.
4. Braja, M. Das (2002), Geotechnical Engineering; , Fifth Edition, Thomson Business Information India (P) Ltd., India
5. Bowles J.E, Foundation Analysis and Design, 5th Edition, McGraw Hill Pub. Co. New York, 1996
6. Aalam Singh and Chowdhary G.R., Soil Engineering in Theory and Practice, CBS Publishers and Distributors Ltd., New Delhi, 1994

**Reference Books:**

1. Gopal Ranjan and Rao A.S.R., Basic and Applied Soil Mechanics, New Age International (P) Ltd., New Delhi., 2000
2. Geotechnical Engineering- Donold P Coduto Phi Learning Private Limited, New Delhi
3. Shashi K. Gulathi& Manoj Datta, Geotechnical Engineering, Tata McGraw Hill. 2009PHI Learning, 3rd Revised edition
4. Iqbal H. Khan, Text Book of Geotechnical Engineering, 2nd Edition, PHI, India, 2005
5. NarasimhaRao A. V. &Venkatrahmaiah C., Numerical Problems, Examples and objective questions in Geotechnical Engineering- (2000), Universities Press., Hyderabad.

**Magazines: Civil Engineering and Construction Review**
**SWAYAM/NPTEL/MOOCs:**

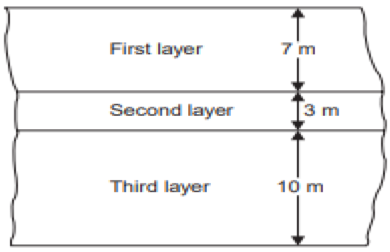
1. NPTEL :: Civil Engineering - NOC:Geotechnical Engineering - 1 (60%)
2. NPTEL :: Civil Engineering - NOC:Geotechnical engineering laboratory (20%)

**Practice**

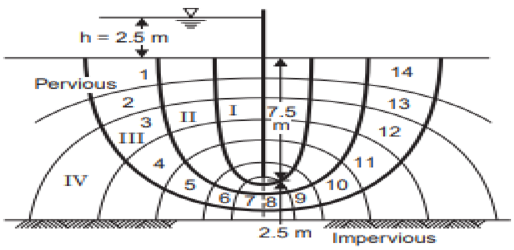
| PRACTICE # | Topics to be Covered |
|---|---|
| 1. | Water content determination (Oven drying method), Determination of Specific gravity by Pycnometer and density bottle method. |
| 2. | Grain size distribution (Sieve analysis Only) |
| 3. | Determination of Liquid (Casagrande method) and Plastic limit. |
| 4. | Determination of Shrinkage limit of soil. |
| 5. | Determination of moisture-density relationship (Standard Proctor's test or modified proctor test) |
| 6. | Determination of Permeability by Constant and Variable head method. |
| 7. | Determination of in-situ density by sand replacement and core cutter method. |
| 8. | Unconfined compression test for fine grained soils. |
| 9. | Triaxial Compression Test. |
| 10 | Direct shear test. |
| 11. | Determination of CBR value. |
| 12. | Only Demonstration - Determination of Relative density – Sand, Vane shear test. Odometer test (Consolidation) |

**PROBLEM BASED LEARNING**

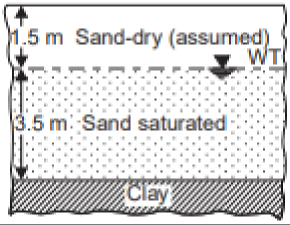
<table>
<tr><th>No</th><th>Problem</th></tr>
<tr><td>1</td><td>One cubic metre of wet soil weighs 19.80 kN. If the specific gravity of soil particles is 2.70 and water content is 11%, find the void ratio, dry density and degree of saturation.</td></tr>
<tr><td>2</td><td>(i) A dry soil has a void ratio of 0.65 and its grain specific gravity is = 2.80. What is its unit weight?<br>(ii) Water is added to the sample so that its degree of saturation is 60% without any change in void ratio. Determine the water content and unit weight.<br>(iii) The sample is next placed below water. Determine the true unit weight (not considering buoyancy) if the degree of saturation is 95% and 100% respectively.</td></tr>
<tr><td>3</td><td>The dry unit weight of a sand sample in the loosest state is 13.34 kN/m3 and in the densest state, it is 21.19 kN/m3. Determine the density index of this sand when it has a porosity of 33%. Assume the grain specific gravity as 2.68.</td></tr>
<tr><td>4</td><td>Determine the coefficient of permeability from the following data: Length of sand sample = 25 cm Area of cross section of the sample = 30 cm2 Head of water = 40 cm Discharge = 200 ml in 110 s.</td></tr>
<tr><td>5</td><td>A horizontal stratified soil deposit consists of three layers each uniform in itself. The permeabilities of these layers are 8 × 10–4 cm/s, 52 × 10–4 cm/s, and 6 × 10–4 cm/s, and their thicknesses are 7, 3 and 10 m respectively. Find the effective average permeability of the deposit in the horizontal and vertical directions.<br>




</td></tr>
<tr><td>6</td><td>A deposit of cohesionless soil with a permeability of 3 × 10–2 cm/s has a depth of 10 m with an impervious ledge below. A sheet pile wall is driven into this deposit to a depth of 7.5 m. The wall extends above the surface of the soil and a 2.5 m depth of water acts on one side. Sketch the flow net and determine the seepage quantity per metre length of the wall.<br>




</td></tr>
<tr><td>7</td><td>A sand fill compacted to a bulk density of 18.84 kN/m3 is to be placed on a compressible saturated marsh deposit 3.5 m thick. The height of the sand fill is to be 3 m. If the volume compressibility mv of the deposit is 7 × 10–4 m2/kN, estimate the final settlement of the fill.</td></tr>
<tr><td>8</td><td>The following data have been obtained in a standard laboratory Proctor compaction test on glacial till:
<table>
<tr><td>Water content (%)</td><td>5.02</td><td>8.81</td><td>11.25</td><td>13.05</td><td>14.40</td><td>19.25</td></tr>
<tr><td>Weight of container and compacted soil (N)</td><td>35.80</td><td>37.30</td><td>39.32</td><td>40.00</td><td>40.07</td><td>39.07</td></tr>
</table>
The specific gravity of the soil particles is 2.77. The container is 9.44 cm3 in volume and its weight is 19.78 N. Plot the compaction curve and determine the optimum moisture content. Also compute the void ratio and degree of saturation at optimum condition.</td></tr>
<tr><td>9.</td><td>A saturated sand layer over a clay stratum is 5 m in depth. The water is 1.5 m below ground level. If</td></tr>
</table>

| | |
|---|---|
| | the bulk density of saturated sand is 17.66 kN/m3, calculate the effective and neutral pressure on the top of the clay layer.<br><br> |
| 10 | In an unconfined compression test, a sample of sandy clay 8 cm long and 4 cm in diameter fails under a load of 120 N at 10% strain. Compute the shearing resistance taking into account the effect of change in cross-section of the sample. |

**Project Based Learning – Integrated Course**

To Enhance the Skill Set in The Integrated Course, The Students Are Advised to Execute Course-Based
Design Projects. Some Sample Projects Are Given Below:

| No. | Suggested Projects |
|---|---|
| 1. | Determination of Index and engineering properties of cohesionless soils. |
| 2. | Determination of Index and of Engineering properties of cohesive soils. |
| 3. | Determination of Index and of Engineering properties of very soft soils. |

## COURSE PACK FOR: DESIGN OF HYDRAULIC STRUCTURES (B20ED0502)

<table>
<tr><td>Course Title</td><td colspan="4">DESIGN OF HYDRAULIC STRUCTURES</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20ED0505</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>TLP</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

Hydraulic structure can be built in rivers or any body of water where there is a need for a change in the natural flow of water. The knowledge about hydraulic structures with their usefulness and design of dams for storing water along with spillways and canal regulatory works are studied.

**Course Objective**

**This course enables graduating students**

1. Study about reservoir and geological considerations of dam
2. Study about types of dam and classification.
3. Learn about earthen dams, stability analysis, seepage & control
4. Learn about design of gravity dam and concepts of rockfill dam, arch dam, buttress dam.
5. Learn about spillways, components & classification.
6. Study about canal regulation and cross drainage works.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Concepts of reservoir and geological considerations of dam | 1,2,3 | 1,2,3,4 |
| CO2 | Types of dams for storing water. | 2,3,6,7,12 | 1,2,4 |
| CO3 | Design concepts of earthen dams and safety measures | 2,3,6,7,12 | 1,2,3,4 |
| C04 | Design concepts of gravity dam and understand other types of dam. | 2,3,4,5,12 | 1,2,3,4 |
| CO5 | Importance of spillways and its components. | 1,3,4,5,7 | 1,2,3,4 |
| C06 | Canal regulation for control of discharge and concepts of cross drainage works. | 2,5,6,12 | 1,2,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | | | | | | | | | 2 | 2 | 2 | 3 |
| CO2 | | 2 | 2 | | | 2 | 3 | | | | | 3 | 3 | 3 | | 3 |
| CO3 | | 2 | 3 | | | 2 | 3 | | | | | 3 | 2 | 2 | 2 | 3 |
| CO4 | | 2 | 2 | 2 | 2 | | | | | | | 3 | 3 | 3 | 2 | 3 |
| CO5 | 3 | | 2 | 2 | 3 | | 2 | | | | | | 3 | 2 | 3 | 3 |
| CO6 | | 3 | | | 3 | 2 | | | | | | 2 | 3 | 2 | | 3 |

**Course Content Theory**

| Contents |
|---|
| **UNIT: 1 Reservoir and dam planning:** Introduction to Dams in India with a case study. Selection of site for a reservoir, classification, Storage zones of reservoir, storage capacity & yield (problems), safe yield, density currents, trap efficiency, sedimentation & life of a reservoir<br>Introduction to faults and fractures, Considerations for dam site, selection of type of dam, Classification of dam, types of dam, multipurpose dams, environmental effects of reservoir/dam. |
| **UNIT: 2 Earthen dams:** Types of earthen dams, significance of zones in earthen dam, Design criteria, sectional elements, seismic design considerations, Phreatic line of dam with filter(problems), flow net, stability analysis considerations and methods, slope protection, seepage control measures, dam sections to suit materials & foundation, Failure of earthen dams. |
| **UNIT:3 Gravity dams:** Gravity dam parameters, selection of sit, forces on dam, design criteria, Principal stresses and shear stresses, stability analysis, elementary profile of dam, low and high gravity dams, gravity dam design(problems), dam foundation treatment, galleries.<br>Other types of dam: Introduction to rock fill dam & classification, arch dams & types, buttress dams & types (theory only). |
| **UNIT: 4 Spillways:** Essentials of storage dam spillway, components, types, energy dissipation below spillways, spillway gates, Intake & types, outlet works & their classification(theory only).<br>Canal regulation & cross drainage works: Canal regulatory works: concepts of canal fall, head regulator, cross regulator, canal escape, canal outlet, Cross drainage works and types (theory only). |

**Reference Book:**

1. Arora, K.R., Irrigation, Water Power and Water Resources Engineering, Standard Publishers Distributors, Delhi
2. Modi, P.N., Introduction to Water Resources And Waterpower Engineering, Standard Publication, Delhi
3. Garg, S.K., Irrigation Engineering and Hydraulic Structures Khanna Publishers
4. Asawa, G, L Irrigation And Water Resources Engineering, New Age Int. Ltd.
5. Sharma RK & T.K Sharma TK, Irrigation engineering, S.Chand Publishers

**Journals/Magazines**

Journal of Hydraulic structures, Scientific professional journal
Journal of Hydraulic engineering, ASCE
Journal of hydro-environment research, Science Direct
Civil Engineering & Construction review

**SWAYAM/NPTEL/MOOCs:**

https://www.swayamprabha.gov.in/index.php/program/current/15
https://swayamprabha.gov.in/index.php/program/Schedule/15
http://nptel.iitm.ac.in/video.php?courseId=1029&v=XmO2pltg7YBz
http://nptel.iitm.ac.in/video.php?courseId=1029&v=SO0suW7TLiCs
http://nptel.iitm.ac.in/courses/Webcoursecontents/
contents/IIT%20Kharagpur/Water%20Resource%20Engg/pdf/m3l05.pdf
http://nptel.iitm.ac.in/courses/Webcourse
contents/IIT%20Kharagpur/Water%20Resource%20Engg/pdf/m3l07.pdf
https://online-learning.tudelft.nl/courses/engineering-building-with-nature

**Problem Based Learning**

| No | Problem |
|---|---|
| 1. | Workout the life of a reservoir with its dead storage capacity of 1000x106 m3 and average annual suspended load in dead storage as 20 x 106 m3. Assume coarse silt of 1%, medium silt of 15% and fine silt of 84% ? |
| 2 | A masonry dam of 10 m high is trapezoidal in section with a top width of 1m and bottom width of 8.25m. The face exposed to water has a batter of 1:10. Test the stability of the dam. Find out the principal stresses at the toe and heel of the dam. Assume unit weight of masonry as 2240 kg/m3, Specific weight of water = 1000 kg/m3, and permissible shear stress of joint= 14 kg/cm2 ? |

| Project |
|---|
| Design of embankment dam.<br>Design of low height gravity dam. |

## COURSE PACK FOR: DESIGN OF RC STRUCTURAL ELEMENTS

| **Course Title** | **DESIGN OF RC STRUCTURAL ELEMENTS** | | | | **Course Type** | | **Integrated** | |
|---|---|---|---|---|---|---|---|---|
| Course Code | B20ED0503 | Credits | 3 | | Class | | V semester | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weight age | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 1 | 2 | 2 | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | Total | 2 | 5 | 5 | 42 | 26 | 50% | 50% |

## Course Overview:

This course introduces the students to understand design concepts of working stress method and limit state method, this subject also imparts the knowledge of IS codes and the basic principles of RCC Design of various structural elements such as beams, columns, slabs, stairs and footings. At the end of the course students will be able to design the basic elements of reinforced concrete structures.

**Course Objective**

This course enables graduating students to learn

1. To learn about the concepts and principles of limit state design
2. To compute the ultimate flexural strength, shear strength and Torsional strength of reinforced concrete beams.
3. To design reinforced concrete one-way , two-way slabs and Stairs
4. To design reinforced concrete columns and footings.
5. Draw SFD and BMD, analyse and design singly reinforced and doubly reinforced beams using MS EXCEL software
6. Analyse 2D trusses, 3D rigid frames and Truss using STAAD Pro software

## COURSE OUTCOMES (Cos)

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

| **CO#** | **Course Outcomes** | **POs** | **PSOs** |
|---|---|---|---|
| **CO1** | Be familiar with the concepts and principles of limit state design and working stress method, loads | 2,3,5 | 1 |
| **CO2** | Compute the Ultimate flexural Strength, Shear Strength of Reinforced concrete beams and Torsional and bond strength of Reinforced Concrete beams | 2,4,8,910,12 | 1,2,4 |
| **CO3** | Analyse and Design reinforced concrete, one-way , Two-way slabs as per codal provisions | 2,4,8,910,12 | 1,2,4 |
| **C04** | Analyze and Design Reinforced concrete columns and footings | 1,2,3,4,5,6,7, 8,10,12 | 1,2,3,4 |

| | | | |
|---|---|---|---|
| **C05** | Analyze and Extract Bending Moment and Shear force of Beams Using MS EXCEL software | 1,2,3,4,5,6,7, 8,10,12 | 1,2,3,4 |
| **C06** | Develop Model and Analyze 2D trusses, 3D rigid frames ,Truss using STAAD Pro software | 1,2,3,4,5,6,7, 8,10,12 | 1,2,3,4 |

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

| CO#/ POs | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | 2 | | 2 | | | | | | | | 3 | | | |
| CO2 | 3 | | | 3 | | | | 2 | 2 | 2 | | 3 | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 2 | | | 2 | | 2 | 2 | | 2 | | 2 | 2 | 3 | 3 |
| C04 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| C05 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| C06 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 | 3 |

## Course Content Theory

| **Contents** |
|---|
| **UNIT: 1 Design Concepts:** Loading standards as per IS 875, grades of steel and concrete. Introduction to working stress, Ultimate load and limit state methods. Advantages of Limit State method over other methods – Limit State philosophy as detailed in current Code. Limit state method: Assumptions. Flexure of RCC beams of rectangular section. Under reinforced, balanced and over-reinforced sections |

| |
|---|
| **UNIT: 2 Limit State Method Design Of Beams (Flexure, Shear, Torsion, Bond):** Design of singly and doubly reinforced rectangular and flanged beams – use of design aids for flexure – Behavior of R.C. beams in shear and torsion – Shear and Torsional reinforcement – Limit State design of R.C. members for combined bending, shear and torsion – Use of design aids. Design requirement for bond and anchorage as per IS code. Serviceability requirements. |
| **UNIT: 3 Limit State Design of Slabs and Stairs:** Behaviour of one way and two way slabs — design of one way simply supported, cantilever and continuous slabs. Design of two-way slabs for various edge conditions. Types of staircases - design of dog-legged staircase. |
| **UNIT: 4 Limit State Design of Columns And Footing:** Types of columns – design of short columns for axial load, combined axial load with uniaxial and biaxial bending - use of design aids. Design of footing for masonry and reinforced walls – design of axially and eccentrically loaded square and rectangular footings – design of combined rectangular footings for two columns only. |

**PRACTICE :**

| No | Title of the Experiment | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1. | Analysis and design of Singly Reinforced and doubly reinforced beams using MS EXCEL software. | MS Excel | Hands on training |
| 2 | Introduction – Basics and Tools | ETABS software. | Hands on training |
| 3. | Analysis and design Moment Resistant RC frames, continuous Beam using ETABS Software for Dead load and Live load. | ETABS Software. | Hands on training |
| 4. | Analysis and Design of Two Room Building (Single and Two Storey) for Dead load and Live load using ETABS Software. | ETABS Software | Hands on training/ |

**REFERENCE BOOKS:**


1. Sinha.S.N., Reinforced Concrete Design, Second Edition, Tata McGraw Hill Publishing Company, 2002.
2. Varghese.P.C., Limit State Design of Reinforced Concrete, Second Edition Prentice Hall Inc., 2010, 3. Gambhir.M.L., Fundamentals of Reinforced Concrete Design, Prentice Hall Inc., 2006.
3. Anand.S.Arya, Masonry and Timber Structures including Earthquake Resistant Design, Nem Chand and Bros., 2006.
4. IS 456–2000, Indian Standard – Plain and Reinforced Concrete – Code of Practice, Fourth Edition.
5. IS 1905–1987, Indian Code of Practice for Structural use of Unreinforced Masonry.

National Building Code of India 2005 (NBC 2005), Bureau of Indian Standards.

6. Learning Excel 2002- Ramesh Bangia, -Khanna Book Publishing Co (P) Ltd.,


**Journals/Magazines**

1. International journal of Concrete Structures and Materials Springer open
2. Wiley online Library, Structural Concrete, International Federation for Structural Concrete

**SWAYAM/NPTEL/MOOCs:**

http://www.nptel.iitm.ac.in

https://www.bentley.com/en/products/product-line/structural-analysis-software/ staadpro

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Project Based Learning Model In The Building Construction And Drawing |
| 2. | To Observe Various On-Going Construction Works And Reinforcement Details Provided For Various Structural Elements |

## COURSE PACK FOR RAILWAYS, AIRWAYS AND WATERWAYS TUNNELS

| **Course Title** | **RAILWAYS, AIRWAYS ANDWATERWAYS TUNNELS** | | | | **Course Type** | | **Theory** | |
|---|---|---|---|---|---|---|---|---|
| Course Code | B20ED0504 | Credits | 4 | | Class | | V semester | |
| Course Structure | TLP | Credits | Contact Hours | WorkLoad | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 4 | 4 | | | | |
| | Practice | 0 | 0 | 0 | Theory | Practical | CIE | SEE |
| | Tutorial | 0 | 0 | 0 | | | | |
| | Total | 3 | 4 | 4 | 42 | 0 | 50% | 50% |

**Course Overview**

This course introduces the students to learn basic elements of railway track and introduction about geometric design, study the airways and design of airfield and understand the concepts of harbour planning and also learn the tunnels with various classification, methods and about open cut.

**Course Objective**

**This course enables graduating students**

1. Provides the basic knowledge about the railway components and the geometric design of railway tracks
2. Provides the basic knowledge about the runways, Taxiways and Aprons.
3. Provides the basic knowledge about the geometric design of runways, Taxiways and Aprons.
4. Provide basic knowledge about Harbour Planning.
5. Provide basic knowledge about design of Harbour.
6. Provide knowledge about the basic aspects of tunnel and also expose them to various methods of tunnelling and drainage, ventilation, lining.

**COURSE OUTCOMES (Cos)**

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

| CO # | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Describe about railway components and evaluate the factors governing design of railways. | 1,2,12 | 1,2,4 |

| | | | |
|---|---|---|---|
| CO2 | Understand the basic knowledge about the geometric design of runways, Taxiways and Aprons. | 1,2,12 | 1,2,4 |
| CO3 | Enumerate geometric design of runways, Taxiways and Aprons. | 1,2,12 | 1,2,4 |
| CO4 | Understand harbour facilities. | 1,2,3,5,12 | 1,2,3,4 |
| CO5 | Plan and design of Harbour | 1,2,12 | 1,2,4 |
| CO6 | Enumerate the different types of harbours and their components; illustrate the effects of wind, waves and tides on water and navigational aids. | 2,4,12 | 1,2,3,4 |

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

| CO#/ POs | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | 2 | | | | | | 2 | 3 | 2 | 1 | 3 | 2 |
| CO2 | 3 | 2 | 2 | 1 | 1 | | | | | | | 3 | 2 | 2 | 3 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 2 | | | | | | 2 | 3 | 3 | 2 | 3 | 2 |
| C04 | 3 | 2 | 3 | 2 | | | | | | | 2 | 3 | 3 | 2 | 3 | 2 |
| C05 | 3 | 2 | 3 | 2 | | | | | | | 2 | 3 | 3 | 2 | 3 | 2 |
| C06 | 3 | 2 | 3 | 2 | | | | | | | 2 | 3 | 3 | 2 | 3 | 2 |

## Course Content Theory

| **Contents :** |
|---|
| **Unit.1-Basic elements and Introduction of Geometric design railway track:** Permanent way, forces acting on rails, function of rails, rail fixtures and fastenings, sleepers and ballast, rail joints, elements of junctions and layouts, types of traction, locomotives and other rolling stock, Field investigation, right of way and formation, geometric design elements and standards, speeds computation tractive effort and hauling power of locomotives. |

| |
|---|
| **Unit-2- Introduction to Airways: Airport classification; Runways:** runway configurations, runway orientation, wind rose, estimating runway length, sight distance and longitudinal profile, transverse gradient, airfield separation requirements, obstacle clearance requirements; Taxiways and taxi lanes: Aprons; Control tower visibility requirements. |
| **Unit-3 - Harbour Planning:** Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations. |
| **Unit-4- Introduction to Tunnels and open-cuts**– advantages and disadvantages, setting out of tunnel, shapes of tunnels, tunneling in soft soils (needle beam and shield methods only), tunneling in rocks, tunnel lining, drainage of tunnels, tunnel ventilation. |

**Text Book:**


1. Saxena S.C. and S.P. Arora, A text book of Railway Engineering, Dhanpat Rai, 2010.
2. Seetharaman, S. Dock and Harbour Engineering, Umesh Publications, New Delhi, India, 1999.
3. Venkatramaiah, Transportation Engineering, Vol. 2: Railways, Airports, Docks and Harbours, Bridges and Tunnels, June 2017


**Reference Books:**


1. Agarwal, M.M. Indian Railway Track, Prabha & Co., New Delhi, India, 1988.
2. Chandra S. and M. Agrawal, Railway Engineering, Second Edition, Oxford University Press, 2013.
3. Clifford F. Bonnett, Practical Railway Engineering, 2nd edition, imperial college press, London, 2005.
4. Srinivasan R, "Harbour Dock and Tunnel Engineering", Charotar Publishing House, Anand.
5. Gupta, B.L. Text Book of Railway Engineering, Standard Publishers, New Delhi, India, 1982.
6. Mundrey, J. S., Railway Track Engineering, Fourth Edition, TATA McGraw- Hill, New Delhi, 2009
7. Rangwala, S.C. Principles of Railway Engineering, Charotar Publishing House, Anand, India, 2009.


**Journals/Magazines**

1. International Journal of railway Engineering

**SWAYAM/NPTEL/MOOCs:**

http://www.nptel.iitm.ac.in

Problem Based Learning

| **No** | **Problem** |
|---|---|
| 1 | Explain the components of Permanent way |
| 2 | Construct windrose diagram |

Project Based Learning

To enhance the skill set in the integrated course, the students are advised to execute course-based **Design projects. Some sample projects are given below:**

| **No** | **Suggested Project** |
|---|---|
| 1 | Plan and design airport |

**COURSE PACK FOR: SOLID WASTE MANAGEMENT**

| **Course Title** | **Solid waste Management** | | | | **Course Type** | | | |
|---|---|---|---|---|---|---|---|---|
| Course Code | B20ED0505 | Credit | 3 | | Class | | Vth Semester | |
| Course Structure | TLP | Credit | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practise | 0 | 0 | 0 | Theory | Practical | IA | SEE |
| | Tutorial | 0 | 0 | 0 | | | | |
| | Total | 3 | 3 | 3 | 48 | 0 | 50% | 50% |

**COURSE OVERVIEW:** Solid waste management is defined as the discipline associated with control of generation, storage, collection, transport or transfer, processing and disposal of solid waste materials in a way that best addresses the range of public health, conservation, economic, aesthetic, engineering, and other environmental considerations. Hazardous-waste management, the collection, treatment, and disposal of waste material that, when improperly handled, can cause substantial harm to human health and safety or to the environment.

**COURSE OBJECTIVE (S):**

The objectives of this course are to:

1. To develop insight into the collection, transfer, and transport of municipal solid waste.
2. To Understand the Characterization and Classification of Solid waste
3. Examine the operation of a resource recovery facility and understanding the different methods of waste to energy facility.
4. Different methods of municipal solid waste disposal are studied.
5. To understand the different types of hazardous waste disposal.
6. To understand the Characterisation of Biomedical waste.

**COURSE OUTCOMES (COs):**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| **CO1** | Students will be in the condition different methods of collection, transfer, and transport of municipal solid waste. | 1, 2, 3, 4, 5 | 1, 2, 3 |
| **CO2** | Students will be in the condition to Classify the different type of Solid waste | 1, 2, 3, 4, 5 | 1, 2, 3 |
| **CO3** | Students will be able to understand the Different methods of municipal solid waste disposal | 1, 2, 3, 4, 5 | 1, 2, 3 |
| **CO4** | Students will be able to explore to different method of waste to energy facility | 1, 2, 3, 4, 5 | 1, 2, 3 |
| **CO5** | Evaluate landfill site and to study the sanitary landfill reactions. | 1, 2, 3, 4, 5 | 1, 2, 3 |
| **CO6** | Students would understand the Different Classification of Biomedical Waste | 1, 2, 3, 4, 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 | 2 | 3 | 3 | 3 | | | | | | | | 3 | 2 | 3 |
| CO2 | 1 | 3 | 3 | 3 | 3 | | | | | | | | 3 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 3 | | | | | | | | 2 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 2 | 3 |
| CO5 | 2 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 2 | 3 |
| CO6 | 3 | 2 | 2 | 3 | 3 | | | | | | | | 3 | 3 | 2 |

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

**Course Content**

| Contents |
|---|
| **UNIT-1 Introduction**<br>Composition and Handling of Solid Wastes: Sources and Types of solid wastes, Characteristics of solid waste, Waste generation and handling at source, Problems due to improper disposal of solid waste. Scope and importance of solid waste management. Solid waste management rules 2016. |
| **UNIT-2 Collection, Transportation and Treatment**<br>Systems of collection, collection equipment, garbage chutes, transfer stations bailing and compacting, route optimization techniques and problems. Components separation, volume reduction, size reduction, chemical reduction, plastic waste- environmental significance and reuse, reuse of materials in other industries. |
| **UNIT-3: Disposal Methods**<br>Open dumping, ocean disposal, feeding to hogs, incineration- Process–3T's,factors affecting incineration process, incinerators–types, 3T's,preventionofairpollution,Pyrolysis, energy recovery operations, composting-Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore processes, mechanical and semi mechanical composting processes. Vermi-composting. |
| **UNIT-4 Disposal Method and Recovery of Energy**<br>Sanitary land fill-Different types, trench area, Ramp and pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate & gas collection and control methods, geo-synthetic fabrics in sanitary landfills. Energy recovery technique from solid waste management. |

**Text Book:**

1. GeorgeTchobanoglous, Hilary Theisen, Samuel A Vigil, “Integrated Solid Waste Management: Engineering principles and management issues”, M/c Graw hill Education. Indian edition
2. Bhideand Sunderashan Solid Waste Management in developing countries.
3. PavoniJ.L. Handbook on Solid Waste Disposal.
4. Howard S Peavy, Donald R Rowe and George Tchobanoglous, “Environmental Engineering”, Tata Mcgraw Hill Publishing Co ltd.,

**Reference Books:**

1. S.K.Garg, Environmental Engineering–Vol. II.
2. Bio medical waste handling rules– 2000.
3. Vesilind.PaWorrell&Reinhart.D;Solid Waste Engineering; Cengage Learning India Private Limited, New Delhi.(2009)

**Magazines:**

Civil Engineering and Construction Review

**COURSE PACK FOR: ENERGY SCIENCE AND ENGINEERING**

| **Course Title** | **ENERGY SCIENCE AND ENGINEERING** | | | | **Course Type** | | **Integrated** | |
|---|---|---|---|---|---|---|---|---|
| Course Code | B20EDS501 | Credits | 3 | | Class | | IV semester | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 2 | 2 | 2 | | | | |
| | Practice | - | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | Total | 2 | 2 | 2 | 32 | - | 50% | 50% |

## Course Overview

The Energy area focuses on technologies for efficient and clean energy conversion and utilization, aiming to meet the challenge of rising energy demands and prices, while simultaneously addressing the concomitant environmental impact.

## Course Objective

**This course enables graduating students**

1. To understand the concept of energy and its usage
2. To learn the fundamentals of solar energy and its measurement aspects
3. To know about first generation, second generation and third generation solar cells
4. To understand the concept of conventional and non-conventional energy systems
5. To get the Fundamental forces in the universe, Quantum mechanics
6. To know the Nuclear fission reactor design, safety, operation and fuel cycles

## COURSE OUTCOMES (Cos)

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

| **CO#** | **Course Outcomes** | **POs** | **PSOs** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| CO1 | Applying concept of energy and its usage | 1,2,12 | 1,2,4 |
| CO2 | To gain confidence in implementing fundamentals of solar energy and its measurement aspects | 1,2,12 | 1,2,4 |
| CO3 | To generate first generation, second generation and third generation solar cells | 1,2,3,5, 12 | 1,2,3,4 |
| C04 | Applying the concept of conventional and non-conventional energy systems | 2,4,12 | 1,2,3,4 |
| C05 | To get the complete understanding of the Fundamental forces in the universe, Quantum mechanics | 2,4,12 | 1,2,3,4 |
| CO6 | To gain confidence in Nuclear fission reactor design, safety, operation and fuel cycles | 2,4,12 | 1,2,3,4 |

## 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 | | | ✓ | ✓ | ✓ | |
| CO2 | | ✓ | ✓ | ✓ | | |
| CO3 | | | ✓ | ✓ | | |
| C04 | | | ✓ | ✓ | ✓ | |
| CO5 | | | ✓ | ✓ | ✓ | |
| CO6 | | | ✓ | ✓ | ✓ | |

## Course Articulation Matrix Note: 1-Low, 2-Medium, 3-High

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO3 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C04 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO5 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO6 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| Contents |
| --- |
| **UNIT:1 Energy and its Usage:** Units and scales of energy use, Mechanical energy and transport, Heat energy: Conversion between heat and mechanical energy, Electromagnetic energy: Storage, conversion, transmission and radiation, Introduction to the quantum, energy quantization, Energy in chemical systems and processes, flow of $CO_2$, Entropy and temperature, Carnot and Sterling heat engines, Phase change energy conversion, refrigeration and heat pumps, Internal combustion engines, Steam and gas power cycles, the physics of power plants. Solid-state phenomena including photo, thermal and electrical aspects |
| **UNIT:2 Solar Energy:** Introduction to solar energy, fundamentals of solar radiation and its measurement aspects, Basic physics of semiconductors, Carrier transport, generation and recombination in semiconductors, Semiconductor junctions: metal-semiconductor junction & p-n junction, Essential characteristics of solar photovoltaic devices, First Generation Solar Cells, Second Generation Solar Cells, Third Generation Solar Cells |
| **UNIT:3 Conventional & non-conventional energy source:** Biological energy sources and fossil fuels, Fluid dynamics and power in the wind, available resources, fluids, viscosity, types of fluid flow, lift, Wind turbine dynamics and design, wind farms, Geothermal power and ocean thermal energy conversion, Tidal/wave/hydro power |
| **UNIT: 4 Nuclear Energy:**<br>Fundamental forces in the universe, Quantum mechanics relevant for nuclear physics, Nuclear forces, energy scales and structure, Nuclear binding energy systematics, reactions and decays, Nuclear fusion, Nuclear fission and fission reactor physics, Nuclear fission reactor design, safety, operation and fuel cycles |

**Text Book:**

1. Energy and the Challenge of Sustainability, World Energy Assessment, UNDP, New York, (2000).
2. Perspective of Modern Physics, A. Beiser, McGraw-Hill International Editions (1968).
3. Introduction to Modern Physics, H.S. Mani and G.K.Mehta, East-West Press (1988).
4. Introduction to Electrodynamics, D. J. Griffiths, Fourth Edition, Prentice Hall (2013).

**Reference Books**

1. Introductory Nuclear Physics, R. K. Puri and V.K. Babbar, Narosa Publishing House (1996).
2. Physics of Solar Cells: From Basic Principles to Advanced Concepts by Peter Wurfel, John Wiley & Sons, 2016
3. Principles of Solar Engineering, D.Y. Goswami, F.Kreith and J.F. Kreider, Taylor and Francis, Philadelphia, 2000.

**Journals/Magazines**

1. Journal of Energy Engineering, ASCE
2. International Journal of Energy Engineering, Publons

**SWAYAM/NPTEL/MOOCs:**

https://www.coursera.org/courses?query=energy
https://www.edx.org/learn/energy
Problem Based Learning

| No | Problem |
|---|---|
| 1.<br>2. | Implementing Carnot and Sterling heat engines, demonstrate an illustration for developing heat energy<br>Develop the concept of First Generation Solar Cells, Second Generation Solar Cells, Third Generation Solar Cells |

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | The students are made to carry out a details understanding and concept of different types of energies such as heat and mechanical energy, Electromagnetic energy, Solar Energy, Conventional & non-conventional energy source: Biological energy sources and fossil fuels and Nuclear Energy, their usage and development by making a batch |

**COURSE PACK FOR: IOT APPLICATION IN CIVIL ENGINEERING**

<table>
<tr><td>Course Title</td><td colspan="4">IOT APPLICATION IN CIVIL ENGINEERING</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EDS612</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes<br>Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It's becoming the Internet of Things (IoT). The course enables student to understand the basics of Internet of things and protocols. It introduces some of the application areas where Internet of Things can be applied in the field of civil engineering.

**Course Objective**

**This course enables graduating students**

1. To have an overall knowledge of the IOT components ,governance and IOT ecosystem
2. To educate students about the IOT device development and its protocols for the same as applied to civil engineering field
3. To develop a strong knowledge of IOT architecture in development of IOT devices and its management in any Civil engineering fields.
4. To develop a strong knowledge related to web of things (WOT) and its applications in the field of civil engineering
5. To give students an overview of the requirements of IOT, application , its uses and limitations and also its importance in smart building technology

To make students appreciate the necessity of RASBERRY-PI programming in implementation of IOT application

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Outline the overall components of IOT , its governance and importance | 1,2,3,6,8,10 , 11 | 1,2,3 |
| CO2 | Explain the necessity IOT device development and its application in the construction sector | 2,3,6,9 | 2,3,4 |
| CO3 | Architecture and development of IOT device in futuristic aspect for various field in civil engineering | 2,3,4,9 | 3,4 |
| C04 | Enumerate the importance of Web Of things and its role in IOT development. Will be able to differentiate between Web of things and internet of things | 1,2,,6,8 | 1,3,4 |
| CO5 | Will be able to identify IOTS applications .Its limitations its advantages in different field of Civil engineering | 1,2,3,6 | 1,2,4 |
| CO6 | Programing involved in development and function of IOT device by RASBERRY-PI programming | 1,3,6,8 | 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 Note: 1-Low, 2-Medium, 3-High

| CO#/ POs | PO | PO | PO | PO | PO | PO | PO | PO | PO | PO1 | PO1 | PO1 | PSO | PSO | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | | | 2 | | 2 | | 1 | 2 | | 2 | 3 | 2 | |
| CO2 | | 2 | 2 | | | 3 | | | 2 | | | | | 3 | | 2 |
| CO3 | | 2 | 2 | 2 | | | | | 1 | | | | | | 2 | 2 |
| C04 | 2 | 3 | 2 | | | 3 | | 3 | | | | | 2 | | 3 | 3 |
| CO5 | 2 | 2 | 3 | | | 1 | | | | | | | 3 | 2 | | 3 |
| CO6 | 2 | | 2 | | | 2 | | 3 | | | | | 2 | | 1 | |

## Course Content Theory

| Contents |
|---|
| **UNIT: 1 INTERNET OF THINGS (IOT)** - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues. |
| **UNIT: 2 IOT PROTOCOLS and IOT ARCHITECTURE** - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols. IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models |
| **UNIT: 3 WEB OF THINGS and Application of IOT in civil engineering** - Web of Things versus Internet of Things – Two Pillars of the Web. IOT utilization in civil engineering – (Building construction smart water supply etc. Application of IOT in smart building construction Advantages of IOT And Limitations of IOT |
| **UNIT: 4 IOT APPLICATIONS - IoT applications for industry:** Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. RASBERRY-PI Introduction to Raspberry pi – configuration of Raspberry pi – programming raspberry pi - Implementation of IOT with Raspberry pi. Eg: Smart Irrigation using IOT/ IoT Based Biometrics Implementation on Raspberry Pi/ Automation etc. |

**Text Book:**


1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.


**Reference Books**


1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1st Edition, Apress Publications, 2013
3. CunoPfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1-4493-9357-1


**Journals/Magazines**

1. Journal of Internet Services and Applications, UK (https://jisajournal.springeropen.com/)
2. IEEE Open Journal of Internet of things and Artificial Intelligence
3. The International Journal of Intelligent Real-Time Automation (https://www.journals.elsevier.com/engineering-applications-of-artificial-intelligence)

**SWAYAM/NPTEL/MOOCs:**

1. Introduction to Internet of Things: (https://onlinecourses.nptel.ac.in/noc20_cs22/preview)
2. Internet of things and AI cloud (Coursera) (https://www.coursera.org/specializations/internet-of-things)

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute following Experiments by Raspberry pi Programming

| No | Suggested Project |
|---|---|
| 1 | Implementation of a IOT based real time system. The concept of the specific embedded design has to be discussed. |
| 2 | Smart Irrigation using IOT |
| 3 | IoT Based Biometrics Implementation on Raspberry Pi |
| 4 | IOT based app design for smart building |

**COURSE PACK FOR: OPEN CHANNEL HYDRAULICS (B20EDS503)**

<table>
<tr><td>Course Title</td><td colspan="4">OPEN CHANNEL HYDRAULICS</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20EDS503</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>TLP</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>Theory</td><td>3</td><td>4</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

## Course Overview

Design of channels for uniform flow and critical flow, concept of specific energy, concept of gradually varied flow, dynamic equation, characteristics of flow profile and classification, analysis and practical problems, gradually varied flow computations by different methods, concepts of rapidly varied flows, hydraulic jump and its applications as energy dissipator.

## Course Objective

## This course enables graduating students

1. Understand about design of channels for uniform flow and critical flow.
2. To study about concept of specific energy, concept of gradually varied flow,
3. Understand and analysis of dynamic equation.
4. To learn characteristics of flow profile and classification, analysis and practical problems.
5. To study gradually varied flow computations by different methods.
6. To learn concepts of rapidly varied flows, hydraulic jump and its applications as energy dissipator.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Design of channels for uniform flow, critical flow and gradually varied flow. | 1,2,3 | 1,2,3 |
| CO2 | Define the concept of specific energy and GVF | 2,3,6 | 1,2,3 |
| CO3 | Able to Derive dynamic equation. | 1,2,3,4 | 2,3 |
| C04 | Define and Recognize the flow profile and classification, analysis and practical problems. | 2,3,4,5 | 1,2,3,4 |
| CO5 | Compute the gradually varied flow by different methods. | 1,2,3,4,5 | 1,2,3 |
| C06 | Define and analyze the rapidly varied flows, hydraulic jump and its applications as energy dissipator. | 2,3,4,5,12 | 1,2,3,4 |

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

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

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO6 | | 3 | 2 | 2 | 3 | | 2 | | | | | 3 | 3 | 2 | 3 | 3 |

## Course Content Theory

| Contents |
|---|
| **UNIT:1 INTRODUCTION**: Difference between pipe flow and open channel flow, Classification of flow, Energy equation, momentum equation, kinetic energy and momentum factors.<br>**UNIFORM FLOW:** Concepts, uniform flow equations, conveyance and hydraulic exponent for uniform flow, design of channels for uniform flow. |
| **UNIT: 2 CRITICAL FLOW:** Concept of specific Energy- Classification of flow. Design of channel, Section factor, Hydraulic exponent of critical flow, critical depth as flow measurement.<br>GRADUALLY VARIED FLOW: Concepts, GVF equation, its different forms, Basic assumptions, Dynamic equation, characteristics of flow profile and classification. |
| **UNIT:3 FLOW PROFILES :** Analysis of flow profiles, method of singular point and transitional depth, methods of computation practical problems. Gradually varied flow computations: Different methods, direct integration method. Bress's Solution, Chow's solution, direct method, standard step method. |
| **UNIT:4 RAPIDLY VARIED FLOW:** Hydraulic jump in rectangular channels, classification of jumps, characteristics of jump-length, location, height, and application of hydraulic jump. Hydraulic jump in rectangular channel, sloping channel, application of hydraulic jump as energy dissipator. |

**Text Book:**

1. Open Channel Hydraulics: Subramanya : Tata McGraw Hill Publishing Co Ltd, New Delhi
2. Open Channel Flow-Madan Mohan Das, Prentice Hall of India Pvt. Ltd., New Delhi 2008 Edition.
3. Flow Through Open Channels – Rajesh Srivastava, Oxford Press, New Delhi 2008 Edition
4. Open Channel Hydraulics: French: Tata McGraw Hill book company New Delhi

**Reference Books:**

1. Fluid Mechanics: Modi & Seth: Standard book home, New Delhi.
2. Open Channel Hydraulics: Henderson: Milan Publishing Co Ltd., New York.
3. Open Channel Hydraulics: Ven Te Chow. McGraw-Hill, New York.

**Journals/Magazines**

1. Journal of Fluid Mechanics
2. Journal of Hydraulic Engineering

**SWAYAM/NPTEL/MOOCs:**

http://www.nptel.iitm.ac.in

Problem Based Learning

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **PAVEMENT MATERIALS AND CONSTRUCTION** | | | | **Course Type** | | **Theory** | |
| **Course Code** | B20EDS502 | **Credits** | **3** | | **Course Code** | | B20EDS502 | |
| **Cours eStr uctu re** | TLP | Credits | Contact Hours | | TLP Theory | | Credits 3 | |
| | Theory | 3 | 4 | 3 | | | | |
| | Practice | - | - | | Practi ce Tutor | - - | - - | |
| | Tutorial | - | - | - | | | | |
| | **Total** | **3** | **4** | | **Tota** | **3** | **4** | |

| No | Problem |
|---|---|
| 1. | The depth of flow of water at a certain section of a rectangular channel of 4m wide is 0.5m. The discharge through the channel is 16 m3/s. If a hydraulic jump taken place on the downstream side. Find the depth of flow after the jump. |
| 2. | In hydraulic jump occurring in a rectangular channel of 3 m width, the discharge is 7.8 m3/sec and depth before the jump is 0.28 m. Estimate i)Sequent depth and ii) energy loss in the jump . |

**Project Based Learning**

**Flow profiles in open channels.**

Flow Visualization of Hydraulics Structures.

**COURSE PACK FOR: PAVEMENT MATERIALS AND CONSTRUCTION**

**COURSE OVERVIEW**

Course Description: This is an elective course is designed to provide the foundational concepts of materials used for pavement construction, including the tests on materials, pavement design mixes and construction methods for flexible and rigid pavement.

**COURSE OBJECTIVE**

1. Understand properties and tests performed on aggregates, soil .
2. Provide the overview about grades of bitumen, tar, Bitumen emulsion and cutbacks and proportioning of materials.
3. Provide the knowledge about the bituminous mixes
4. To learn the Marshall Mix and marshall method of mix design.
5. Understand pavement and its components, different pavement construction and its requirements,
6. Provide the knowledge of Specifications and quality checks for flexible and rigid pavements.

**COURSE OUTCOMES (COs)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Characterize the properties of soil, aggregates, bitumen, tar and its tests | 1,2,3,5 | 1,2 |
| CO2 | Analyses the properties of Tar, bituminous emulsion and cutback | 2,3,5,12 | 2,3 |
| CO3 | Analyse the properties of bitumen mixes | 1,2,3,5,12 | 2,3 |
| CO3 | Describe the Marshall Mix and marshall method of mix design. | 1,2,3,5,12 | 2,3 |
| C04 | Understand the different pavement construction and its requirements. | 2,3,5,12 | 1,3,4 |
| C04 | Capable to understand specifications, quality checks in pavement construction. | 2,3,5,12 | 1,3,4 |

**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 Code | POS/ COs | PO1 | P0 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 | PS O4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B20ED S502 | CO1 | 3 | 3 | | | | 2 | 3 | 3 | 3 | 3 | | 1 | 3 | 3 | 2 | 3 |
| | CO2 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | | | 3 | 2 | 3 | 3 |
| | CO3 | 3 | 3 | 3 | 3 | | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 2 |
| | CO4 | 3 | | | 3 | 3 | 3 | 3 | 2 | 2 | 3 | | 2 | 3 | 3 | | 1 |

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

## COURSE ASSESSMENT

| SN | Component | | Duration in | Component Wise | Total Marks | Weightag | Mark |
|---|---|---|---|---|---|---|---|
| 1 | Continuous Internal Evaluation (CIE) | Theory: Test-1 | 1.5 | 30 | 100 | 0.5 | 50 |
| 2 | | Theory: Test-2 | 1.5 | 30 | | | |
| | | Alternate Assessment* | | 40 | | | |
| 5 | Semester End Exam (SEE) | | 3 | 100 | 100 | 0.5 | 50 |
| **Total Marks** | | | | | | | **100** |

*** Assignment, Quiz, Class test, SWAYAM/NPTEL/MOOCs and etc..**

**COURSE CONTENT:**

**THEORY**

| Contents |
|---|
| **UNIT-I Introduction to Pavement materials**<br>Pavement Types and Materials: Types and component parts of pavements; highway and airport Pavements. Soil- Desirable Properties, functions of soil subgrade.<br>Aggregates: Classification of aggregates, properties, specifications on road aggregates for flexible and rigid pavements. Blending of aggregates to meet specification, Aggregate gradation and Shape factor in mix design. |
| **UNIT-II Bitumen and Tar**<br>Bitumen – Properties, Grades, Classification, Tar-Grades of Tar, Tests on tar, Bituminous Emulsions and Cutbacks: Manufacturing process, Uses.<br>Adhesion of Bituminous to Binders to Road Aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion. |
| **UNIT-III Bituminous Mixes**<br>Mechanical properties, dense and open textured mixes, flexibility and brittleness, bituminous mix, design methods using Marshall stability and specification using different criteria- voids in mineral aggregates, voids in total mix, density, flow, stability, percentage voids filled with bitumen. Numerical problems. |
| **UNIT-IV Construction of Flexible and Rigid Pavement**<br>Construction method, specifications and field control checks for various types of flexible pavement layers like GSB,WBM, WMM, bituminous macadam, dense bituminous macadam, binder course and bitumen surface course.<br>Specifications and method of cement concrete pavement construction, PQC, DLC, Quality control tests, Construction of various types of joints. |

**REFERENCE BOOKS**

1. S K Khanna, C E G Justo and A Veeraragavan, Highway Engineering, Revised 10th Edition, Nemchand and Bros, Roorkee

2. S K Khanna, C E G Justo and A Veeraragavan, Highway Material and Pavement Testing Laboratory Manual, Revised 5th Edition, Nemchand and Bros, Roorkee
3. MoRTH Specifications for Roads and Bridges Works- Indian Roads Congress
4. HMSO Publication - Soil Mechanics for Road Engineers
5. Relevant BIS and IRC Codes

**JOURNALS/MAGAZINES**

International Journal of Pavement Engineering: https://www.tandfonline.com/gpav20
Journal of Transportation Engineering: https://ascelibrary.org/journal/jpeodx

**SWAYAM/NPTEL/MOOCs:**

1. https://nptel.ac.in/courses/105/101/105101087/
2. http://www.nptelvideos.in/2012/11/introduction-to-transportation.html
3. https://www.coursera.org

**PROJECT BASED LEARNING:**

| No | Projects/Questions |
|---|---|
| 1 | To determine physical properties of aggregates, soil in laboratory |
| 2 | To determine physical properties of Bitumen, Cutback in laboratory |
| 3 | To determine Marshall Properties on bituminous mixes on BC grade, DBM layer |
| 4 | To assess the subgrade soil condition by various tests. |
| 5 | A case study of Flexible Road construction in Bangalore or any other city |
| 6 | A detailed study on construction of overlay pavements. |
| 7 | Enlist and explain the design elements of highway embankment. |
| 8 | Explain briefly the material specification, construction method for Cement Concrete Pavements. |
| 9 | Explain briefly materials, specifications and construction procedure of WMM layer. |
| 10 | Explain briefly materials, specifications and construction procedure of WBM layer. |

## COURSE PACK FOR: Rural Water Supply and Sanitation

<table>
<tr><td>Course Title</td><td colspan="4">Rural Water Supply and Sanitation</td><td colspan="2">Course Type</td><td colspan="2">Regul<br>ar</td></tr>
<tr><td>Course Code</td><td>B20EDS50<br>5</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Course Code</td><td colspan="2">B20EDS505</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Course Structure</td><td colspan="2" rowspan="2">TLP/Theory</td><td colspan="2" rowspan="2">Credits<br>3</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td></td><td rowspan="2">Practice<br>Tutorial</td><td rowspan="2">0<br>0</td><td rowspan="2">0<br>-</td><td rowspan="2"></td></tr>
<tr><td>Tutorial</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td></td><td>Total</td><td>3</td><td>3</td><td></td></tr>
</table>

**COURSE OVERVIEW:** The course explains treatment technologies used in public water supply and sewage, their operation and design principles. It also includes low cost treatment methods and advanced technologies for unconventional pollutants.

**COURSE OBJECTIVE: This course enables graduating students**

To Identify the various Water sources and water borne diseases and types of pumps for rural water supply

1. To find out the Water treatment methods to control contamination of water.
2. To Describe Principles of rural sanitation and rain water harvesting.
3. To Identify the Methods of communicable diseases.
4. To discuss the Refuse collection system
5. To Describe the Milk Sanitation principle and identify the insects control measures.

**COURSEOUTCOMES (COs)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Categorize the different types of water borne diseases and types of pumps for rural water supply | 1, 2, 3, 4, 5 | 1, 2, 3 |
| CO2 | Explain the Water treatment methods to control contamination of water. | 1, 2, 3, 4, 5 | 1, 2, 3 |
| CO3 | Apply the principles of rural sanitation and rain water harvesting. | 1, 2, 3, 4, 5 | 1, 2, 3 |
| C04 | Recognize the communicable diseases | 1, 2, 3, 4, 5 | 1, 2, 3 |
| CO5 | Examine the management of solid waste collection and disposal. | 1, 2, 3, 4, 5 | 1, 2, 3 |
| C06 | Explain the Milk Sanitation principal and insects control measures. | 1, 2, 3, 4, 5 | 1, 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**

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

| CO#/ POs | 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 | 2 | 1 | | | | | | | | | | 3 | 3 | 3 | |
| CO3 | 3 | 2 | | | | | | | | | | | 3 | 3 | 3 | |
| C04 | 3 | 2 | | | | | 3 | | | | | | 3 | 3 | 3 | |
| CO5 | 3 | 2 | | | | | | | | | | | 3 | 3 | 3 | |
| CO6 | 3 | 2 | | | | | 3 | | | | | | 3 | 3 | 3 | |

**COURSE CONTENT THEORY**

| |
|---|
| **Contents** |
| **10 hrs** |
| **UNIT: 1**<br>**Introduction:** Need for a protected water supply, Investigation and selection of water sources, water borne diseases, Protection of well waters, drinking water quality standards.<br>Types Of Pumps, Supply systems viz., BWS,MWS,PWS, water treatment methods-disinfection, deflouridation, hardness and iron removal, ground water contamination and removal. |
| 10 hrs |
| **UNIT:2**<br>**Rural Sanitation:**<br>Conservancy, public latrine, concept of eco-sanitation, trenching and composing methods, two pit latrines, aqua privy, W.C, septic tank, soak pit, Drainage Systems: Storm water and sullage disposal, rain water harvesting and uses. |
| 10 hrs |
| **UNIT:3**<br>**Communicable Diseases:** Terminology, Classifications, Methods of communication, general methods of control.<br>Refuse Collection And Disposal: Garbage, ash, rubbish, collection methods, transportation and disposal-salvaging, dumping, controlled tipping, incineration and composting, dung disposal-digester, biogas plant. |
| 10 hrs |
| **UNIT:4**<br>**Milk Sanitation:** Essentials, test for milk quality, pasteurization, quality control, cattle borne diseases, planning for a cow shed.<br>Insect Control: House fly and mosquito-life cycle, diseases, transmission and control measures |

**Text Books:**


1. Water supply Engineering –S.K.Garg, Khanna Publishers
2. Environmental Engineering I –B C Punima and Ashok Jain
3. Environmental Engineering -Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), McGraw Hill Book Co.
4. Wastewater Engineering –B C Punima and Ashok Jain, Lakshmi Publishers
5. Tchobanoglous: Integrated Solid Waste Management: M/c Graw Hill.
6. Manual on Water supply and treatment –CPHEEO, Ministry of Urban Development, New Delhi
7. Hammer, M.J., (1986), Water and Wastewater Technology –SI Version, 2nd Edition, John Wiley and Sons.
8. Karia, G.L., and Christian, R.A., (2006), Wastewater Treatment – Concepts and Design Approach, Prentice Hall of India Pvt. Ltd., New Delhi.

**Reference Books:**


1. Sincero, A.P., and Sincero, G.A., (1999), Environmental Engineering – A Design Approach–Prentice Hall of India Pvt. Ltd., New Delhi.
2. E.W.Steel,Mc Ghee, Terence -'Water Supply Engineering and Sewerage; Mc.Graw Hill
3. E.W.Steel,Mc Ghee, Terence -'Water Supply Engineering and Sewerage; Mc.Graw Hill
4. Fair, Geyer and Okun-'Water and Wastewater Engineering: Water Supply and Wastewater Removal, 3rd Edition, John Wiley and Sons.
5. Metcalf and Eddy: 'Waste Water Treatment, Disposal and Reuse'; Tata McGraw Hill Publications.


**PROJECT BASED LEARNING**

| No. | Suggested sample Projects |
|---|---|
| 1. | Wastewater treatment model. |
| 2. | Analysis of water quality. |

## COURSE PACK FOR APPLIED GEOLOGY

<table>
<tr><td>Course Title</td><td colspan="4">Applied Geology</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EDS506</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>TLP</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

### Course Overview

Applied Geology is an integrated field of science that deals with Geology as Science. The prime focus of the course is planet Earth as the subject and the study involves understanding the processes and changes that take place on the planet. This course covers a wide area of topics which spans from the investigation of land, geotechnical studies, and detail of environmental sectors. This program eases the task of civil engineers in framing the structure of bridges, dams, buildings, etc.

**Course Objective**

**This course enables graduating students**

1. To learn about Geomorphology and interior of the Earth and properties and uses of minerals and rocks.
2. To study the causes and effects of earth quakes and the various structures developed in rocks.
3. To know the Geological details in the selection of dam and tunnel sites and study the groundwater formation, exploration and exploitation.
4. To study the Geomatics and its applications in the field.

### COURSE OUTCOMES (Cos)

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

| CO # | Course Outcomes | Pos | PSOs |
|---|---|---|---|
| CO1 | Students will have knowledge about Engineering properties of Rocks. | 1,3,9,10 | 1,2,3 |
| CO2 | Students will have knowledge about Engineering properties of Minerals. | 1,3,9,10 | 1,2,3 |
| CO3 | Student will be appraised about Dam, reservoir, tunnel | 1,3,9,10 | 1,2,3 |
| CO4 | Student will understand about Earth-quake phenomena. | 1,3 | 1,2,3 |
| CO5 | Student will able to carry out Physical exploration | 1,3 | 1,2,3 |
| CO6 | Students will able to estimate various geological parameters by use of modern tools & techniques | 1,3 | 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 | | ✓ | ✓ | ✓ | ✓ | |
| C05 | | ✓ | ✓ | ✓ | ✓ | |
| C06 | | ✓ | ✓ | ✓ | ✓ | ✓ |

**Course Articulation Matrix Note: 1-Low, 2-Medium, 3- High**

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 2 | 1 | | | | | 2 | 2 | | 2 | 3 | 1 | 2 | 2 |
| CO2 | 3 | 1 | 2 | 1 | | | | | 2 | 2 | | 2 | 3 | 1 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 1 | | | | | 2 | 2 | | 2 | 3 | 1 | 2 | 2 |
| CO4 | 3 | 2 | 3 | 1 | | | | | 2 | 2 | | 3 | 3 | 1 | 2 | 2 |
| C05 | 3 | 2 | 3 | 1 | | | | | 2 | 2 | | 3 | 3 | 1 | 2 | 2 |
| C06 | 3 | 2 | 3 | 1 | | | | | 2 | 2 | | 3 | 3 | 1 | 2 | 2 |

**Course Content Theory**

| Contents |
|---|
| **Unit.1 – Introduction to Geology :**<br>Role of Earth Science in Civil Engineering Practices, Understanding the earth, interior of the earth, composition and density of crust, mantle and core layers.<br>Mineralogy: Quartz Group (Glass); Feldspar Group (Ceramic wares and Flooring tiles); Kaolin (Paper, paint and textile); Asbestos (AC sheets); Carbonate Group (Cement) ; Gypsum (POP, gypsum sheets, cement); Mica Group (Electrical industries); Ore minerals - Iron ores (Steel); Chromites (Alloy); Bauxite (aluminum); Chalcopyrite (copper). Mineral properties, composition and uses, in the manufacture of construction materials of above minerals.<br>Petrology: Strength Characteristics of rocks - Compressive, Tensile and Shear strengths and Hardness. Formation, Classification of Engineering properties and uses of rocks in construction: Igneous Rocks - Granite, Dolerite, Gabbro, Basalt; Sedimentary rocks - Sandstone, Shale, Limestone, Laterite; Metamorphic rocks - Gneiss, Quartzite, Slate, Charnockite: Decorative stones - Porphyries, Marble and Quartzite. |

| |
|---|
| **Unit-2- Geomorphology and Seismology:**<br>Geomorphological agents: River valley, Drainage development and patterns; Coastlines and their engineering considerations, deserts and its features. Rock weathering and its effect on Civil Engineering projects.<br>Seismology: Introduction, seismic waves, Engineering problems related to Earthquakes, Earthquake intensity, causes and effects, Seismograph: Seismic zones- World and India, Tsunami. Reservoir Induced Seismicity, Plate Tectonics. |
| **Unit-3 - Rock Mechanics and Construction Materials:**<br>Concept of stress and strain, deformation of rocks, Development of Joints, Folds, Faults and Unconformity and their impact on the selection of sites for Dams, Reservoirs, Tunnels, Highways and bridges.<br>Construction Materials: Introduction, Selection of good quality rocks based on geological and engineering properties for use in the construction of Dams, Roads, Railway lines; Flooring slabs, Masonry, aggregates; Decorative stones-Colour, texture, hardness and durability. |
| **Unit-4- Hydrogeology, Toposheets and Geological Maps:**<br>Hydrological cycle, Occurrence of Groundwater in different terrains -Weathered, Hard and Stratified rocks. Groundwater pollution, Groundwater Exploration- Electrical Resistivity Method, Resistivity curves, Aquifer and its types, Springs and Artesian Wells, Rain water harvesting and recharge of Groundwater, Sea water intrusion and remedies.<br>Study of Toposheets, Geological maps, Use of maps in Civil Engineering, Disaster Management – types of Disasters early warning system and their mitigation. A case study on Geological maps |

**Text Book:**

1. Dimitri P Krynine and William R Judd, "Principles of Engineering Geology and Geotechnics" CBS Publishers and Distributors Ltd., New Delhi, 1957
2. C V R Murthy, "Earthquake Tips - Learning Earthquake Design and Construction" Publishers National Information Centre of Earthquake Engineering, Indian Institute of Technology, Kanpur.
3. Bureau of Indian Standards, IS: 1893, IS: 4326, IS: 13827, IS: 13828, IS: 13920, IS: 13925, IS: 15662-2006.
4. K V G K Gokhale, "Principles of Engineering Geology" BS Publications, Hyderabad, 2006
5. A B Roy, "Fundamentals of Geology" Narosa Publishing House, New Delhi, 2010.

**Reference Books:**

1. M Anji Reddy, "Text book of Remote Sensing and Geographical information System", BS Publications, Hyderabad, 2004.
2. Arthur Holmes, "Physical Geology" Tata Mac Grow Hill, New Delhi, 1944.
3. K. Todd, "Ground Water" Tata Mac Grow Hill, New Delhi, 1959.
4. M P Billings, "Structural Geology", CBS Publishers and Distributors, New Delhi, 1946.
5. D. Venkata Reddy, "Engineering Geology", New Age International Publications, New Delhi, 2015.

**Magazines: Civil Engineering and Construction Review**

**SWAYAM/NPTEL/MOOCs:**

1. NPTEL :: Civil Engineering - Engineering Geology (100%)

**PROBLEM BASED LEARNING**

| No | Problems |
|---|---|
| 1 | Study the properties of locally available Rocks and Minerals. |
| 2 | Study and explanation of Geological maps. |
| 3 | Selection of good quality rocks based on geological and engineering properties for use in the construction of Dams, Roads. |

**Project Based Learning – Integrated Course**

To Enhance the Skill Set in The Integrated Course, The Students Are Advised to Execute Course-Based
Design Projects. Some Sample Projects Are Given Below:

| No. | Suggested Projects |
|---|---|
| 1. | Preparation of a bore-log for proposed construction site |
| 2. | Study of Faults and Folds in local areas. |

**COURSE PACK FOR: BUILDING MATERIALS AND CONSTRUCTION**

<table>
<tr><td>Course Title</td><td colspan="4">BUILDING MATERIALS AND CONSTRUCTION</td><td>Course Type</td><td colspan="2">Open Elective</td></tr>
<tr><td>Course Code</td><td>B20EDO501</td><td>Credits</td><td colspan="2">3</td><td>Class</td><td colspan="2">V semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>4<br>8</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

This course provides the knowledge about the various major building materials used for constructions. It emphasizes on the types, composition, properties and uses of these materials. Further the course also provides information related to basic construction methods such as brick and stone masonry, joint, flooring types, plastering etc.

**Course Objective**

**This course enables graduating students**

1. To introduce different types and properties of building materials

2. To provide an overview of different smart materials
3. To understand the composition, uses and defects of cement, mortar and steel
4. To introduce the concept involved in brick masonry and stone masonry
5. To explain about the different types of flooring and its construction
6. To establish the knowledge of plastering, its types, methods and defects.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Identify the types, qualities and uses of building materials | 1,10,12 | 1 |
| CO2 | Explain about various smart materials | 1,10,12 | 1 |
| CO3 | Describe the composition, uses and defects of cement, mortar and steel | 1,10,12 | 1 |
| C04 | Identify the materials and explain the types of joints in brick and stone masonry. | 1,6,10, 12 | 1 |
| C05 | Explain the different types of flooring and its construction | 1,6,10, 12 | 1 |
| C06 | Represent the various types and uses of plastering and flooring materials. | 1,6,10, 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** | ✓ | ✓ | ✓ | | | |
| **C04** | ✓ | ✓ | ✓ | | | |
| **C05** | ✓ | ✓ | ✓ | | | |
| **C06** | ✓ | ✓ | ✓ | | | |

**Course Articulation Matrix Note: 1-Low, 2-Medium, 3-High**

| CO#/ POs | PO | PO | PO | PO | PO | PO | PO | PO | PO | PO1 | PO1 | PO1 | PSO | PSO | PSO | PSO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | | | | | | | 1 | | 2 | 2 | | | |
| CO2 | 1 | | | | | | | | | 1 | | 2 | 2 | | | |
| CO3 | 1 | | | | | | | | | 1 | | 2 | 2 | | | |
| C04 | 1 | | | | | 1 | | | | 1 | | 2 | 2 | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C05 | 1 | | | | | 1 | | | | 1 | | 2 | 2 | | | |
| C06 | 1 | | | | | 1 | | | | 1 | | 2 | 2 | | | |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1 INTRODUCTION TO CONSTRUCTION MATERIALS:**<br>Bricks: Introduction, types of bricks, quality of good brick, testing of brick, uses of bricks.<br>Stones: Introduction, classification, characteristics, different types of stones.<br>Cement: Chemical composition, physical properties of cement, tests on cement, uses of cement, types of cement.<br>Aggregates: Fine aggregate: River sand and M-sand, Coarse aggregate: natural and recycled aggregate, light weight aggregate.<br>Mortar: Definition, types of mortar and uses of mortar.<br>Steel: Uses of steel, different types of steels, factors affecting physical properties of steel, defects in steels.<br>Wood : Timber, Teakwood and Ply wood |
| **UNIT:2 SMART MATERIALS :**<br>Piezoelectric materials - Introduction, classification, Properties and Applications in construction<br>Smart Materials – Introduction, classification, properties, Applications of Smart Materials in Construction<br>Shape memory alloys, Light weight bricks, Introduction to Special concretes – Fly ash based concrete, Geo-polymer concrete, fiber reinforced concrete and Self compacting concrete. |
| **UNIT:3 BRICK MASONRY AND STONE MASONRY:**<br>Brick masonry: Introduction, Definition of terms used in Masonry, materials used, types of bonds, joints in brick work, maintenance of brick work.<br>Stone masonry: Introduction, Definition of terms used in Masonry, cutting and dressing of stones, types of stone masonry (rubber and ashlar), joints of stones, maintenance of stone works. |
| **UNIT:4 FLOORING, PLASTERING AND FINISHING :**<br>Flooring: Types of flooring and their construction- brick, stone, concrete, tile flooring.<br>Plastering: Definition, material used for plastering, types of plastering, and methods of plastering, defects of remedial measures in plastering. Introduction to Pointing and Painting. |

**Text Books:**

1. Engineering Materials by Rangawala P.C. Charter Publishing House, Anand, India.
2. Engineering Materials, by Sushil Kumar, Standard Publication and Distributors, New Delhi.
3. Building Materials, by P.G. Varghese, Prentice-Hall of India Pvt. Ltd., Publication.
4. Reference Books:
5. Concrete technology – Theory and practice, M.S. Shetty, S. Chand and Co, New Delhi, 2002.
6. Advances in Building Materials and Construction by Mohan Rai and M.P. Jain Singh – publication by CBRI, Roorkee.
7. Material Testing Laboratory Manual by C B Kukreja and Ravi Chawla, Standard Publishers Distributors, New Delhi.

**Journals/Magazines**

1. Construction and Building Material, Elsevier

**SWAYAM/NPTEL/MOOCs:**
http://nptel.ac.in/courses/105/102/105102088

**Problem Based Learning**

| No | Problem |
|---|---|
| 1. | - |

Project Based Learning

To enhance the skill set in the integrated course, the students are advised to execute course-based design projects. Some sample projects are given below:

| **No.** | **Suggested Projects** |
|---|---|
| 1. | Field visit to manufacturing industries of bricks, cement, steel |
| 2. | To observe various on-going construction works |

**Indian Traditions and Culture**

**Course objectives:**

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:**

1. On completion of the course students will be able to:
2. Gain conceptual understanding of Indian culture and traditions.
3. Describe various ancient theories in treatment of any disease.
4. Appreciate the science and technological advancements in ancient India.
5. Comprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana.
6. Demonstrate the theory behind celebrating Hindu festivals and concept of making varieties of food
7. Understand India as a land united by cultural diversity.

**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, Indian Cultural Renaissance of the 19th Century

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, puppetry

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**

**i.** Development of Science in Ancient India- Astronomy, Mathematics, Medicine, Metallurgy.
**ii.** 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
**iii.** Science and Scientists in Medieval India- Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture.
**iv**. 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**

I. Hindu Spirituality based on shruti and smriti- Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.
ii. 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
iii. Buddhist, Jaina Spiritualities- Main Doctrines of Buddhism: Four Noble Truths (Arya Satya), Concept of Nirvana - Ashtanga Marga

**Unit IV: 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 – Festival Types: 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.
2. Griffiths Bede, Yoga and the Jesus Prayer Tradition, Asian Trading Corporation, Bangalore, 1992
3. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998
4. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.
5. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018

## SEMESTER VI

## COURSE PACK FOR: ADVANCED GEOTECHNICAL ENGINEERING

| **Course Title** | **Advanced Geotechnical Engineering** | | | | **Course Type** | | **Theory** | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **B20ED0601** | **Credits** | **3** | | **Class** | | **VI semester** | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 0 | 0 | 0 | Theory | Practical | CIE | SEE |
| | Tutorial | 0 | 0 | 0 | | | | |
| | Total | 3 | 3 | 3 | 42 | 0 | 50% | 50% |

**Course Overview**

This course introduces the students to learn application of basic Geotechnical engineering concepts in practice, that requires both judgment and experience to arrive at a satisfactory solution. Unlike steel or concrete for instance, soil is quite different. The ground below us ultimately supports all structures and to be successful, the ground must not fail under the applied structural load.

**Course Objective**

**This course enables graduating students**

1. To understand the different methods of soil exploration methods and dewatering techniques.
2. To understand earth pressures on foundations and retaining structures.
3. To understand the analysis of soil slope stability.
4. To understand vertical stress distribution in soils.
5. To understand the uses of different types foundations.
6. To understand bearing capacity and settlement in different soils.

### COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | Pos | PSOs |
|---|---|---|---|
| CO1 | Prepare a detailed site investigation report based on geotechnical data. | 1,2,4 | 1,2,3 |
| CO2 | Analyze the earth pressure on retaining structures. | 1,2,3 | 1,2,3 |
| CO3 | Evaluate the stability of slopes based on different methods of analyses | 1,2,3 | 1,2,3 |
| CO4 | Analyze the vertical stresses in soils for various loads. | 1,2,3,6 | 1,2,3 |
| CO5 | Assess the bearing capacity of soils and foundation settlements. | 1,2,3,6,7 | 1,2,3 |
| CO6 | Select type of foundation required for the soil at work place | 1,2,3,6,7 | 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 | | ✓ | ✓ | ✓ | ✓ | |
| C05 | | ✓ | ✓ | ✓ | ✓ | |
| C06 | | ✓ | ✓ | ✓ | ✓ | |

## Course Articulation Matrix Note: 1-Low, 2-Medium, 3- High

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 3 | 2 | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |
| CO2 | 3 | 2 | 1 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |
| CO3 | 3 | 2 | 1 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 1 |
| C05 | 3 | 2 | 3 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |
| C06 | 3 | 2 | 3 | 3 | | 2 | 1 | | | 2 | | | 3 | 3 | 3 | 2 |

## Course Content Theory

| Contents |
|---|
| **Unit.1 : Subsurface Exploration, Drainage and Dewatering:**<br>Importance of exploration program, Methods of exploration: Boring, Seismic refraction method of geophysical exploration, Types of samples - undisturbed, disturbed and representative samples, Samplers, sample disturbance, area ratio, Recovery ratio, clearance, Stabilization of boreholes - Typical bore log. Number and depth of borings for various civil engineering structures, soil exploration report – a case study.<br>Determination of ground water level by Hvorselev's method, Control of ground water during excavation: Dewatering - Ditches and sumps, well point system, Vacuum method, Electro- Osmosis method. |
| **Unit-2- Lateral Earth Pressure and Stability of Earth Slopes :**<br>Active and Passive earth pressures, Earth pressure at rest. Rankine's and Coulomb's Earth pressure theories-– Graphical solutions for active earth pressure (cohesion less soil only) – Culmann's and Rebhann's methods, Lateral earth pressure in cohesive and cohesion less soils.<br>Types of slopes, causes and type of failure of slopes. Definition of factor of safety, Stability of infinite slopes, Stability of finite slopes by Method of slices and Friction Circle method, Taylor's stability number, Fellineous method. |

| |
|---|
| **Unit-3 - Stresses in Soils and Bearing Capacity of Shallow Foundation:**<br>Boussinesq's and Westergaard's theories for concentrated, circular and rectangular loads. Comparison of Boussinesq's and westergaard's analysis. Pressure distribution diagrams, Contact pressure, Newmark's chart.<br>Introduction – Bearing capacity- definition – types of shear failure – Bearing capacity of shallow foundation on homogeneous deposits - Methods: Terzaghi's , Skempton's and BIS methods – Effect of water table on bearing capacity – Plate load test – Bearing capacity from in-situ tests - SPT, SCPT and plate load test –Types of foundation – contact pressure distribution below isolated footing |
| **Unit-4- Foundation Settlement, Proportioning Shallow and Pile Foundations:**<br>Importance and Concept of Settlement Analysis, Immediate, Consolidation and Secondary settlements (no derivations, but computation using relevant formula for Normally Consolidated soils), Tolerance. BIS specifications for total and differential settlements of footings and rafts.<br>Allowable Bearing Pressure, Factors influencing the selection of depth of foundation, Factors influencing Allowable Bearing Pressure, Factors influencing the choice of foundation, Proportioning isolated, combined, strip and mat foundations, Classification of pile foundation, Pile load capacity, Proportioning pile foundation |

**Text Book:**


1. Alam Singh and Chowdhary G.R. , Soil Engineering in Theory and Practice, CBS Publishers and Distributors Ltd., New Delhi, 1994
2. Punmia B.C. , Soil Mechanics and Foundation Engg., 16th Edition Laxmi Publications Co., New Delhi, 2005
3. Bowles .J.E, "Foundation analysis and design", McGraw Hill, 2001.
4. Murthy .V.N.S, "Textbook of Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors, New Delhi, 2009.
5. Gopal Ranjan and Rao A.S.R. , Basic and Applied Soil Mechanics, New Age International (P) Ltd., New Delhi, 2000


**Reference Books:**

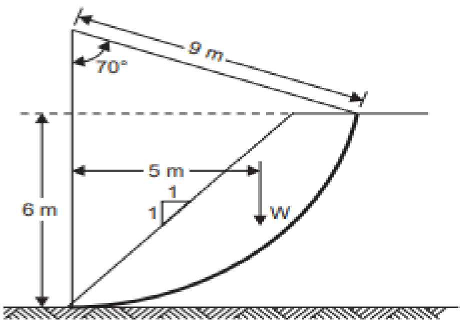

1. Venkatrahmaiah C. , Geotechnical Engineering, 3rd Edition New Age International (P) Ltd., New Delhi, 2006
2. Craig R.F , Soil Mechanics, Van Nostrand Reinhold Co. Ltd., 1987
3. Braja M. Das , Principles of Geotechnical Engineering, 5th Edition, Thomson Business Information India (P) Ltd., India., 2002
4. Iqbal H. Khan , Text Book of Geotechnical Engineering, Edition, PHI, India, 2005


**Magazines: Civil Engineering and Construction Review**

**SWAYAM/NPTEL/MOOCs:**

1. NPTEL :: Civil Engineering - NOC:Geotechnical Engineering II Foundation Engineering (100%)

**PROBLEM BASED LEARNING**

| No | Problems |
|---|---|
| 1 | What are the advantages and disadvantages of accessible exploration? Discuss. Explain (a) Wash boring, (b) Split spoon sampler. Write a brief note on the precautions to be taken in transporting undisturbed samples. |
| 2 | A vane, used to test a deposit of soft alluvial clay, required a torque 72 metrenewtons. The vane dimensions are D = 100 mm, and H = 200 mm. Determine a value for the undrained shear strength of the clay. |
| 3 | A retaining wall, 6 m high, retains dry sand with an angle of friction of 30° and unit weight of 16.2 kN/m3. Determine the earth pressure at rest. If the water table rises to the top of the wall, determine the increase in the thrust on the wall. Assume the submerged unit weight of sand as 10 kN/m3. |
| 4 | Fig. shows the details of an embankment made of cohesive soil with $\phi = 0$ and c = 30 kN/m2. The unit weight of the soil is 18.9 kN/m3. Determine the factor of safety against sliding along the trial circle shown. The weight of the sliding mass is 360 kN acting at an eccentricity of 5.0 m from the centre of rotation. Assume that no tension crack develops. The central angle is 70°<br><br>Trial slip circle  |
| 5 | A concentrated load of 22.5 kN acts on the surface of a homogeneous soil mass of large extent. Find the stress intensity at a depth of 15 meters and (i) directly under the load, and (ii) at a horizontal distance of 7.5 metres. Use Boussinesq's equations. |
| 6 | A strip footing, 1.5 m wide, rests on the surface of a dry cohesionless soil having $\phi = 20°$ and $\gamma$ = 19 kN/m3. If the water table rises temporarily to the surface due to flooding, calculate the percentage reduction in the ultimate bearing capacity of the soil. Assume $N\gamma = 5.0$ |
| 7 | A reinforced concrete foundation, of dimensions 18 m × 36 m, exerts a uniform pressure of 180 kN/m2 on a soil mass, with E-value 45 MN/m2. Determine the value of immediate settlement under the foundation. |
| 8 | A raft, 9 m × 27 m, is founded at a depth of 3 m in sand with a value of N = 25 upto great depth. Determine the total load which the raft can support. If the raft is designed as a floating foundation, what will be the load it can support ? |

**Project Based Learning – Integrated Course**

To Enhance the Skill Set in The Integrated Course, The Students Are Advised to Execute Course-Based

**Design Projects. Some Sample Projects Are Given Below:**

| No. | Suggested Projects |
|---|---|
| 1. | Preparation of a bore-log for proposed construction site |
| 2. | Determination of settlements in shallow foundation. |

**COURSE PACK FOR: DESIGN OF PRE-STRESSED AND PREFABRICATED STRUCTURES**.

<table>
<tr><td>Course Title</td><td colspan="3">DESIGN OF PRE-STRESSED AND PREFABRICATED STRUCTURES</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0602</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment inWeightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>4</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>4</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview:**

Pre-stressed concrete is used extensively in bridges, multistory buildings and many other important parts of today's modern infrastructure. The inherent weakness of concrete in tension is offset by introducing a pre-compression in a pre-stressed member, which improves its service load behavior, such as reduced deflections and cracking, therefore the Design of Pre-stressed Concrete Structures will introduce you to concepts of pre-stressed concrete, dealing with Materials, Principles Of Pre-stressing, Analysis Of Sections For Flexure, Losses Of Pre-Stress, Limit State Of Collapse (In Flexure And Shear), Design Of End Blocks And Beam. Also Prefabricated Structures dealing with Materials, Principles of Prefabricated Structures.

**Course Objective**

**This course enables graduating students to learn:**

1. To understand the working principles of Pre-stressing.
2. To understand the different losses and deflections in Pre-stressing members.
3. To Analyse the Ultimate Flexural Strength and Shear capacity of PSC Members
4. To understand the failure pattern and Design suitable end Block
5. TO designs of PSC beam.

6. Identify the Requirements and Applications of materials used in prefabricated structures.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Familiar with the concepts, Principles and Methods of Pre-stressing and Materials. | 2,3,5 | 1 |
| CO2 | To Analysis for Stress developed after Pre-stressing in PSC Sections. | 2,4,8,910,12 | 1,2,4 |
| CO3 | Compute the losses in pre-stressed concrete beams at transfer and working condition and to compute the short-term and long-term deflections of Prestressed concrete beams | 2,4,8,910,12 | 1,2,4 |
| C04 | Compute the Ultimate flexural strength and shear strength of PSC beam sections | 1,2,3,4,5,6,7, 8,10,12 | 1,2,3,4 |
| C05 | Design of PSC beams with the provisions of Relevant IS Code. | 1,2,3,4,5,6,7, 8,10,12 | 1,2,3, 4 |
| C06 | Identify the suitable Pre-fabricated Elements Required for Pre-fabricated Structures. | 1,2,3,4,5,6,7, 8,10,12 | 1,2,3,4 |

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

| CO#/ POs | PO | PO | PO | PO | PO | PO | PO | PO | PO | PO | PO | PO | PS | PS | PSO | PSO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | 3 | 2 | | 2 | | | | | | | | 3 | | |
| CO2 | 3 | 3 | | | 3 | | | | 2 | 2 | 2 | | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | | | 2 | | 2 | 2 | | 2 | | 2 | 2 | 3 |
| C04 | 3 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C05 | 3 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 |
| C06 | 2 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 |

**Course Content Theory**

| **Contents** |
|---|
| **UNIT: 1 – Introduction to Pre-stress concrete :**<br>Materials: Stress-Strain Characteristics And Properties, Non-Cementitious Materials. High Strength Concrete And Steel, Necessity Of High Strength Concrete And Steel,<br>Basic Principles of Pre-Stressing: Pre-Tensioning And Post-Tensioning Systems, Tensioning Methods And End Anchorages. Fundamentals, Load Balancing Concept, Pressure Line, Stress Concept, Centre Of Thrust With Examples.<br>Analysis Of Sections For Flexure: Stresses In Concrete Due To Pre-Stress And Loads, Stresses In Steel Due To Loads, Cable Profiles, Numerical. |
| **UNIT: 2- Limit State of Serviceability:**<br>Various losses encountered in Pre-tensioning and Post-tensioning Methods with Numerical.<br>Deflection of pre-stressed members, Short term and long term deflections, deflections at transfer and working load conditions with different cable profiles. Deflection limits as per IS 1343-2012. Load versus deflection curve, Methods of reducing deflections and methods for control of cracking. |
| **UNIT: 3 – Limit State of Collapse :**<br>Types of Failures in beams due to Flexure and Shear, Codal provisions for Flexure and Shear. Design of beams for Ultimate flexural strength, Shear resistance and shear reinforcement using IS-1343<br>Design of Pre-tensioned and Post-tensioned symmetrical and asymmetrical sections by limit state method. Permissible stresses, Design of pre-stressing force and eccentricity and design of end block as per IS 1343-2012 with numerical. |
| **UNIT:4 – Prefabricated structures** : General Civil Engineering Requirements, specific requirements for planning and layout of prefabrication plant. IS Codal specifications. Modular co-ordination, standardization, Disuniting of Prefabricates, production, Transportation, Erection, Stages of Loading and Code Provisions, safety factors, Material Properties. Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, -Connections – Beam to column and column to column. |

**Text book/s:**


1. Pre-stressed Concrete- N. Krishna Raju - Tata Mc. Graw Publishers
2. Design of pre-stressed concrete structures- T.Y. Lin and Ned H. Burns - John Wiley & Sons, New York.
3. Fundamental of pre-stressed concrete- N.C. Sinha & S.K. Roy
4. References
5. Warner, RF & Faulkes, KA 1988, Pre-stressed concrete, 2nd edn, Longman Cheshire, Melbourne.
6. IS : 1343 : Code
7. Rajgopalan, “Prestressed Concrete”, Asia Publishing House, Bombay.
8. IS: 1343-Code for Practice for Prestressed Concrete, BIS India.


**Journals/Magazines**


1. Pre-stressed concrete Structures Journal and Book, Science direct
2. PCI – Precast/ Prestressed concrete Institute, Elsevier


**SWAYAM/NPTEL/MOOCs:**

http://www.nptel.iitm.ac.in

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Project Based Learning Model In The Building Construction And Drawing /PSC Structural Elements |
| 2. | To observe various on-going construction works and Reinforcement details provided for Various PSC Structural Elements |

**COURSE PACK FOR: DESIGN OF STEEL STRUCTURES**

<table>
<tr><td>Course Title</td><td colspan="4">Design of Steel Structures</td><td colspan="2">Course Type</td><td colspan="2">Hardcore</td></tr>
<tr><td>Course Code</td><td>B20ED0603</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">1<br>-</td><td rowspan="2">2<br>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>5</td><td>5</td><td>39</td><td>26</td><td>2</td><td>5</td></tr>
</table>

**Course Overview**

Many civil engineering structures are made up of steel. Knowledge of designing and detailing of steel structures is very important for civil engineers in order to make structures safe and serviceable during its life span. Limit State design philosophy is currently used worldwide for design of steel structures and its various components. Also precise and correct detailing of structural drawing is necessary in order to get the correct behavior of structures and leads to smooth construction of structures. This course will provide detailed knowledge of design and detailing of steel structures as per Indian standards

**Course Objective**

**This course enables graduating students**

Familiarize the steel structures and its basic components, Understand the steel code provisions in the design of simple steel structures

1. Introduce structural steel fasteners like welding and bolting.
2. Design of compression members, built-up columns and columns splices.
3. Design of tension members.
4. Analyze laterally supported and un-supported steel beams
5. Application of plastic theory to beams and designing of roof trusses.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Understand the behavior and properties of structural steel members to resist bending, shear, tension and compression and apply the relevant codes of practice. | 1,2 | 1,2 |
| CO2 | Able to Design the Bolted connections and welded connections. | 1,2,3 | 1,2,3,4 |
| CO3 | Understand the Concept of Design of compression members, built-up columns and columns splices. | 1,2,3 | 1,2,3,4 |
| C04 | Understand the Concept of Design of tension members. | 1,2,3 | 1,2,3,4 |
| C05 | Understand the Concept of Design of laterally supported and un-supported steel beams | 1,2,3 | 1,2,3,4 |
| C06 | Analyse the beam in plastic state condition and design of plane roof trusses. | 1,2,3 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | | 3 | 2 | | |
| CO2 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | | | | | | | | | | 3 | 3 | 3 | 2 |
| C04 | 3 | 3 | 3 | | | | | | | | | | 3 | 3 | 3 | 2 |
| C05 | 3 | 3 | 3 | | | | | | | | | | 3 | 3 | 3 | 2 |
| C06 | 3 | 3 | 3 | | | | | | | | | | 3 | 3 | 3 | 2 |

## Course Content Theory

| Contents |
|---|
| **UNIT: 1 Introduction to Steel structures and bolted connections**<br>Advantages and Disadvantages of Steel Structures, Limit state method of design, IS—800:2007 code provisions, Specification and Section classification.<br>Bolted Connections: Introduction, Types of Bolts, Behaviour of bolted joints, Design of High Strength friction Grip (HSFG) bolts, Design of Simple bolted Connections (Lap and Butt joints), Beam to Beam connections, Moment-resistant connections , Beam to column flange connections. |
| **UNIT: 2 Welded Connections and Compression Members:**<br>Welding process, Types of Welds, Types of joints, Design of welds, Beam to Beam connections, Moment resistant connections-Beam to column flange connections.<br>Sections used for compression members, Effective length of compression members, Design of simple and built up compression members, Design of Laced and Battened Systems. |
| **UNIT: 3 Design of Tension Members and Beams:**<br>Introduction, Types of tension members, Design of tension member, Splices and Gussets (theory).<br>Design of Beams: Introduction, Beam types, Lateral stability of beams, Design strength of laterally supported beams in Bending, Design of laterally supported and unsupported beams. |
| **UNIT: 4 Plastic analysis and Design of plane roof truss :**<br>Plastic theory, Plastic hinge concept, Plastic collapse load, Shape factor, conditions of plastic analysis, upper bound, lower bound and uniqueness theorems, Methods of Plastic analysis, Plastic analysis of statically indeterminate beams including continuous beams. |

**PRACTICE:**

| No | Title of the Experiment | Tools and Techniques | Expected Skill /Ability |
|---|---|---|---|
| 1. | Introduction to STAAD.Pro – Creation of nodes, model generation, stages of analysis, result generation. | STAAD.Pro | Hands on training |
| 2 | Plane trusses – determination of member forces & deflections | STAAD.Pro | Hands on training |
| 3. | Space trusses – determination of member forces & deflections, including design of space trusses | STAAD.Pro | Hands on training |
| 4. | Transmission towers – modelling, analysis and design | STAAD.Pro | Hands on training |
| 5. | Building – modelling, analysis and design (not more than two storey) | STAAD.Pro | Hands on training |


Text Book:

1. N Subramanian., "Design of Steel Structures" (2016), Oxford University Press, New Delhi.
2. Duggal S K., "Limit State Method of Design of Steel Structures", Tata McGraw Hill, New Delhi.
3. Theory of Structures, Pandit and Gupta, Vol. – I, Tata McGraw Hill, New Delhi.

Reference Books

1. Dayarathnam P, "Design of Steel Structures", S Chand and Company Ltd., New Delhi.
2. Kazim S M A and Jindal R S, "Design of Steel Structures", Prentice Hall of India, New Delhi.
3. IS 800-2007: General Construction in Steel Code Practice (Third revision), Bureau of Indian Standards, and New Delhi.

**Journals/Magazines**

1. Steel Construction - Wiley Online Library
2. Journal of Constructional Steel Research - Elsevier

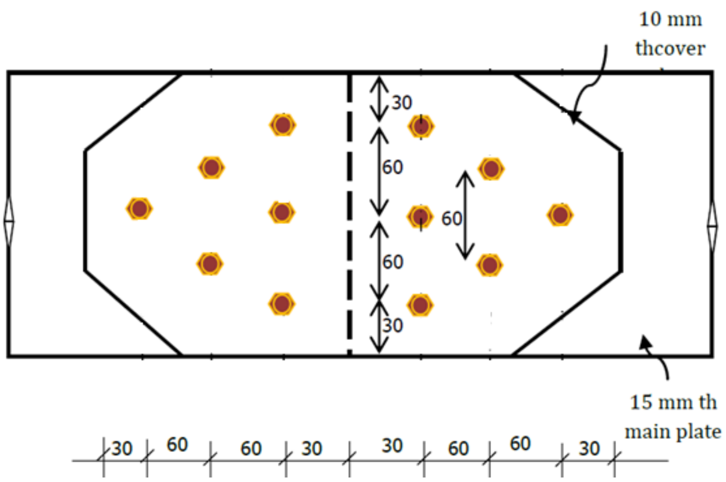
3. Journal of Steel Structures & Construction, Watermael-Boitsfort, Brussels, Belgium

**SWAYAM/NPTEL/MOOCs:**

https://nptel.ac.in/courses/105/105/105105162/

https://onlinecourses.nptel.ac.in/noc19_ce25/preview

**Problem Based Learning**

<table>
<tr><td>No</td><td>Problem</td></tr>
<tr><td>1</td><td>A single bolted double cover butt joint of plates 16 mm thick is made with 3 number of 22 mm diameter of bolts at a gauge of 100 mm. Find the safe load of the joint. Also, determine the efficiency of the joint. Take thickness of cover plate is 12 mm and edge distance is equal to 45 mm.</td></tr>
<tr><td>2</td><td>Find the maximum load which can be transferred through the double cover butt joint shown in figure. Find the efficiency of the joint. Use 20 mm diameter common bolts.<br><br></td></tr>
<tr><td>3</td><td>Design a built- up column with 2 channel sections back to back to carry an axial factored load of 1300 KN. The height of the column is 7 m and effectively held in position at both ends, but not restrained against rotation. Design single lacing system with 16 mm diameter bolt of 4.6 grade and Fe 410 plate.</td></tr>
<tr><td>4</td><td>A cantilever beam is supports a load of 30 kN/m. The length of beam is 5 m. Design a suitable section with necessary checks. Assume stiff bearing length of 100mm.</td></tr>
</table>

## COURSE PACK FOR: Financial and Construction Management

<table>
<tr><td>Course Title</td><td colspan="3">Financial and Construction Management</td><td>Course Type</td><td colspan="2">Soft Core</td></tr>
<tr><td>Course Code</td><td>B20ED0604</td><td>Credits</td><td colspan="2">3</td><td>Class</td><td colspan="2">VI semester</td></tr>
<tr><td rowspan="4">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Workload</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
</table>

| | Total | 3 | 3 | 3 | 4<br>8 | - | 50<br>% | 50<br>% |
|---|---|---|---|---|---|---|---|---|

**Course Overview:**
Financial management is the use of a company's financial resources. Construction companies are different from most other companies and are faced with many unique challenges and problems not faced by companies in other industries. Although the construction industry is producing a product—as do manufacturing plants—the construction of buildings, roads, and other structures is different from the manufacturing of most other products. Because of these unique characteristics, the financial management principles applied to other product-producing industries often need to be modified before they are applied to the construction industry, otherwise they are useless.

**Course Objective:**

**This course enables graduating students to**

1. Understand financial management and supply-demand mechanism.
2. Understand the broad financial responsibilities of the project manager.
3. Apply Production and cost theory analysis and pricing.
4. Perform Time value for money and discounted cash flow analysis.
5. Understand accounting information and application in construction industry.
6. Recognize the importance of cash flow

**COURSE OUTCOMES (Cos):**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Understand financial management and supply-demand mechanism. | 1,7,8,10,12 | 2 |
| CO2 | Understand the broad financial responsibilities of the project manager. | 1,5,6,7,12 | 3,2 |
| CO3 | Apply Production and cost theory analysis and pricing. | 2,4,4,4,7,8,9 | 3 |
| C04 | Perform Time value for money and discounted cash flow analysis. | 2,3,4,5,6,7,10,11,12 | 1,4 |
| C05 | Understand accounting information and application in construction industry. | 2,3,4,5,6,7,8,9,11, | 3,4 |
| C06 | Recognize the importance of cash flow. | 2,3,4,5,6,7,9, | 3,4 |

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

| CO#/ POs | P | P | P | P | P | P | P | P | P | PO | PO | PO | PS | PS | PSO | PSO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | 1 | 3 | 2 | | 2 | | 2 | 2 | | | 1 |
| CO2 | 2 | 1 | | | 3 | 3 | 3 | | 1 | | | 2 | 3 | 2 | | |
| CO3 | | 3 | | 2 | 2 | 2 | 3 | 3 | 2 | | 1 | 3 | | 1 | 3 | |
| C04 | | 2 | 3 | 2 | 2 | 2 | 3 | | 1 | 3 | 3 | 2 | 2 | | 1 | 3 |
| CO5 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | | 3 | 1 | 1 | | 3 | 2 |
| CO6 | | 2 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | | | 1 | 3 | 2 |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1 Introduction to Financial Management:**<br>Meaning and Scope, Economics and Scope, Supply and Demand Mechanism, analysis and forecasting. Balance sheet, profit & loss account, fund flow statement |
| **UNIT:2 Production and Cost theory:**<br>Introduction- analysis. Pricing; objectives, determinants, absorption, marginal costing. Financial analysis, Decisions. Capital Budgeting, budgetary control, standard costing and variance, investment appraisal Practical problems and case studies |
| **UNIT:3 Engineering economics:**<br>Introduction- Time value of money, discounted cash flow, NPV, ROR, Bases of comparison, Incremental analysis, Benefit-Cost analysis, Replacement analysis, Breakeven analysis, Capital budgeting, Taxation, and Inflation, Working capital management, Construction. Accounting, Income statement, Financial statements.. |
| **UNIT:4 Construction Finance:**<br>Introduction- Accounting information and application, Financial versus economic evaluation, financial statements, and project appraisal. Project yield, taxation and inflation, risk and uncertainty, Turnkey activities; finance and working capital, depreciation, and amortization; cost control, performance budgeting, equipment rentals. Bidding and awards, work pricing, cost elements of contracts, letters of credit, financing plans, multiple sources of finance. Qualifying, bidding, bidders, comparing the bids, under-writing. unforeseen revisions, costs and rates escalation, cost progress reporting. Legal aspects |

**Textbook:**


1. Blank, L. T. and Tarquin,A. J.,"Engineering Economy", Fourth Edition, WCB/McGraw-Hill, 1998.
2. Bose, D. C.,"Fundamentals of Financial management", 2nd ed.,PHI, New Delhi, 2010.
3. Boyer, C.B. and Merzbach, U. C.,"A History of Mathematics", 2nd ed., John Wiley & Sons, New York, 1989.
4. Gould, F.E.,"Managing the Construction Process", 2nd ed.,Prentice Hall, Upper Saddle River, New Jersey, 2002.


Reference Books

1. Gransberg, D. G.,Popescu, C. M. and Ryan, R. C.,“Construction Equipment Management for Engineers,Estimators, and Owners, CRC/Taylor & Francis,Boca Raton, 2006.
2. Harris, F. , McCaffer, R. and Edum-Fotwe, F.,“Modern Construction Management”, 6th ed.,Blackwell Publishing, 2006.
3. Jha,K. N.,“Construction Project Management, Theory and Practice”,Pearson, New Delhi, 2011.

**Journals/Magazines**

International Journal of Construction Management - https://www.tandfonline.com/toc/tjcm20/current

Journal of Construction Engineering & Management- https://ascelibrary.org/journal/jcemd4

**SWAYAM/NPTEL/MOOCs:**

Construction Economics & Finance by Dr. Bulu Pradhan IIT Guwahati

NPTEL Course: https://nptel.ac.in/courses/105/103/105103023/

Construction Planning and Management buy Prof. Arbind Kumar Singh IIT Guwahati

NPTEL : https://nptel.ac.in/courses/105/103/105103093/

## COURSE PACK FOR: Construction Engineering and Management

<table>
<tr><td>Course Title</td><td colspan="4">Construction Engineering and Management</td><td colspan="2">Course Type</td><td colspan="2">Soft Core</td></tr>
<tr><td>Course Code</td><td>B20EDS606</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Workload</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

Construction Engineering and management (CE& M) is a professional discipline that deals with the designing, planning, construction, and management of infrastructures such as roads, tunnels, bridges, airports, railroads, facilities, buildings, dams, utilities, and other projects. The purpose of Construction management is to control a project's time / delivery, cost and quality—sometimes referred to as a project management triangle or "triple constraints. CE& M is compatible with all project delivery systems, including design-bid-build, design-build, Risk and Public Private Partnerships. Professional construction managers may be reserved for lengthy, large-scale, high budget undertakings (commercial real estate, transportation infrastructure, industrial facilities, and military infrastructure), called capital project.

**Course Objective:**

**This course enables graduating students to**

1. Understand the various management techniques for successful completion of construction projects.
2. Understand to prepare the project feasibility report economic analysis.
3. Construct Networks in construction projects
4. Understand the effect of management for project organization.
5. Perform Precedence Network Analysis
6. Perform Time cost analysis, scheduling, and monitoring of construction projects

## COURSE OUTCOMES (Cos):

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Apply the management techniques for the successful completion of the project | 1,7,8,10,12 | 2 |
| CO2 | Prepare the project feasibility report and analyse the economics of the project | 1,5,6,7,12 | 3,2 |

| | | | |
|---|---|---|---|
| CO3 | Implement project organization charts such as bar chart, CPM and PERT | 2,4,4,4,7,8,9 | 3 |
| C04 | To provide time cost management, scheduling, and implementation | 2,3,4,5,6,7,10, 11,12 | 1,4 |
| C05 | Perform Precedence Network Analysis | 2,3,4,5,6,7,8,9, 11, | 3,4 |
| C06 | Perform Time cost analysis, scheduling, and monitoring of construction projects. | 2,3,4,5,6,7,9, | 3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | 1 | 3 | 2 | | 2 | | 2 | 2 | | | 1 |
| CO2 | 2 | 1 | | | 3 | 3 | 3 | | 1 | | | 2 | 3 | 2 | | |
| CO3 | | 3 | | 2 | 2 | 2 | 3 | 3 | 2 | | 1 | 3 | | 1 | 3 | |
| C04 | | 2 | 3 | 2 | 2 | 2 | 3 | | 1 | 3 | 3 | 2 | 2 | | 1 | 3 |
| CO5 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | | 3 | 1 | 1 | | 3 | 2 |
| CO6 | | 2 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | | | 1 | 3 | 2 |

## Course Content Theory

| Contents |
|---|
| **UNIT:1 Construction Engineering & Planning for Construction Projects:**<br>Introduction to Planning- Steps Involved in Planning- Objectives of Planning- Principles of Planning- Advantages of Planning- Limitations of Planning- Stages of Planning -Types of Planning. Construction Networks- Types of Network- Rules for Drawing the Network- Fulkerson’s Rule for Numbering the Events. Project Feasibility Reports: Introduction- Technical Analysis- Financial Analysis-Economic Analysis-Ecological Analysis-Feasibility Study. |
| **UNIT:2 Construction Management Through Networks:** |

| |
|---|
| Introduction – Programme Evaluation and Review Technique (PERT)- Introduction- Time Estimates- Slack- Critical Path- Probability of Completion Time for A Project. Critical Path Method: Introduction – Difference Between PERT & CPM - Earliest Event Time- Latest Event Time- Float- Criticality and Critical Activity. Related Network Problems. |
| **UNIT:3 Precedence Network Analysis:**<br>Introduction- Representation of Nodes in A-O-N Networks- Logic of precedence Diagram- Forward pass and Backward pass Calculations- Advantages of Precedence Networks. |
| **UNIT:4 Time – Cost Analysis :**<br>Introduction- Direct Cost- Indirect Cost- Total Project Cost-Optimization of Cost Through Network Contraction- Network Crashing Problems. Resource Allocation: Introduction- Resource Smoothing- Resource Levelling. |

**Textbook:**


1. S Seetharaman "Construction Engineering and Management"- Umesh Publisher: Delhi- 2000.
2. Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 1998.
3. Choudhury. S, "Project Management", McGraw-Hill Publishing Company, New Delhi, 1988.
4. Chris Hendrickson and Tung Au, "Project Management for Construction Fundamental Concepts for Owners, Engineers, Architects and Builders" Prentice Hall, Pittsburgh, 2000.


**Reference Books**


1. Jha K.N., Construction Project Management- Theory and practice, 2nd Edition, Pearson India Education Services Pvt. Ltd., UP, India 2015.
2. Kerzner H., Project Management- A systems approach to planning, scheduling and controlling, 10th edition, John Wiley & Sons, Inc., New Jersey, USA, 2009.
3. Chitkara K.K., Construction Project Management – Planning, Scheduling and Controlling, TMH Publishing Company Ltd., 9th Edition, New Delhi, India, 2005.
4. Crundwell F.K., Finance for Engineers-Evaluation and Funding of Capital Projects, Springer, London, UK, 2008. (ISBN 978-1-84800-032-2).
5. Theusen G.J., Fabrycky W.J., Engineering Economy, 9th Edition, Prentice-Hall, Inc., New Delhi, India, 2001.
6. Srinath L.S., PERT and CPM – Principles and Applications, 3rd Edition, East West publishers, New Delhi, India, 1989.


**Journals/Magazines**

International Journal of Construction Management -
https://www.tandfonline.com/toc/tjcm20/current
Journal of Construction Engineering & Management- https://ascelibrary.org/journal/jcemd4

**SWAYAM/NPTEL/MOOCs:**

Principles of Construction Management by Prof. Sudhir Misra IIT Kanpur
Swayam Course: https://onlinecourses.nptel.ac.in/noc21_ce20/
Construction Planning and Management buy Prof. Arbind Kumar Singh IIT Guwahati
NPTEL : https://nptel.ac.in/courses/105/103/105103093/

## COURSE PACK FOR: DISASTER PREPAREDNESS, PLANNING AND MANAGEMENT(B20EDS607)

<table>
<tr><td>Course Title</td><td colspan="4">Disaster Preparedness, Planning and Management</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ED0703</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</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>Tutorial</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

**Course Prerequisite: Environmental Engineering**

**Course Objective**

**This course enables graduating students**

1. To create awareness on various natural and man-made disasters occurrence.
2. To learn vulnerability assessment for various disasters.
3. To learn preparedness for various disasters
4. To learn about the various measures of disaster mitigation and disaster management.
5. To learn the importance of public awareness and rehabilitation.
6. To learn the application of remote sensing, information system and decision-making tools for disaster management.

**COURSE OUTCOMES (CO's)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Learn the usefulness of integrating management principles in disaster mitigation work and awareness of various disasters. | 1,6,7,8,9,10,11,12, | 1,2,3,4 |
| CO2 | Study distinction between the different approaches needed to manage pre, during& post disaster periods and examine the vulnerability, preparedness of disasters. | 1,2,3,4,6,7,8,9,11,12 | 1,2,3,4 |
| CO3 | Learn the preparation of for various disasters | 1,2,3,4,6,7,8,9,11,12 | 1,2,3,4 |
| CO4 | Learn the strategies of disaster management and explain the various mitigation measures | 1,3,4,5,7,8,9,11,12 | 1,2,3,4 |
| C05 | Learn the various safety programme, rehabilitation programme and general awareness on disasters | 1,2,3,4,5,8,9,10,12 | 1,2,3,4 |

| | | | |
|---|---|---|---|
| CO6 | Study space technology and understand decision tools of disaster management. | 1,2,3,4,5,8,9,10,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 3 | 2 | 1 | 2 |
| CO2 | 2 | 2 | 2 | 1 | | 2 | 3 | 1 | 3 | | 2 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 2 | 2 | 2 | 1 | | 2 | 3 | 1 | 3 | | 2 | 3 | 3 | 2 | 3 | 2 |
| C04 | 2 | | 3 | 2 | 3 | | 3 | 1 | 3 | | 1 | 3 | 3 | 2 | 2 | 2 |
| CO5 | 2 | 2 | 3 | 1 | 2 | | | 3 | 3 | 2 | | 3 | 3 | 2 | 1 | 2 |
| C06 | 2 | 2 | 3 | 1 | 2 | | | 3 | 3 | 2 | | 3 | 3 | 2 | 1 | 2 |

## Course Content Theory

| **Contents** |
|---|
| **UNIT:1 Introduction to Disasters:** Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters; Principles of Disaster Management; Types of Disasters- floods, Landslides, earthquakes, Tsunamis, and Drought- Classification, causes, impacts including social, economic, environmental, psychological; Significance of earth processes in natural disasters, Hazards, Risks and Vulnerabilities; Human induced disasters; Global trends in disaster- pandemics, Climate change- case studies. |
| **UNIT:2 Vulnerability Assessment and Preparedness:** Definition: Vulnerability; Assessment of Disaster Vulnerability of a location and vulnerable groups; Vulnerability assessment for floods, earthquakes, tsunamis, landslides.<br>Preparation of Disaster Management Plans- Roles and responsibilities of community, Panchayat Raj Institutions/Urban local Bodies (PRIs/ULBs); Framework at State and Central Level-State Disaster Management Authority (SDMA)- Early warning system-Advisories from Appropriate Agencies for Earthquake, Landslide, Flood, Drought |

| |
|---|
| **UNIT:3 Mitigation Measures and Disaster Management:** Disaster mitigation planning of human settlements and townships for earthquakes, floods/Flash floods, Fire, tsunamis, Landslides, drought; Issues in Environmental Health, Water, Food & Sanitation, Post disaster Relief & Logistics Management; Basic principles of disaster Management, Emergency Support Functions, Resource & Material Management, Management of Relief Camp, Information systems & decision-making tools, Voluntary Agencies & Community Participation at various stages of disaster management. |
| **UNIT:4 Rehabilitation and Awareness:** School Awareness & Safety Programme; Integration of Rural Development Programs with disaster reduction and mitigation activities; Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment; Role of Remote Sensing, Science & Technology Information systems and decision-making tools in disaster management, Rehabilitation programme; New initiatives, Disaster management in India. |

**Text Book:**


1. R.B.Singh, Environmental Geography, Heritage Publishers New Delhi,1990
2. Savinder Singh Environmental Geography, PrayagPustakBhawan, 1997
3. Kates,B.I& White, G.F The Environment as Hazards, oxford, New York, 1978
4. R.B. Singh, Disaster Management, Rawat Publication, New Delhi, 2000
5. H.K. Gupta, Disaster Management, Universiters Press, India, 2003
6. R.B. Singh, Space Technology for Disaster Mitigation in India (INCED) University of Tokyo, 1994
7. Dr.Satender , Disaster Management in Hills, Concept Publishing Co., New Delhi, 2003
8. A.S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994
9. R.K. Bhandani An overview on Natural & Manmade Disaster & their Reduction, CSIR, New Delhi
10. M.C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster
11. Abbott, P.L, Natural Disasters. 3rd Ed., McGraw Hill Company, 2001.


**Journals:**

https://www.sciencedirect.com/journal/disaster-management-and-response
https://www.igi-global.com/journal/international-journal-disaster-response-emergency
https://www.journals.elsevier.com/international-journal-of-disaster-risk-reduction
International Journal of Earthquake and Impact Engineering

**SWAYAM/NPTEL/MOOCs:**

https://onlinecourses.swayam2.ac.in/cec19_hs20/preview
https://nptel.ac.in/courses/105/104/105104183/
https://onlinecourses.swayam2.ac.in/ugc19_ar02/preview
https://onlinecourses.swayam2.ac.in/cec20_ge35/preview
https://mooc.es/course/disaster-preparedness
https://www.cssteap.org/documents/MOOC_GeospatialDRR_Brochure.pdf

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based

**Design projects. Some sample projects are given below:**

| No. | Suggested Projects |
|---|---|
| 1. | Assessment of natural disaster and proposals for mitigation measures |
| 2. | Effective ways of School awareness program on preparedness of disasters |
| 3. | Risk assessment & measures to prevent the disaster |
| 4. | Management of Relief camps and logistics. |
| 5 | Remote Sensing and GIS application in disaster management |
| 6 | Application of Space Technology & Decision tools in disaster management |

## COURSE PACK FOR: EARTHQUAKE RESISTANT STRUCTURES

<table>
<tr><td>Course Title</td><td colspan="4">EARTHQUAKE RESISTANT STRUCTURES</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EDS608</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

### Course Overview

Earthquake-resistant structure, building designed to prevent total collapse, preserve life, and minimize damage in case of an earthquake or tremor, If a skyscraper has too flexible a structure, then tremendous swaying in its upper floors can develop during an earthquake

### Course Objective

1. To understand the basics of structural dynamics, Single Degree of freedom systems
2. To know the concept of Multi-Degree of Freedom systems.
3. To impart knowledge on causes and effects of earthquakes.
4. To formulate & analyse structures subjected to earthquakes.
5. To describe the need of ductile detailing & behavior of RCC during earthquake
6. To learn the analysis of masonry structures during earthquakes.
7. This course enables graduating students

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Apply the basics of structural dynamics, Single Degree of freedom systems | 1,2,12 | 1,2,4 |
| CO2 | To gain the concept of Multi-Degree of Freedom systems. | 1,2,12 | 1,2,4 |
| CO3 | To get a knowledge on causes and effects of earthquakes for application | 1,2,3,5, 12 | 1,2,3, 4 |
| C04 | To gain confidence in formulation & analyse structures subjected to earthquakes | 2,4,12 | 1,2,3, 4 |
| CO5 | To design the ductile detailing & behavior of RCC during earthquake | 2,4,12 | 1,2,3, 4 |
| CO6 | To apply the knowledge of analysis of masonry structures during earthquakes. ✓ | 2,4,12 | 1,2,3, 4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO3 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C04 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO5 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO6 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1**<br>**Introduction to Structural Dynamics:** Types of dynamic analysis, types of dynamic forces, important definitions in vibrations, free vibration analysis of undamped and damped SDF systems, free vibration analysis of undamped MDF systems, vibration measuring instruments, concept of response spectrum. |
| **UNIT:2**<br>**Engineering Seismology:** Earthquake phenomenon, causes & effects of earthquakes, plate tectonics, elastic rebound theory, important definitions of earthquake engineering, classification of earthquakes, seismic waves, seismic zones, seismic zone map of India, review of latest Indian seismic code. |
| UNIT:3 Earthquake Analysis: Seismic design requirements, design earthquake loads, load combinations & mathematical modelling, methods of earthquake analysis – seismic coefficient method, response spectrum method and time history method, earthquake design philosophy |
| UNIT:4<br>RCC & Masonry Structures: Codal provisions for ductile detailing of reinforced concrete buildings – beam, column & joints, design of shear walls, behaviour of unreinforced & reinforced masonry structures during earthquakes, , concepts of retrofitting. |

**Text Book:**

1. Anil K Chopra, "Dynamics of Structures", Pearson Education, New Delhi.
2. Pankaj Agarwal & Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall India, New Delhi.
3. Duggal S K, "Earthquake Resistant Design of Structures", Oxford University Press, New Delhi.
4. Mario Paz, "Structural Dynamics", Springer International Publishing.

**Reference Books**

1. Dr. Vinod Hosur, "Earthquake-Resistant Design of Building Structures", Wiley Publication
2. C. V. R. Murthy," Some concepts in Earthquake behaviour of buildings", Gujarat State Disaster Management Authority

**Journals/Magazines**

Journal of Structural Engineering, ASCE, USA
Journal of Structural Engineering, Chennai, India

**SWAYAM/NPTEL/MOOCs:**

https://onlinecourses.nptel.ac.in/noc20_ce52/
https://www.mooc-list.com/tags/earthquake-resistant-structures
https://www.coursera.org/courses?query=structural%20engineering

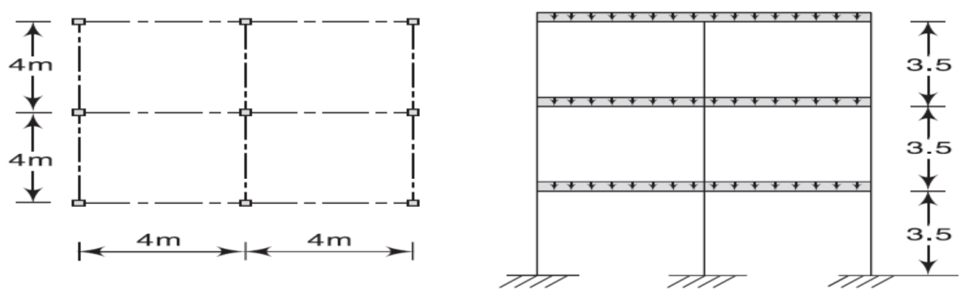
**Problem Based Learning**

| No | Problem |
|---|---|
| 1 | Determine the frequency and design seismic coefficient for an ordinary masonry shear wall in a school building at Allahabad, for the following data.<br>Roof load P = 15 kN/m<br>Height of wall h = 3.0 m<br>Width of wall b = 0.2 m |

| | |
|---|---|
| | Unit weight of wall w = 19.2 kN/m3<br>Soil is medium |

Project Based Learning

To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | The plan and elevation of a three-Storey RCC school building is shown in Figure. The building is located in seismic zone V. The type of soil encountered is medium stiff and it is proposed to design the building with a special moment resisting frame. The intensity of DL is 10 kN/m2 and the floors are to cater to an IL of 3 kN/m2. Determine the design seismic loads on the structure by static analysis.<br><br><br>(a) Plan (b) Elevation<br>The above problem can be given with different spans and height of the structure and loading conditions to different batch of students so that students will get confidence in solving the problems |

## COURSE PACK FOR: GLOBAL WARMING AND CLIMATE CHANGE

| Course Title | GLOBAL WARMING AND CLIMATE CHANGE | | | | Course Type | | Soft Core | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **B20EDS609** | **Credits** | **3** | | **Class** | | **VI semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number ofClasses Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | - | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | **3** | **3** | **3** | **48** | **-** | **50%** | **50%** |

**Course Overview**

India is an agricultural nation and, the challenges of climate change hold much more important to get addressed at the first instance than any other issue. The current policies are not enough to deal with the challenges of global warming
and there is a serious need to revisit the available policies to make them more efficient and in line with international standards. Agriculture in India is practiced widely, as two-thirds of the country's population depends on rain for agriculture besides other allied activities for their livelihood and sustenance. Water resource sectors are burdened with pressure owing to industrialization, urbanization, and climate change impacts and, thus, making it more vulnerable and posing substantial challenges to water resources planners. Climate change is a difficult, contentious, and important issue. It will perhaps be the defining environmental issue of the 21st century. This course aims to address the whole complexity of climate change as an issue, by bringing together the science, impacts, economics, abatement technologies, and policy solutions into one course. Through this course, we will address several important questions.

**Course Objective**

**This course enables graduating students**

1. To learn the basics of Climate, atmosphere structure and importance of greenhouse gases
2. To understand the fundamentals of climate science.
3. To know about extreme weather conditions and understand the Climate projections and it's uncertainties
4. To exposed to fundamentals of climate models and methods of assessing impacts of climate change

## COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Apply their knowledge to illustrate and understand the physical basis of the natural greenhouse effect | 1,7,8,10,12 | 2 |

| | | | |
|---|---|---|---|
| CO2 | Understand the current evidence for global warming and connections between global warming and human activities | 1,5,6,7,12 | 3,2 |
| CO3 | Explain factors forcing climate change, and the extent of anthropogenic influence | 2,4,4,4,7, 8,9 | 3 |
| C04 | Explain and evaluate the evidence for human-caused climate change, in the context of historical climate change, as well as the relevant scientific uncertainties and possible evidence to the contrary. | 2,3,4,5,6, 7,10,11,1 2 | 1,4 |
| C05 | Develop critical thinking and/or observation skills on the factors responsible for climate change and model possible scenarios for assessing future climate change | 2,3,4,5,6, 7,8,9,11, | 3,4 |
| C06 | Evaluate the issue of climate change from the perspective of individual nations and Achieve possible ways to deal with climate change | 2,3,4,5,6, 7,9, | 3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | 1 | 3 | 2 | | 2 | | 2 | 2 | | | 1 |
| CO2 | 2 | 1 | | | 3 | 3 | 3 | | 1 | | | 2 | 3 | 2 | | |
| CO3 | | 3 | | 2 | 2 | 2 | 3 | 3 | 2 | | 1 | 3 | | 1 | 3 | |
| C04 | | 2 | 3 | 2 | 2 | 2 | 3 | | 1 | 3 | 3 | 2 | 2 | | 1 | 3 |
| CO5 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | | 3 | 1 | 1 | | 3 | 2 |
| CO6 | | 2 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | | | 1 | 3 | 2 |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1 Introduction to Paleoclimate**, Greenhouse Gases and Atmosphere. Atmospheric structure and composition.<br>Greenhouse Gases: An Overview, -The Role of Carbon Dioxide and Methane. Human Emissions of CO2.<br>Greenhouse Gas emissions in developed and developing nation. |

| |
|---|
| **UNIT:2 Observations and theory of the general circulation of the atmosphere, Global energy balance,** Radiative processes in the atmosphere, Causes of Climate Change, natural and anthropogenic climate change, weather systems, tropical dynamics and monsoons, ocean circulation. Weather and Climate of India. |
| **UNIT:3** Extreme weather events and climate change catastrophes : Global and Indian Scenarios. Climate data and trends; Analyses of climate data. Climate projections and their uncertainties. Climate and weather prediction. |
| **UNIT:4** Climate impacts, vulnerability and risks Assessing climate impacts on key sectors and systems (heat stress, water resources, coastal zones, agricultural systems). Climate projections, long-term changes, regional changes. Fundamentals of the Global Climate Models, Intergovernmental Panel on Climate Change<br>Statistical Downscaling, Dynamical Downscaling (Case Studies). |

**Text Book:**

1. Barry R.G., and Chorley R.L., "Atmosphere, Weather and Climate", 4th Edition, ELBS Publication.
2. Bolin B., (Ed.), "Carbon Cycle Modelling", John Wiley and Sons Publications.
3. Wyman R.L., (Ed.), , "Global Climate Change and Life on Earth", Chapman and Hall Publications.
4. Yadav, Chander and Bhan, "Global Warming: India's Response and Strategy", RPH Publications.

**Reference Books**

1. Srivatsava A.K., "Global Warming", APH Publications.
2. Climate Change 2014: Impacts, Adaptation and Vulnerability, IPCC
3. India: Climate Change Impacts, Mitigation and Adaptation in Developing Countries : ISBN: 978-3-030-67865-4

**Journals/Magazines**

1. Journal of Sustainable Water in the Built Environment; ASCE ISSN (online): 2379-6111
2. Global Environmental Change: Human and Policy Dimensions : Elsevier : ISSN: 0959-3780
3. Climatic Change: An Interdisciplinary, International Journal Devoted to the Description, Causes and Implications of Climatic Change; Springer ; Print ISSN 0165-0009

**SWAYAM/NPTEL/MOOCs:**

swayam : Ecology and Environment : https://onlinecourses.nptel.ac.in/noc19_ge23/preview
coursera : Global Warming I: The Science and Modeling of Climate Change : https://www.coursera.org/learn/global-warming

## COURSE PACK FOR: INDUSTRIAL WASTE WATER TREATMENT

| **Course Title** | **INDUSTRIAL WASTE WATER TREATMENT** | | | | **Course Type** | | **Integrated** | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **B20EDS610** | **Credits** | **3** | | **Class** | | **VI semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number ofClasses Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 0 | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | 0 | - | - | | | | |
| | **Total** | **3** | **3** | **3** | **39** | **0** | **50%** | **50%** |

**Course Overview**

The focus of this course is on treatment of industrial wastewater including topics such as effect of industrial effluents on streams, treatment unit operations, combined treatment of domestic and industrial waste, treatment of wastes of various industries. The student is expected to know about the polluting potential of major industries and the methods of controlling the same

**Course Objective**

**This course enables graduating students**

1. To understand the effect of industrial effluents on streams.
2. To explain various tertiary treatment unit operations.
3. To explain combined treatment feasibility.
4. To explain various treatment facilities for the specific industries
5. To understand the design technique for the industrial wastewater treatment unit.
6. To understand the treatment of Radio Active Wastes

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Assess the effect of industrial waste on stream | 1, 2, 3, 4, 5 | 1,2,3 |
| CO2 | Make use of tertiary treatment unit operations. | 1, 2, 3, 4, 5 | 1,2,3 |
| CO3 | Make a choice of combined treatment of domestic and industrial waste | 1, 2, 3, 4, 5 | 1, 2, 3 |
| C04 | Differentiate the treatment facilities for the specific industries | 1, 2, 3, 4, 5 | 1, 2, 3 |
| C05 | Design a treatment plant for few selected industrial processes. | 1, 2, 3, 4, 5 | 1, 2, 3 |
| C06 | Make a choice of treatment of Radio Active Wastes | 1, 2, 3, 4, 5 | 1, 2, 3 |

## Bloom's Level Of The Course Outcomes

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

## Course Articulation Matrix Note:

| 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** | 2 | 2 | 1 | | | | | | | | | | 3 | 3 | 3 |
| **CO3** | 3 | 2 | | | | | | | | | | | 3 | 3 | 3 |
| **C04** | 3 | 2 | | | | | 3 | | | | | | 3 | 3 | 3 |
| **C05** | 3 | 2 | | | | | | | | | | | 3 | 3 | 3 |
| **C06** | 3 | 2 | | | | | 3 | | | | | | 3 | 3 | 3 |

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

**Course Content Theory**

| **Contents** |
|---|
| **UNIT: 1 Introduction:** Difference between Domestic and Industrial Wastewater, Effect on Streams and on Municipal Sewage Treatment Plants. Stream Sampling, Effluent and Stream Standards and Legislation to Control Water Pollution. Stream Quality, Dissolved oxygen Sag Curve in Stream, Streeter– Phelps formulation, Numerical Problems on DO prediction |
| **UNIT: 2 Pre-treatment of Industrial Wastewater:** Volume Reduction, Strength Reduction, Neutralization, Equalization and Proportioning, Removal of Inorganic suspended solids, Removal of Organic Solids, Removal of suspended solids and colloids. Treatment and Disposal of Sludge Solids. |
| **UNIT: 3 Combined Treatment and Wastewater Treatment in specific industries:** Feasibility of combined Treatment of Industrial Raw Waste with Domestic Waste, Discharge of Raw, Partially Treated and completely treated Wastes to Streams.<br>Distillery, Sugar, Pulp and paper, Cement, Textile, Dairy, Fertilizer, Pesticides, Pharmaceutical canning & tanning industries |
| **UNIT: 4 Other treatment system and disposal for industries:**<br>Distillery, Diary, Textile, paper and pulp mill to meet P.C.B. norms.<br>Low activity and high activity radiation, application of radioactive techniques for wastewater treatment. |

**Text Book:**

Nemerow N.N., "Liquid Waste of industry theories, "Practices and Treatment. Addison Willey New York.

Eckenfelder, "Industrial Water pollution Control"-McGraw hill Company, New Delhi American Chemical Society, Washington D.C. USA 7.Bioremediation books

**Reference Books:**


1. Rao MN, and Dutta A.K., "Waste Water Treatment", Oxford & IBH Publishing Co.Pvt Ltd. 2008.
2. Azad N. S.,–"Industrial Wastewater Management Hand Book" McGraw Hill book Co., Newyork.
3. Metcalf and Eddy, "Waste Water Treatment, Disposal and Reuse", Tata McGraw Hill Publications, 2003.
4. Patwardhan A.D., "Industrial Wastewater Treatment", PHI Learning Private Ltd., New Delhi, 2009
5. Ross R.D. "Industrial Waste Disposal", Reinhold Environmental Series –New York.
6. Mahajan S.P., "Pollution Control Processes in industries", Tata McGraw Hill Publications, 2004


**Journals/Magazines**

Special Issue "Industrial and Urban Wastewater Treatment and Reuse"

Water & Wastewater Magazines & Journals

**SWAYAM/NPTEL/MOOCs:**

Water and waste water treatment (https://onlinecourses.nptel.ac.in/noc21_ce25/preview)

Wastewater Treatment and Recycling (https://onlinecourses.nptel.ac.in/noc19_ce32/preview

**Problem Based Learning**

| No | Problem |
|---|---|
| 1 | A case study of wastewater treatment of any nearby industries |
| 2 | IOT in wastewater treatment |

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Design of Integrated wastewater treatment plant for any specific industry |
| 2. | Creating model of mini wastewater treatment for any specific industry |

## COURSE PACK FOR: AIR AND NOISE POLLUTION

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **Air and Noise Pollution** | | | | **Course Type** | | **Integrated** | |
| **Course Code** | **B20EDS611** | **Credits** | **3** | | **Class** | | **VI semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number ofClasses Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 0 | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | 0 | - | - | | | | |
| | **Total** | **3** | **3** | **3** | **39** | **0** | **50%** | **50%** |

### Course Overview

This course introduces students to the theory, knowledge and skills that are required to successfully undertake air and noise pollution investigations that may be required as part of their professional engineering practice. Students learn about the key role that engineering plays in understanding the sources and impacts of air and noise pollution, and implementing methods of control. The subject objectives are met by enabling students to master underpinning theory, develop problem-solving and communication skills, undertake research work independently and in a team, and complete laboratory investigations.

### Course Objective

**This course enables graduating students**

1. To introduce source, classification, characterization and effects of air pollution.
2. To explain the meteorological definitions & air transport equations.
3. To know the characteristics of plume behaviour, the Gaussian Plume Model, stack height and dispersion of air pollutants.
4. To introduce the sampling & pollution control matters and devices.
5. Ability to design stacks and particulate air pollution control devices to meet applicable laws
6. To demonstrate legislations and regulations pertinent to air pollution.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Identify the sources of air pollution and effects of air pollution on humans, vegetation, materials etc. | 1,2,3,4,9,12 | 1,2,3,4 |
| CO2 | Solve problems on stack height, concentration of pollutants. | 1,2,3,4,9,12 | 1,2,3,4 |
| CO3 | Characteristics of plume behaviour, the Gaussian Plume Model, stack height and dispersion of air pollutants | 1,2,3,4,9,12 | 1,2,3,4 |
| CO4 | Explores the various types of air pollution control equipment and explains their respective functions and mechanisms | 1,2,3,4,9,12 | 1,2,3,4 |
| C05 | Identify the effects and control measures of air pollution due to automobiles. | 1,2,3,4,9,12 | 1,2,3,4 |
| CO6 | To know legislations and regulations pertinent to air pollution | 1,2,3,4,9,12 | 1,2,3,4 |

**Bloom's Level Of The Course Outcome**

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

### Course Articulation Matrix Note: 1-Low, 2-Medium, 3-High

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | - | - | - | - | 1 | - | - | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 2 | 2 | 3 | - | - | - | - | 1 | - | - | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 3 | - | - | - | - | 2 | - | - | 3 | 3 | 3 | 1 | 3 |
| C04 | 3 | 3 | 2 | 3 | - | - | - | - | 2 | - | - | 3 | 3 | 3 | 1 | 3 |
| C05 | 3 | 3 | 2 | 3 | - | - | - | - | 2 | - | - | 3 | 3 | 2 | 3 | 3 |
| C06 | 3 | 3 | 2 | 3 | - | - | - | - | 2 | - | - | 3 | 3 | 3 | 1 | 3 |

### Course Content Theory

| Contents |
|---|
| **UNIT:1 Introduction:**<br>**Definition** – Classification and Characterization of Air Pollutants, Concentration of pollutants, Numerical Problems. Emission Sources, Behavior and Fate of air Pollutants, Chemical Reactions in the Atmosphere, Photo-chemical Smog, Coal-induced smog. Effects of air pollution: On Human Health, Animals, Plants and Materials. Firework and cracker pollution; their hazards; safety and health effects Ambient Air Quality criteria- National & International air emission standards and AAQ guidelines |
| **UNIT:2 Meteorology:**<br>Introduction – Meteorological Variables, Primary and Secondary Lapse Rate, Inversions, Stability Conditions, Wind rose, pollution roses. General Characteristics of Stack Plumes, Meteorological Models - Gaussian dispersion model (Equation). Plume rise, stack height - Determination of effective stack height, Stack monitoring for Industries-Trends of AAQ in Urban, Rural and Industrial areas. Numerical problems, Factors to be considered in Industrial Plant Location and Planning. |
| **UNIT:3 Sampling, Analysis And Control:**<br>Sampling and Measurement of Gaseous and Particulate matter, Stack Sampling, Analysis of Air Pollutants, Smoke and Smoke Measurement, Air Pollution Control Methods – Particulate, Emission Control, Gravitational Settling Chambers, Cyclone Separators, Fabric Filters, Electrostatic Precipitators, Wet Scrubbers – numerical problems. Selection of a Particulate Collecting Equipment, Control of Gaseous Emissions, Adsorption by Liquids, Adsorption by Solids, Combustion Odors and their control. |
| **UNIT:4 Environmental Issues and Noise Pollution:**<br>Air Pollution due to Gasoline Driven and Diesel Driven Engines, Effects, Direct and Indirect Methods of Control. Burning Environmental Issues – Acid Rain, Global Warming, Ozone Depletion in Stratosphere, Indoor Air Pollution.<br>Major Environmental Air Pollution Episodes – London Smog, Los Angeles Smog & Bhopal Gas Tragedy.<br>Noise Pollution – Sources, measurement units, effects and control of Noise pollution.<br>Environmental Issues: Environmental Policy, Environmental Acts, Water, Air and Noise Pollution Standards. |

**Text Book:**

1. Rao M N. and Rao H V N., “Air Pollution” Tata McGraw Hill Publishing Co. Ltd., New Delhi. 2004.
2. Murali Krishna K V S G., “Air Pollution & Control” Kaushal & Co., 1995.
3. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., “Environmental Engineering” – Tata McGraw Hill Publishing Co. Ltd., New Delhi. 1986.
4. Rao C S., “Environmental Pollution Control Engineering”, New Age International, New Delhi. 2007.

**Reference Books:**

1. Boubel, R W., Donald, L.F., Turner, D.B., and Stern, A.C., “Fundamentals of Air Pollution” – Academic Press, 1994.
2. Crawford, M., “Air Pollution Control Theory” – Tata McGraw Hill Publishing Co. Ltd., New Delhi. 1980.
3. Henry C Perkins, “Air Pollution” – Tata McGraw Hill Publishing Co. Ltd., New Delhi. 1980.
4. Sincero, A.P and Sincero, G.A., “Environmental Engineering – A Design Approach”, Prentice Hall of India. 1999.
5. Wark, K., Warner, C.F. and Davies, W.T., “Air Pollution- Its Origin and Control”, Harper & Row Publishers, New York. 1998.

**Journals/Magazines**

Journal of Environmental Pollution
Journal of water, air and noise pollution

**SWAYAM/NPTEL/MOOCs:**

https://nptel.ac.in/courses/105/102/105102089/
https://onlinecourses.swayam2.ac.in/cec21_ge08/preview

Problem Based Learning

| No | Problem |
|---|---|
| 1 | Air pollution detector project |
| 2 | IoT based Air Pollution Monitoring System using Arduino |

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Smart air pollution detection and monitoring using iot |
| 2. | Air Quality Monitoring near any Industries |
| 3. | Air Pollution Control Projects |

## COURSE PACK FOR: TRAFFIC ENGINEERING AND MANAGEMENT

<table>
<tr><td>Course Title</td><td colspan="4">TRAFFIC ENGINEERING AND MANAGEMENT</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EDS612</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>TLP</td><td>Credits</td><td>Contac tHours</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

Traffic engineering pertains to the analysis of the behavior of traffic and to design the facilities for a smooth, safe and economical operation of traffic. The traffic stream parameters provide information regarding the nature of traffic flow, which helps the analyst in detecting any variation in flow characteristics. Traffic management deals with different devices and techniques which can be adopted for overall smooth flow of traffic.

**Course Objective**

**This course enables graduating students**

1. To have an overall knowledge of the traffic components and assess the traffic characteristics and related problems.
2. To educate students about the importance of traffic engineering as applied to road transportation and features of traffic characteristics.
3. To develop a strong knowledge base of traffic planning and its management in any transportation area.
4. To develop a strong knowledge related to various traffic studies conducted and the methods of analyzing and presenting the data.
5. To give students an overview of the requirements of intersections, types of intersections and grade separators.
6. To make students appreciate the necessity of traffic regulations, types of traffic regulations and design of traffic regulations

## COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Outline the scope of traffic engineering, describe the road user characteristics and discuss the characteristics of different classes of vehicles. | 1,2,3,6,8,10, 11 | 1,2,3 |
| CO2 | Explain the necessity and methods of conducting various traffic studies and analyse the data collected to be presented in the form relevant to the purpose. | 2,3,6,9 | 2,3,4 |
| CO3 | Conduct various traffic surveys and analyse the data and suggest the required measures | 2,3,4,9 | 3,4 |

| | | | |
|---|---|---|---|
| C04 | Enumerate: features and requirements of intersections, forms and types of intersections, and outline the features of: grade separators, underpasses, overpasses, interchanges. | 1,2,3,6,8 | 1,3,4 |
| CO5 | Associate the traffic regulations to the safe and efficient operation of traffic, to identify the control measures and to design the basic regulatory devices. | 1,2,3,6,10,1 1 | 1,2,4 |
| CO6 | Classify the traffic regulations, design traffic control devices including redesign of existing signals | 1,3,6,8 | 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 Note: 1-Low, 2-Medium, 3-High**

| CO#/ POs | P | P | P | P | P | P | P | P | P | PO | PO | PO | PS | PS | PSO | PSO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | | | 2 | | 2 | | 1 | 2 | | 2 | 3 | 2 | |
| CO2 | | 2 | 2 | | | 3 | | | 2 | | | | | 3 | | 2 |
| CO3 | | 2 | 2 | 2 | | | | | 1 | | | | | | 2 | 2 |
| C04 | 2 | 3 | 2 | | | 3 | | 3 | | | | | 2 | | 3 | 3 |
| CO5 | 2 | 2 | 3 | | | 1 | | | | 2 | 2 | | 3 | 2 | | 3 |
| CO6 | 2 | | 2 | | | 2 | | 3 | | | | | 2 | | 1 | |

**Course Content Theory**

| **Contents** |
|---|
| **UNIT: 1** Scope of traffic engineering & study of its elements: Introduction, objectives and scope of traffic engineering, Components of road traffic, road user characteristics –physical and psychological, vehicle characteristics- static and dynamic. Passenger Car Units, Traffic stream characteristics- relationship between speed, flow and density- Numerical examples |
| **UNIT: 2** Traffic Engineering Studies and Analysis: methods of traffic study, equipment, data collection, analysis and interpretation of - Speed studies, Travel time and Delay studies, Volume studies, Origin – destination studies, Parking studies and Accident Studies. Advanced traffic studies- Video image processing, Bluetooth, GPS and sensors. |

**UNIT:3** Design and Management of traffic control measures – need, control of traffic movements through time sharing and space sharing concepts, Design of channelizing islands, T, Y, skewed, staggered, round about and other at grade intersections, provision for safe crossing of pedestrians and cyclists – grade separated intersection.

**UNIT: 4** Traffic control devices – traffic signs, markings and islands. Different methods of signal design, signal system and co-ordination, Numerical example (IRC and Webster method of signal design). Traffic Regulation- Road lighting, Regulations on vehicles, drivers, and traffic. Traffic engineering impacts on environment – air and noise pollution, impacts on land development, technological approaches to improving environment.

**Text Book:**


1. Hutchison, B.G., Introduction to Transportation Engineering, & Planning, McGraw Hill Book Co.
2. Kadiyali. L. R., "Traffic Engineering and Transport planning", Khanna publishers, New Delhi.
3. Khanna S.K and Justo C.E.G, "Highway Engineering", Nemchand and Bros, Roorkee.
4. Papacostas, C.A., "Fundamentals of Transportation Engineering", Prentice-Hall of India Private Limited, New Delhi
5. William R. Mc Shane and Roger P. Roess,, "Traffic Engineering", Prentice hall, New Jersey, 2000.
6. Matson, Smith and Hurd, "Traffic Engineering", McGraw Hill and Co, New York
7. Hutchison, B.G., Introduction to Transportation Engineering, & Planning, McGraw Hill Book Co.


**Reference Books**


1. Jotin Khisty, C. and Kent Lall, B., Transportation Engineering – An Introduction, Prentice-Hall, NJ
2. C. S Papacostas. Fundamentals of Transportation Engineering. Prentice-Hall, New Delhi, 1987.


**Relevant IRC Publications.**

**Journals/Magazines**

**1. Journal of traffic and transportation engineering, UK (** https://www.sciencedirect.com/journal/journal-of-traffic-and-transportation-engineering-english-edition )

**2. IEEE Open Journal of Intelligent Transportation Systems**

**3. Recent journal of traffic and transportation engineering** (http://www.keaipublishing.com/en/journals/journal-of-traffic-and-transportation-engineering-english-edition/recent-articles/ )

**SWAYAM/NPTEL/MOOCs:**

1. Traffic engineering and management: (https://nptel.ac.in/courses/105/101/105101008/)
2. Introduction to Traffic engineering (Coursera)

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute following studies in the field. Some sample topics to be conducted in field are given below:

| No | Suggested Project |
|---|---|
| 1 | Calculation of PCU |
| 2 | Spot Speed Survey and Analysis |
| 3 | Traffic Volume Survey and Analysis |
| 4 | Traffic Growth Rate Estimation |
| 5 | Signal Design I |

| | |
|---|---|
| 6<br>7 | Signal Design II<br>Island Design by using HCM 2010 manual |

## COURSE : INTRODUCTION TO REMOTE SENSING AND GIS

| **CourseTitle** | **Introduction to Remote sensing and GIS** | | | | **CourseType** | **Integrated** | |
|---|---|---|---|---|---|---|---|
| **CourseCode** | **B20EDS613** | **Credits** | **4** | | **Class** | **VI semester** | |
| **CourseStructure** | **TLP** | **Credits** | **Contact Hours** | **Work Load** | **Total Number of Classes Per Semester** | **Assessment in Weightage** | |
| | **Theory** | 3 | 3 | 3 | | | |
| | **Tutorial** | - | - | - | Theory | IA | SEE |
| | **Total** | **3** | **3** | **3** | **48** | **50%** | **50%** |

**COURSEOVERVIEW:** The course familiarizes students with concepts of Remote sensing and GIS. It deals with spatial data and non-spatial data and geo referencing. They also learn about data structure analysis and applications of GIS and remote sensing in Civil Engineering.

**COURSE OBJECTIVE::**

**The objectives of this course are to:**

1. To educate students about the basics of Remote sensing
2. To make students familiar with the recent techniques of remote sensing
3. To impart the knowledge of GIS concepts
4. To educate the features of GIS.
5. To make students familiar with importance and application of GIS in highway & railway facilities
6. To impart the knowledge of application of GIS in various fields of civil engineering

**COURSEOUTCOMES (COs)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Understanding about the basics of Remote sensing | 1,2,3, 4,5 | 1,2,3 |
| CO2 | Familiarize with the techniques of remote sensing | 1,2,3, 4,5 | 1,2,3 |
| CO3 | Gain the knowledge of Concepts of GIS | 1,2,3, 4,5 | 1,2, 3 |
| C04 | understanding the data structure features of GIS | 1,2,3, 4,5, | 1,2, 3 |
| CO5 | Knowledge of application of GIS in highway & railway facilitie | 1, 2, 3, 4, 5 | 1, 2, 3 |
| CO6 | Gain the knowledge of applications of GIS in various fields of civil engineering | 1,2,3,4.12 | 1,2,3 |

## BLOOM'SLEVELOFTHECOURSEOUTCOMES

| CO# | Bloom'sLevel | | | | | |
|---|---|---|---|---|---|---|
| | Remember(L 1) | Understand(L 2) | Apply(L 3) | Analyze(L 4) | Evaluate(L 5) | Create(L 6) |
| CO1 | ✓ | ✓ | ✓ | ✓ | | |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | | ✓ |
| C04 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## COURSEARTICULATIONMATRIX

| 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 | 2 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 3 | 3 |
| C04 | 2 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 2 | | | | | | | | 3 | 3 | 3 |
| CO6 | 3 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 3 | 3 |

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

## Course Content

| Contents |
|---|
| **Unit-I: Introduction to Remote Sensing (RS)**<br>Introduction to Remote Sensing: Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body – Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Electromagnetic Radiation – EMR Spectrum |
| **UNIT–II: Introduction to Geographic Information System(GIS)**<br>GIS: Basic Concept and Components – Hardware, Software – Data Spatial and non-spatial – Geo- referencing – Map Projection – Types of Projection – Simple Analysis |
| **Unit-III: Data Structures and Analysis**<br>Database – Raster and Vector data structures – Data storage – Run length, Chain and Block coding – Vector data storage – Topology – GIS Modeling |
| **Unit-IV: Applications of RS & GIS**<br>Applications In Civil Engineering: Applications of Aerial Photography and Satellite, Imageries in Highway and Railway Alignment- terminals and roadside facilities – Accident analysis –. GIS as an integration technology – Integration of GIS, GPS and Remote Sensing Techniques– applications in various streams of civil engineering. |

**REFERENCES BOOKS:**


1. Anji Reddy, "Remote Sensing and Image Interpretation", John Wiley and Sons Inc., New York,1987.
2. M.G.Srinivas, "Remote Sensing Applications", Narosa Publishing House,2001.

3. Burrough P.A, "Principles of GIS for Land Resources Assessment", Oxford Publication,1994.
4. Jeffrey Star and John Ester, Geographical Information System – An Introduction, Prentice Hall Inc., Englewood Cliffe,1990.
5. Marble, D.F, Calkins, H.W and Penquest, Basic Readings in GIS, Speed System Ltd., New York,1984.

**Reference Books:**

1. Remote Sensing Principles and Interpretation" by Sabins
2. Remote Sensing & GIS and Image Interpretation" by Lillesand T M and Kieffer R WA.
3. Remote Sensing and GIS Technology" by KataraPratibha
4. "Text Book of Remote Sensing and Geographical Information Systems" by M Anji Reddy

**Journals/Magazines**

https:// satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309
https://www.grss-ieee.org/wp-content/uploads/2014/07/EN_TUTORIAL_COMPLETO.pdf
https://puguhdraharjo.wordpress.com/tutorial-remote-sensing-gis/

**SWAYAM/NPTEL/MOOCs:**

https://nptel.ac.in/courses/105/108/105108077/Remote sensing
https://nptel.ac.in/courses/105/102/105102015/GIS

**Self-LearningExercises:**

Mapping of spatial variations in GIS software
IOT in Remote sensing and GI

## COURSE PACK FOR: BUILDING PLANNING AND BYE LAWS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **BUILDING PLANNING AND BYE LAWS** | | | | **Course Type** | | **Open Elective** | |
| **Course Code** | **B20EDO6 02** | **Credits** | **3** | | **Class** | | **VI semester** | |
| **Course Structure** | TLP | Cred its | Contac tHours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | - | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | **3** | **3** | **3** | **48** | **-** | **50%** | **50%** |

## Course Overview

This course provides the concepts related to building planning. It emphasizes on the understanding of the standards and bye laws of construction. Further it also provides exposure to the planning of residential and commercial buildings along with the introduction to architectural aspects.

**Course Objective**

**This course enables graduating students**

1. To introduce building classifications, functional requirements and regulations
2. To understand the regulations as per National Building Codes
3. To introduce the principles of planning and building bye laws of construction
4. To understand the principle of planning for residential & public buildings

5. To ascertain the architectural requirements and laws for various building plans
6. To understand the modular concept of planning and safety aspects

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | To explain the building classifications, functional requirements and regulations | 1,2,5,12 | 1 |
| CO2 | Follow the National Building Code standards during planning | 1,2,512 | 1 |
| CO3 | Apply the principles of planning and building bye laws of construction | 1,2,5,12 | 1 |
| C04 | Develop the plans and implement the regulations for residential and commercial buildings | 1,2,5,12 | 1 |
| C05 | Explain the architectural requirements and laws for various building plans | 1,2,5,12 | 1 |
| C06 | Apply the modular concept of planning and safety aspects | 1,2,5,12 | 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 | ✓ | ✓ | ✓ | | | |
| C04 | ✓ | ✓ | ✓ | | | ✓ |
| C05 | ✓ | ✓ | ✓ | | | |
| C06 | ✓ | ✓ | ✓ | | | |

## Course Articulation Matrix Note: 1-Low, 2-Medium, 3-Hig

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | | | 1 | | | | | | | 2 | 2 | | |
| CO2 | 2 | 2 | | | 1 | | | | | | | 2 | 2 | | |
| CO3 | 2 | 2 | | | 1 | | | | | | | 3 | 2 | | |
| C04 | 2 | 2 | | | 1 | | | | | | | 3 | 2 | | |
| C05 | 3 | 2 | | | 1 | | | | | | | 3 | 2 | | |
| C06 | 3 | 2 | | | 1 | | | | | | | 3 | 2 | | |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1 Introduction to Building planning :**<br>Classification of buildings, Building Regulations as per Indian Standards- BIS, ISO, Architecture and ANSI Specifications and Notations. |
| **UNIT:2 Building bye-laws:**<br>Provisions of National Building Codes and rules - Building bye-laws - Objectives, importance of bye-laws, open area - setbacks - FAR terminology<br>Principles of planning - orientation - ventilation and lighting. Provisions for differently abled persons.<br>Principles underlying building bye laws, rules governing light, parking, fire, water supply etc. |
| **UNIT:3 Building Planning and Services :**<br>Planning of Residential Plans - Single bed room and two storeyed building, Planning of Commercial and Industrial buildings, Concepts and philosophies<br>Introduction to Building Services- water supply, sewerage and drainage systems |
| **UNIT:4 Introduction to Architectural Planning**<br>Architectural Planning, Landscape planning, Aspects of planning within and with respect to surroundings, Modular planning concept, Safety Aspects, Introduction to Green Buildings – a case study. |

**Text Book:**

1. Shah M.H and Kale C.M, "Building Drawing", Tata Mc-Graw Hill Publishing co. Ltd., New Delhi.
2. N.Kumarswamy and A. KameswaraRao, "Building Planning and Drawing", Chartor Publishing House Pvt. Ltd.

**Reference Books**

1 Dr.Balagopal and T.S.Prabhu, Building Drawing and Detailing - Spades Publishers, Calicut.
2. Randy Shih "Autocad 2016 Tutorial First Level - 2D fundamentals" Schroff Development Corp, 2015
3. Building byelaws by state and Central Governments and Municipal corporations, 2011.
4. Urban Development Authority, Building Bye laws; Local Authority like AUDA

**Journals/Magazines**

1. National Building Code, BIS, New Delhi.
2. Model building bye-laws 2016.

**SWAYAM/NPTEL/MOOCs:**

http://nptel.ac.in/courses/php

Problem Based Learning

| No | Problem |
|---|---|
| 1. | Prepare concept plan of any one type of building considering local bye laws:<br>High school building, Hospital and Industrial Building in sketch book. |

**Project Based Learning**
To enhance the skill set in the integrated course, the students are advised to execute course-based design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Prepare a model of a simple building using card board |

## COURSE PACK FOR: TECHNICAL DOCUMENTATION

| **Course Title** | **TECHNICAL DOCUMENTATION** | | | | **Course Type** | | **Integrated** | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **B20ED6070** | **Credits** | **3** | | **Class** | | **VI semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 1 | 1 | 1 | | | | |
| | Practice | - | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | **1** | **1** | **1** | **16** | **-** | **50%** | **50%** |

**Course Overview:** Documentation requires communication skills and a knowledge of documentation using emails, letters and reports and basic concept of application programming interface
**Course Objective:** This course is designed to the graduation students to gain knowledge in communication skills such as writing, editing and proof reading and enabling them to understand documentation
**This course enables graduating students**
COURSE OUTCOMES (Cos): will be enabled to gain confidence in technical communication and documentation with various software and hardware concepts

### Course Content Theory

| Contents |
|---|
| 1**. Technical Communication Overview:** Meaning of Technical Writer; Role of Technical Writer; Evolution of Technical Communication Characteristics of Technical Communication; Essential Skills of Technical Communication; Indicators of Excellence in Technical Communication<br>**2. Technical Communication Editing:** Meaning; Types of Editing; Role of a Technical Editor; Proof Reading: Proof reading symbols, Abbreviations<br>**3. Common Types of Documents**<br>Emails.<br>Business Letters.<br>Business Reports. |

Transactional Documents.
Financial Reports and Documents.
**4. Basics of Software documentation:** Technical – Documentation of code, algorithms, interfaces, and APIs
5**. Introduction to software:** latex and grammerly.

## COURSE PACK FOR: Extensive Survey Project (Detailed Project Report) (B20ED0605)

<table>
<tr><td>Course Title</td><td colspan="4">Extensive Survey Project (Detailed Project Report)</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20ED0605</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">VI semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</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>Theory</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>1</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>2</td><td>2</td><td>-</td><td>2 hr/batch</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**
Note: The Extensive Survey Project camp should be conducted after the 5th Semester B.Tech for 7 Days and Submit the Detailed Project Report in the 6th Semester. (one of the project should be conducted using Total station).

Course Prerequisites: Hydrology & Irrigation, Design of Hydraulic Structures and Surveying practice lab.
**Course Objective**
**This course enables graduating students**
To acquire a sound practical knowledge and application of theory and in practical to overcome the difficulties that could arise in field during surveying.
To carry out New Tank Bund alignment, Storage capacity, Canal alignment and distribution system with detailed Drawings.
To carry out survey for water supply to identifies and locate source, sanitary system for sewer lines and treatment plant with detailed Drawings.
To carry out survey work New Highway Alignment, Geometric design and Final Alignment.

## COURSE OUTCOMES (Cos)
## After the completion of the course, the student will be able to:

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Use of surveying instruments and performing various survey works in difficult terrain and to identify sites necessary for conducting various surveys. | 1,2,3,5,7 | 1,2,3,4 |
| CO2 | Learnt about New Tank Bund alignment, Storage capacity, and Canal alignment and distribution system with detailed Drawings. | 1,2,3,5,7 | 1,2,3,4 |

| | | | |
|---|---|---|---|
| CO3 | Learnt about survey for water supply to identifies and locate source, sanitary system for sewer lines and treatment plant with detailed Drawings. | 1,2,3,5,7 | 1,2,3,4 |
| C04 | Learnt about survey work New Highway Alignment, Geometric design and Final Alignment | 1,2,3,5,7 | 1,2,3,4 |
| CO5 | Able to Design and Drawings of New tank Project, Water supply and sanitation project and Highway Project. | 1,2,3,5,7,11,12 | 1,2,3,4 |
| C06 | Able to Compute the total cost of the project and Prepare detailed project report. | 1,2,3,5,7,11,12 | 1,2,3,4 |

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

| CO# / POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | 2 | 2 | 2 | 2 | 2 | 3 |
| CO2 | 3 | 2 | 2 | | 3 | | 2 | | | | 2 | 2 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 2 | | 3 | | 2 | | | | 2 | 2 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 2 | 2 | | 3 | | | | | | 2 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | | 3 | | 2 | | | | 2 | 2 | 3 | 2 | 3 | 3 |
| CO6 | 3 | 3 | 2 | | 3 | | 2 | | | | 3 | 3 | 3 | 2 | 3 | 3 |

## Course Content Theory

| **Contents** |
|---|
| **Project 1 : NEW TANK PROJECT -**<br>Reservoir site selection, Reconnaissance of the sites and fly levelling to establish bench marks.<br>Alignment of centre line of the proposed bund, Longitudinal and cross sections of the centre line.<br>Reservoir capacity surveys using total station.<br>Sluice & Surplus weir surveys.<br>Canal alignment surveys.<br>Design and preparation of drawing with report.<br>Restoring of Old Tank (Visit and explanations) |
| **Project 2 : WATER SUPPLY AND SANITATION PROJECT -**<br>Locating Source of water.<br>Calculation of quantity of water required based on existing and projected population.<br>Town planning: Preparation of map by any suitable method of surveying (like plane tabling).<br>Location of sites for treatment plants, ground level and overhead tanks, pipe lines underground drainage system, surveys for laying the sewers. |

| |
|---|
| Design of all elements and preparation of drawing with report |
| **Project 3 : HIGHWAY PROJECT (using Total station)**<br>Preliminary and detailed investigations for a new alignment of a road between two obligatory points.<br>The investigation shall consists of topographic surveying of strip of land for considering alternate routes and for final alignment.<br>Design of highway geometric elements: Report should justify the selected alignment with details of all geometric design for traffic and design speed is assumed.<br>Drawing shall include, key plan initial alignment and final alignment, longitudinal sections and Cross Sections along final alignment, typical cross sections of roads.<br>Design and preparation of drawing with report. |

**Text & Reference Books :**

1. Surveying Vol 1, 2, 3: Punmia B C, Ashok K Jain, Arun K Jain, Surveying, laxmi Publications (P) Ltd, New Delhi.
2. Irrigation, water Resources and water power Engineering- P.N.Modi- standard book house, New Delhi.
3. Irrigation Engineering and Hydraulic Structures by Santosh Kumar Garg.
4. Water Resources Engineering: Principles and Practice-ChallaSatya Murthy, New Age International Publishers, New Delhi (2nd Ed.)
5. Water supply Engineering –S.K.Garg, Khanna Publishers
6. Environmental Engineering I –B C Punima and Ashok Jain
7. Highway engineering by khanna S.K &C.E.G.Justo, Nem Chand and Bros, Roorkee.

**Journals/Magazines**

1. Journal of Hydraulic Engineering

**SWAYAM/NPTEL/MOOCs:**

http://www.nptel.iitm.ac.in

**Problem Based Learning**

| No | Problem |
|---|---|
| 1. | Design of Hydraulic structures such as dams, reservoirs and cross drainage works. |
| 2. | Design of Water supply and waste water disposal. |
| 3. | Geometric Design of Highways. |

**Project Based Learning**

- Determine the storage capacity of the reservoir.
- Determine the water quality parameters of potable water.
- Project on Trea
- tment of waste water from domestic usage.
- Geometric design for curve fittings in highway constructions.

## COURSE PACK FOR: PROJECT MANAGEMENT LAB (B20ED0606)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **Project Management Lab** | | | | **Course Type** | | HC | |
| **Course Code** | **B20ED0606** | **Credits** | **2** | | **Class** | | **VI semester** | |
| **Course Structure** | TLP | Credits | Contac tHours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 1 | 2 | 2 | | | | |
| | Practice | 1 | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | **2** | **2** | **2** | **-** | **2 hr/batch** | **50%** | **50%** |

**Course Overview**

This course introduces the students to learn about the concepts of Project planning and scheduling of a building project using any project management software: (PRIMAVERA, MS-OFFICE) and GIS applications using open-source software

**Course Prerequisites: Construction Planning and Management**

Course Objective

This course enables graduating students

1. Use industry standard software in a professional set up.
2. Understand the elements of finite element modelling, specification of loads and boundary condition, performing analysis and interpretation of results for final design
3. Develop customized automation tools.
4. Learning GIS applications to create shape files

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Understand about the basic features of project management software like creation of WBS, Activities, tasks and Computation Time using Excel using spread sheet and check it software | 1,2,3,5,7 | 1,2,3,4 |
| CO2 | Learnt about the identification of Predecessor and Successor activities with constrain | 1,2,3,5,7 | 1,2,3,4 |
| CO3 | Learnt about Constructing Network diagram (AON Diagram) and analyzing for Critical path & Critical activities | 1,2,3,5,7 | 1,2,3,4 |
| C04 | Able to understand about Resource Creation and allocation, Splitting the activity, linking multiple activity, assigning Constrains, | 1,2,3,5,7 | 1,2,3,4 |
| CO5 | Able to know merging Multiple projects, Creating Baseline Project | 1,2,3,5,7, 11,12 | 1,2,3,4 |
| C06 | Able to understand GIS applications for creation of shape files on map reference and decision maps | 1,2,3,5,7, 11,12 | 1,2,3,4 |

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

| **CO#/ POs** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | 2 | 2 | 2 | 2 | 2 | 3 |
| CO2 | 3 | 2 | 2 | | 3 | | 2 | | | | 2 | 2 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 2 | | 3 | | 2 | | | | 2 | 2 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 2 | 2 | | 3 | | | | | | 2 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | | 3 | | 2 | | | | 2 | 2 | 3 | 2 | 3 | 3 |
| CO6 | 3 | 3 | 2 | | 3 | | 2 | | | | 3 | 3 | 3 | 2 | 3 | 3 |

**Course Content Theory**

**Contents**

List of experiments: Project Management- Exercise on Project planning and scheduling of a building project using

**any project management software: (PRIMAVERA, MS-OFFICE)**

1. Understanding basic features of Project management software
2. Constructing Project: create WBS, Activities, and tasks and Computation Time using Excel spread sheet and transferring the same to Project management software.
3. Identification of Predecessor and Successor activities with constrain
4. Constructing Network diagram (AON Diagram) and analyzing for Critical path, Critical activities and other on Critical paths, Project duration, Floats.
5. Study on various View options available
6. Basic understanding about Resource Creation and allocation
7. Understanding about Splitting the activity, linking multiple activity, assigning Constrains, Merging Multiple projects, Creating Baseline Project

**GIS applications using open-source software**

1. To create shape files for point, line and polygon features with a map as reference
2. To create decision maps for specific purpose.

**Text & Reference Books:**

1. Training manuals and User manuals and Relevant course reference books
2. TENSIX Consulting Primavera P6 Exercise Worksheet

3. Information Technology Project Management – Providing measurable organizational value by Jack T. Marchewka.

**Journals/Magazines**

1. Journal of Project Management Software Utilization and Project Performance

**SWAYAM/NPTEL/MOOCs:**

https://www.classcentral.com/course/swayam-software-project-management-14294
https://www.coursera.org/courses?query=software%20project%20management

**Problem Based Learning**

| No | Problem |
|---|---|
| 1. | Define the Problem of Project |
| 2. | Determine the Causes of project problem |
| 3. | Generate Ideas for project problem |
| 4. | Select the Best Solution for project problem |
| 5. | Take Action on project problem |

**Project Based Learning**

Globalization causing high competition.
Older legacy systems and infrastructure issues.
Adoption rates and time to market pressures.

**SEMESTER VII**

**COURSE PACK FOR: Estimation , Costing and Valuation, Project Report**

<table>
<tr><td>Course Title</td><td colspan="3">Estimation , Costing and Valuation, Project Report</td><td colspan="2">Course Type</td><td colspan="2">Hard core</td></tr>
<tr><td>Course Code</td><td>B20ED0701</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>TLP</td><td>Credits</td><td>Contac tHours</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>Theory</td><td>2</td><td>4</td><td>4</td></tr>
<tr><td>Practice</td><td>1</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>64</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

## Course Overview

In the construction of any civil structure, specifications of the civil work are the significant parameters in deciding the cost of the project. In construction, it is often required to use the local material for which the rates are varying in greater extent across the country. The rate analysis justifies the rates to be finalized for various items of works based on local market survey for budget provision. Therefore there emerges the need of a discipline to suggest a specific scientific technique to determine the quantities and cost of the materials along with its justification. Thus, this course provides the necessary knowledge and skills in developing the competency in the areas mentioned above in professional manner. Today being the era of technology, a provision has also been made to use the various software's for more accuracy and speedy determination of quantities.

## Course Objective

**This course enables graduating students**

1. Determination of quantities of items and labor requirement of civil engineering works.
2. Preparation of estimate of the civil engineering works.
3. Preparation of specification of construction items.
4. To carry out rate analysis for various civil engineering works
5. To learn about the measurement of earth work for roads and other civil engineering works.
6. To introduce the students in depth knowledge of professional practice as well the quantity analysis of construction works like, multi-storied structures, Water works & sanitary works, Irrigation works, Road estimates, culverts, etc.

## COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | The students will get a diverse knowledge of estimating, costing and professional practice, which will be use full in tackling real life problems. | 1,2,3 | 1,2, |
| CO2 | Able to understand the procedure to carry out the estimation and steps to prepare reports of construction works. | 1,2,3 | 1,2 |
| CO3 | Carry out rate analysis for various items of works and Obtain measurement of earth work for roads by various standard methods | 1,2,3 | 1,2,4 |
| C04 | Justify the rate for given items of work using rate analysis techniques. | 1,2,3 | 1,2,4 |

| | | | |
|---|---|---|---|
| C05 | The students will learn the purpose and importance of valuation | 1,2,3 | 1,2 |
| C06 | Preparation of contract document related to a project. | 1,2,3 | 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 Note: 1-Low, 2-Medium, 3-High

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 2 | | |
| CO3 | 3 | 3 | 3 | | | | | | | | | | 3 | 2 | | 1 |
| C04 | 3 | 3 | 3 | | | | | | | | | | 3 | 2 | | 1 |
| C05 | 3 | 3 | 1 | | | | | | | | | | 3 | 2 | | |
| C06 | 3 | 3 | 1 | | | | | | | | | | 3 | 2 | | |

## Course Content Theory

**Contents**

**UNIT:1 Introduction and Estimation**

Estimation: Study of various drawings with estimates, important terms, units of measurement, abstract Methods of taking out quantities and cost –center line method, long and short wall method or crossing method. Preparation of detailed and abstract estimates for the following Civil Engineering works – Buildings – RCC framed structures with flat, RCC roofs with all Building components

**UNIT: 2 Estimation of structures and specifications :**

Estimation: Different type of estimates, approximate methods of estimating buildings, cost of materials. Estimation of wooden joineries such as doors, windows & ventilators.

Estimation:: Steel truss (Fink and Howe truss), manhole and septic tanks, RCC Culverts, Waste weir.

Specifications: Definition of specifications, objective of writing specifications, essentials in specifications, general and detail specifications of common item of works in buildings.

**UNIT:3 Rate Analysis and Estimation of Earthwork :**

Definition and purpose. Working out quantities and rates for the following standard items of works – earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works for doors, windows and ventilators.

| |
|---|
| Estimation of Earthwork for Roads: Methods for computation of earthwork – cross sections – mid section formula or average end area or mean sectional area, Trapezoidal & Prismoidal formula with and without cross slope. |
| **UNIT:4 Contracts and Valuations :**<br>Types of contract – essentials of contract agreement – legal aspects, penal provisions on breach of contract. Definition of the terms –Tender, earnest money deposit, security deposit, tender forms, documents and types. Acceptance of contract documents. Termination of contract, completion certificate, quality control, right of contractor, refund of deposit. Administrative approval – Technical sanction. Nominal muster roll, measurement books – procedure for recording and checking measurements – preparation of bills.<br>Valuation- Definitions of various terms, method of valuation, Freehold & Leasehold properties, Sinking fund, depreciation and method of estimating depreciation, Outgoings.<br>Case study and preparation of report. |

**Text Book:**

1. B. N. Dutta, Estimating and Costing In Civil Engineering, Ubs Publishers Distributors Ltd.
2. S. C. Rangwala, Estimating And Costing, Charotar Publishing House, Anand
3. G. S. Biridi, Textbook of Estimating & Costing, Dhanapat Rai & Sons. Delhi.
4. M.Chakroborti, Estimating, Costing, Specification and Valuation.Calcutta.
5. P.W.D. Hand Book Is Codes

**Reference Books**

1. Patil, B.S., Civil Engineering Contracts, Vol. – I, Orient Longman Publication, 1998.
2. Rangwala, S.C., Elements of Estimating and Costing, Professional practice, Charotar Publishing House, Anand.
3. Aggarwal, A., Upadhyay, A.K., Civil Estimating, Costing &Valuation, S.K Kataria & Sons, New Delhi.
4. Chandola, S.P. and Vazirani, Estimating and Costing, Khanna Publication.

**Journals/Magazines**

1. Journal of Construction Engineering and Management, ASME library
2. Advances in civil engineering, Hindawi.
3. Construction and building materials, Elseiver

**SWAYAM/NPTEL/MOOCs:**

1. https://nptel.ac.in/courses/105/103/105103093/
2. https://onlinecourses.swayam2.ac.in/nou20_cs11/preview


**Text Book:**

1. B. N. Dutta, Estimating and Costing In Civil Engineering, Ubs Publishers Distributors Ltd.
2. S. C. Rangwala, Estimating And Costing, Charotar Publishing House, Anand
3. G. S. Biridi, Textbook of Estimating & Costing, Dhanapat Rai & Sons. Delhi.
4. M.Chakroborti, Estimating, Costing, Specification and Valuation.Calcutta.
5. P.W.D. Hand Book Is Codes

**Reference Books**

1. Patil, B.S., Civil Engineering Contracts, Vol. – I, Orient Longman Publication, 1998.
2. Rangwala, S.C., Elements of Estimating and Costing, Professional practice, Charotar Publishing House, Anand.
3. Aggarwal, A., Upadhyay, A.K., Civil Estimating, Costing &Valuation, S.K Kataria & Sons, New Delhi.
4. Chandola, S.P. and Vazirani, Estimating and Costing, Khanna Publication.

**Journals/Magazines**

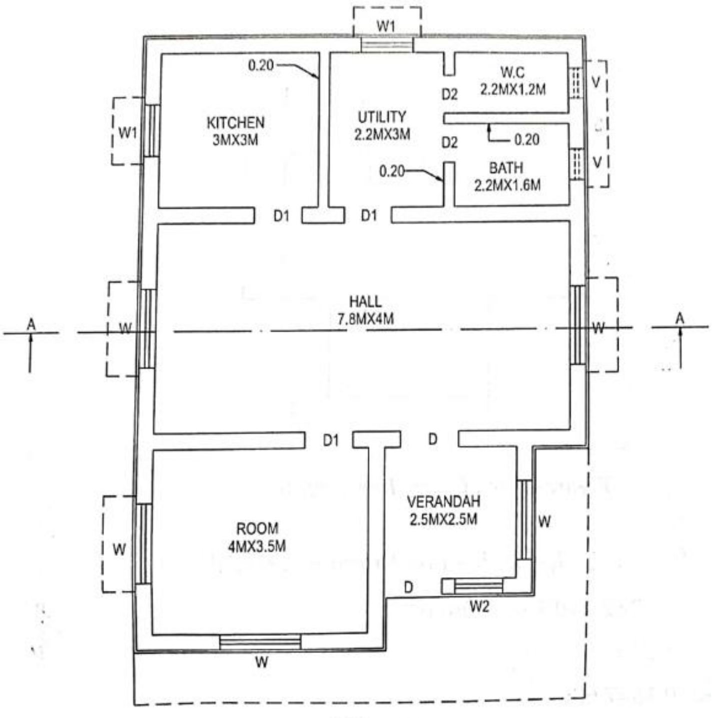
1. Journal of Construction Engineering and Management, ASME library
2. Advances in civil engineering, Hindawi.
3. Construction and building materials, Elseiver

**SWAYAM/NPTEL/MOOCs:**

1. https://nptel.ac.in/courses/105/103/105103093/
2. https://onlinecourses.swayam2.ac.in/nou20_cs11/preview

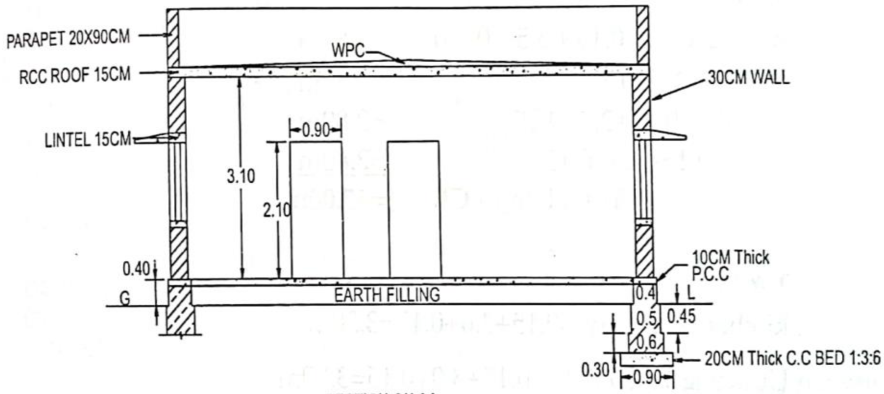
**Problem Based Learning**

| No | Problem |
|---|---|
| 1 | **Estimate the following items of a work of a residential building as shown in Fig. i) Calculate c/c lengths to estimate the quantities.**<br>ii) Earth work excavation for foundation in hard soil @ Rs.230/ m3<br>iii) Cement concrete in foundation @ Rs.3250/ m3<br>iv) BBM walls with CM (1:6) for superstructure @, Rs.4500/ m3<br>Total cost abstract for the above items. |

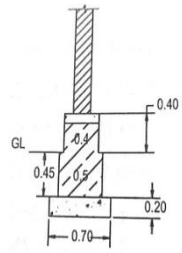


PLAN

D – 1.1m X 2.1m W – 1.5m X 1.2m
D1 – 0.9m X 2.1m W1– 1.0m X 1.2m
D2 – 0.75 X 2.1m W2 – 0.9m X 1.2m
V – 0.6mX0.75m
All dimensions in meters




SECTION ON AA




20CM WALL

2 **Write the detailed specifications for any three of the following:**

Earth work excavation in foundation

Cement concrete foundation

First class brick work in CM 1:6 in superstructure

Cement Plastering in CM (1:6)

3 **Estimate the quantities of earth work for a portion of road for 300m length from the following** data. Formation width is 10m, side slopes in banking is 2:1 and sides slope in cutting is 1.5:1, The formation level at first chainage is 102. The road is in downward gradient of 1 in 150 up to distance of 120m afterward gradient changes to 1 in 100.

| Distance | 0 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RL of Ground | 101 | 100.9 | 100.5 | 100.7 | 100.8 | 100.6 | 100.0 | 99.8 | 99.2 | 99.1 | 98.5 |

4 **Differentiate between**

Tender and quotation

Measurement book and schedule of rates

Earnest money deposit and security deposit

## COURSE PACK FOR: ANALYSIS AND DESIGN OF BRIDGES

<table>
<tr><td>Course Title</td><td colspan="4">ANALYSIS AND DESIGN OF BRIDGES</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0702</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>TLP</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 Weight age</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>4</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>4</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

### Course Overview:

Bridges are a very important part of a nation's transportation infrastructure. Proper Planning, Analysis design and Construction, as well maintenance, are of utmost importance. In general, engineers will benefit from exposure to sophisticated bridge typologies and construction practices, as well as the assessment of the existing bridges. The competency needed in this field has to be enhanced significantly and rapidly to respond to the requirements in large infrastructure projects being undertaken and planned in India. This course will extend the concepts and methodologies given in bridge engineering courses to cover the Planning, Analysis and design of medium- and long-span road bridges, which can be optimized in terms of load-carrying capacity, durability, ease of construction and maintenance.

**Course Prerequisite: Design of RCC, PSC Structures**

**Course Objective**

**This course enables graduating students to learn**

To understand the concept of codal provisions for the design of bridges.
To study the loading patterns on the bridges.
To design the different types of bridges for railway and highway standards.
To understand the design principles of PSC bridges.

### COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | To develop an understanding of an appreciation of basic concepts and terms involve in design of bridges. | 2,3,5 | 1 |
| CO2 | Concept of Rolling loads and To Analyze, Design Slab Culvert bridge starting from conceptual design using IS Code Specifications | 2,4,8,910,12 | 1,2,4 |
| CO3 | To Analyze and Design Pipe Culvert bridge starting from conceptual design | 2,4,8,910,12 | 1,2,4 |
| C04 | Analyze and Design the Interior Slab of Tee Beam bridges | 1,2,3,4,5,6,7,8,10,12 | 1,2,3,4 |
| C05 | To Analyze and Design the Main girder of Tee Beam bridges | 1,2,3,4,5,6,7,8,10,12 | 1,2,3,4 |

| | | | |
|---|---|---|---|
| C06 | Design PSC bridges | 1,2,3,4,5,6, 7,8,10,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | 3 | 2 | | 2 | | | | | | | | 3 | | |
| **CO2** | 3 | 3 | | | 3 | | | | 2 | 2 | 2 | | 3 | 2 | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | | | 2 | | 2 | 2 | | 2 | | 2 | 2 | 3 |
| **C04** | 3 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 |
| **C05** | 3 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 |
| **C06** | 2 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 |

**Course Content Theory**

| Contents |
|---|
| UNIT: 1- Introduction to bridges<br>History of bridges, Railway bridges and highway bridges, components of bridges and their definitions, classification of bridges and loads on bridges, selection of site for bridge design, types of abutments, piers, and wing walls, IRC codes for the design.<br>Methods to calculate design discharge, Natural, Artificial and Linear Water Ways, Afflux, Economic span, Load Combinations for different working state and limit state designs. |
| UNIT: 2- Slab Culvert and Pipe culvert Bridges<br>Influence line diagram for Moving Loads for reaction, SF and BM at a given section. Design of Slab Culvert & Design of Pipe Culvert for Class AA and Class A loading. Design of pier. |
| UNIT: 3 – Tee- beam Bridges:<br>Introduction- Design of slab by Pie gaud's and Longitudinal Girder Courbon's method for class AA loading, Empirical. Design of Cross girder. Concept of Substructures and foundations in Bridges. |
| UNIT: 4 – Pre Stressed Concrete Bridges:<br>Introduction- Analysis Of Pre Stressed Concrete Deck Slab and Main Girder Using Courbon's Method For |

| |
|---|
| IRC Class AA Tracked Vehicle, Design of End Block. |

**REFERENCE BOOKS:**


1. Essential of bridge engineering” – D Johnson victor, Oxford and IBH publishing Co New Delhi.
2. “Design of bridges” – N Krishnaraju, Oxford and IBH publishing New Delhi.
3. 3“Design of bridge structures”- Jagadeesh T R and Jayaram M A Prentice hall of India pvt ltd.
4. IRC 6 – 1966 “Standard specification and code of practice for road bridges” section II
5. Vazrani.V.N and Ratwani, M.M, Analysis of Structures, Vol.II, Khanna Publishers, 2015.
6. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi, Publications, 2004.


**Journals/Magazines**

Journal of Bridge Engineering, ASCE library

Proceedings of the Institution of Civil Engineers – Bridge Engineering

**SWAYAM/NPTEL/MOOCs:**

http://www.nptel.iitm.ac.in

**COURSE PACK FOR: CIVIL ENGINEERING-SOCIETAL AND GLOBAL IMPACT**

<table>
<tr><td>Course Title</td><td colspan="3">CIVIL ENGINEERING-SOCIETAL AND GLOBAL IMPACT</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EDS713</td><td>Credits</td><td colspan="2">3</td><td colspan="1">Class</td><td colspan="2">IV semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td rowspan="2" colspan="2">Total Number of Classes Per Semester</td><td rowspan="2" colspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

The world is going through some profound changes: automation and general improvement of productivity is resulting in the abundance of industrial products, the domination of the West in global economy, climate change is requiring a reconsideration of the energy system. Civil engineers and their forerunners have been shaping the infrastructure of societies

**COURSE OBJECTIVES**

**This course enables graduating students**

1. To know the role of Civil engineering in evolution and revolution of mankind and globally present status of development in India.
2. To learn to Estimate the level of resource utilization for present and future infrastructural projects using various tools/methods
3. To Infer the necessity of different conventional as well as futuristic infrastructural projects
4. To Incorporate the goal of sustainable development to minimize the potential impacts on the global environment
5. To Associate various measures for enhancing the build environment, thereby improving quality of life of the occupants
6. To Evaluate the potential of Civil Engineering for employment creation and its contribution to the GDP.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Outline the role of Civil engineering in evolution and revolution of mankind and globally present status of development in India. | 1,2,12 | 1,2,4 |
| CO2 | Estimate the level of resource utilization for present and future infrastructural projects using various tools/methods | 1,2,12 | 1,2,4 |
| CO3 | Infer the necessity of different conventional as well as futuristic infrastructural projects | 2,4,12 | 1,2,3,4 |
| CO4 | Incorporate the goal of sustainable development to minimize the potential impacts on the global environment | 1,2,3,5,12 | 1,2,3,4 |
| CO5 | Associate various measures for enhancing the build environment, thereby improving quality of life of the occupants | 2,4,12 | 1,2,3,4 |

| | | | |
|---|---|---|---|
| C06 | Evaluate the potential of Civil Engineering for employment creation and its contribution to the GDP. | 2,4,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO3 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C04 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| CO6 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1 Civil Engineering breakthroughs and innovations**<br>Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis |
| **UNIT:2 Habitats**<br>Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning |
| **UNIT:3 Environment and Society**<br>Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non-stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability |

| **UNIT:4 Built environment** |
|---|
| Built environment – Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures |

Text Book:
1. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.

Reference Books
1. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options
2. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx
3. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
4. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. P 129-130
5. Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability

**Text Book:**
1. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
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4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.

**Reference Books**
1. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options
2. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx
3. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
4. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. P 129-130
5. Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability

**Journals/Magazines**
1 Civil Engineering research Journal, Juniper Publishers

**SWAYAM/NPTEL/MOOCs:**
http://www.nptel.iitm.ac.in

https://www.coursera.org/courses?query=civil%20engineering
Project Based Learning
To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | A questionnaire survey and field visits can be undertaken on the role of civil engineers in building the infrastructure considering impact of economy and climate |

**COURSE PACK FOR: EARTH RETAINING STRUCTURES**

| **Course Title** | **EARTH RETAINING STRUCTURES** | | | | **Course Type** | | **Integrated** | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **B20EDS714** | **Credits** | **3** | | **Class** | | **IV semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number ofClasses Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | - | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | **3** | **3** | **3** | **48** | **-** | **50%** | **50%** |

**Course Overview**
A Mechanically Stabilized Earth (MSE) retaining wall is a composite structure consisting of alternating layers of compacted backfill and soil reinforcement elements, fixed to a wall facing.
**Course Objective**
1. To understand lateral earth pressure theories
2. To know the design of retaining walls.
3. To design anchored bulkheads by different methods.
4. To understand pressure envelops
5. To understand the design of various components in braced cuts and cofferdams.
6. To understand stability of earth dams and its protection and construction

This course enables graduating student
**COURSE OUTCOMES (Cos)**
**After the completion of the course, the student will be able to:**

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | To determine lateral earth pressure theories | 1,2,12 | 1,2,4 |
| CO2 | To design of retaining walls | 1,2,12 | 1,2,4 |
| CO3 | To design anchored bulkheads by different methods | 2,4,12 | 1,2,3,4 |
| CO4 | To develop pressure envelops | 1,2,3,5,12 | 1,2,3,4 |
| CO5 | To design of various components in braced cuts and cofferdams | 2,4,12 | 1,2,3,4 |
| C06 | To determine the stability of earth dams and its protection and construction | 2,4,12 | 1,2,3,4 |

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

| **CO#/ POs** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **PO** | **PO** | **PO** | **PS** | **PS** | **PSO** | **PSO** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO3 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C04 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| CO6 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| **Contents** |
|---|
| **UNIT:1 –Lateral Pressure and Retaining walls:**<br>Lateral Pressure: Basic concepts, Rankine and Coulomb earth pressure theories, graphical methods. Determining active and passive pressures: Cullman's, Rebhan's, logarithmic spiral methods, friction circle method. Consideration of surcharge, seepage, earth quake, wave effect, stratification, type of backfill, wall friction and adhesion.<br>Retaining walls: Uses, types, stability and design principles of retaining walls, backfill drainage, settlement and tilting. Design of abutment. Numerical problems |
| **UNIT:2- Anchored bulkheads and Braced cuts & Cofferdams:**<br>Classification of anchored bulkheads, free and fixed earth support methods. Rowe's theory for free earth supports and equivalent beam methods for fixed earth supports. Design of anchored rods<br>Braced excavations and stability of vertical cuts, lateral pressures in sand and clay, Braced and cellular cofferdams: uses, types, components, stability, piping and heaving. Stability of cellular cofferdams, cellular cofferdams in rock and in deep soils. Numerical problems |
| **UNIT:3 - Earth dams- Stability analysis:**<br>Classification, seepage control in embankments and foundations, seepage analysis, stability analysis: upstream and downstream for steady seepage, rapid draw down, end of construction, method of slices and Bishop's method. Numerical problems |
| **UNIT:4 - Earth dams -Protection & Construction:**<br>Slope protection, filters, embankment construction materials and construction, quality control, grouting techniques. Instrumentation and performance observations in earth dams. Numerical problems |

**Text Book:**

1Basic & Applied soil mechanics – Gopal Ranjan & ASR Rao, New Age International Publishers, 2011.

2. Embankment Dams by Sharma, Publisher: India Book House(IBH) Limited,1991
3. Engineering for Embankment Dams By B. Singh & R. S. Varshney, A Balkma Publishers, 1995

**Reference Books**

1. Foundation design by W. C. Teng, Prentice Hall,1962

2.Analysis and design of foundations by Bowles. J. W McGraw Hill, 4th edition, 1955.

3.Earth and Rock-Fill Dams: General Design and Construction Considerations by United States Army Corps of Engineers, University Press of the Pacific,2004

4.Soil mechanics in engineering and practice by Karl Terzaghi, Ralph B. Peck, Gholamreza Mesri,3rd Edition. Wiley India Pvt Ltd,2010.

**Journals/Magazines**

1 Journal of Geotechnical Engineering ASCE USA

SWAYAM/NPTEL/MOOCs:

http://www.nptel.iitm.ac.in

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Problems may be given to a batch of students to solve with different parameters stability and design principles of retaining walls, backfill drainage, settlement and tilting Stability of cellular cofferdams, cellular cofferdams in rock and in deep soils. |

## COURSE PACK FOR: GROUND WATER HYDRAULICS (B20EDS715)

| Course Title | GROUND WATER HYDRAULICS | | | | Course Type | SC | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **B20EDS715** | **Credits** | **3** | | **Class** | **VII semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage |
| | Theory | 3 | 4 | 3 | | | |
| | Practice | - | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | **3** | **4** | **3** | **48** | **-** | **50%** | **50%** |

### Course Overview

This course will enable students to characterize the properties of ground water and aquifers. To quantify the ground water flow. To locate occurrence of ground water and augment ground water resources. To synthesize ground water development methods.

### Course Objective

**This course enables graduating students**

1. Study about characteristics of aquifers.
2. Study about Ground Water Recharge techniques and water balance studies.
3. Learn about Well Hydraulics.
4. Learn and understand about theis method, Cooper and Jacob method, Chow's method.
5. Learn about Ground Water Exploration Techniques.
6. Study about Ground Water Development.

### COURSE OUTCOMES (Cos)

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Define the characteristics of aquifers. | 1,2,3 | 1,2,3 |
| CO2 | Estimate the quantity of ground water recharge by various methods. | 2,3,6 | 1,2,3 |
| CO3 | Understand the ground water flow through confined and unconfined aquifers. | 1,2,3,4 | 2,3 |
| C04 | Computing the unsteady state flows using theis method, Cooper and Jacob method, Chow's method. | 2,3,4,5 | 1,2,3,4 |
| CO5 | Select particular type of well and augment the ground water storage. | 1,2,3,4,5 | 1,2,3 |
| C06 | Understand the ground water developments. | 2,3,4,5,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 2 | 2 | 2 | 2 | 3 |
| CO2 | 3 | 2 | 2 | 2 | | | 2 | | | | | 2 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 2 | 2 | | | 2 | | | | | 2 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 2 | 2 | | | | | | | 2 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | 2 | 3 | | 2 | | | | | 2 | 3 | 2 | 3 | 3 |
| CO6 | | 3 | 2 | 2 | 3 | | 2 | | | | | 3 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| **Contents** |
|---|
| **UNIT: 1 Introduction:** Ground water occurrence (in soil & rock), definition of aquifer, aquifuge, aquitard and aqueduct. Types of aquifer & its parameters, Darcy's law, hydraulic conductivity, permeability coefficient, intrinsic permeability, transmissibility, Numerical problems. A case study on ground water management. |
| **UNIT: 2** Ground Water Recharge, Runoff and Balance: Artificial recharge: spreading method, urban storm runoff, vertical recharge, recharge component estimation, ground water discharge estimation, ground water balance and its components, case study. Numerical problems. |
| **UNIT: 3** Well Hydraulics: Steady Flow, Radial flow in confined and unconfined aquifers, pumping test, Unsteady Flow. Cooper and Jacob method, Chow's method, solution of unsteady flow equations, leaky aquifers (only introduction), interference of well, image well theory. Numerical problems. |
| **UNIT:4 Ground Water Exploration Techniques:**<br>Hydro geologic well logging, geophysical well logging, tracer techniques, problems, seismic method, electrical resistivity method. Ground water extraction& intrusion, ghyben-Herzberg relation, saline zones & interface, prevention & control of saline water intrusion. Numerical problems.<br>Ground Water Development<br>Types of wells, methods of construction, dug wells, pumps for lifting water, working principles, power requirement, Conjunctive use, necessity, techniques and economics. |

**Text Book:**

1. H.M. Raghunath, "Ground Water", Wiley Eastern Publication, New Delhi.
2. K. Todd, "Ground Water Hydrology", Wiley and Sons, New Delhi.
3. Bower. H., "Ground Water Hydrology" McGraw Hill, New Delhi.
4. Garg Satya Prakash, "Ground Water and Tube Wells", Oxford and IBH, New Delhi.

**Reference Books :**

1. W. C. Walton, "Ground Water Resources and Evaluation" McGraw Hill, Delhi.

2. Michel, D. M., Khepar, S. D., Sondhi, S. K., “Water Wells and Pumps” McGraw Hill, Delhi
3. Journals/Magazines

1. Journal of Groundwater Science and Engineering
2. Journal of Hydraulic Engineering

**SWAYAM/NPTEL/MOOCs:**
http://www.nptel.iitm.ac.in
Problem Based Learning

| No | Problem |
|---|---|
| 1. | An aquifer has an average thickness of 60m and areal extent of 100 ha. Estimate the available ground water storage if :<br>The aquifer is unconfined and the fluctuation in ground water table is observed as 15 m.<br>The aquifer is confined and the piezometric head is lowered by 50 m which drains half the thickness of aquifer. Assume a storage coefficient of 2 x 10-4 and a specific yield of 16%. |

Project Based Learning
Urban Ground Water Hydrology & Ground Water Quality in and around Bangalore cit

## COURSE PACK FOR: REPAIR AND REHABILITATION OF STRUCTURES

<table>
<tr><td>Course Title</td><td colspan="4">STRUCTURAL ANALYSIS</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EDS716</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>TLP</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>Theory</td><td>3</td><td>4</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>5</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**
Repair and Rehabilitation is the process of improving an existing structure for new conditions of use. It aims at restoring the structure to its original service level it once had and has now lost. In some cases, this consists of giving the structure the service level which was intended, but could not be attained because of deficiencies in the original design and or construction.
**Course Objective**
**This course enables graduating students**

1. To learn about causes of deterioration of structures, the investigation and methods of diagnosis of damaged structures and Quality assurance for concrete properties.
2. To learn about influence on serviceability and durability properties of concrete, cause of corrosion and methods to prevent corrosion. Importance and protective measures on various aspects of maintenance.
3. To learn about Inspection, Assessment procedure for evaluating a damaged structure and materials used for repair of damaged structure

4. To learn about techniques for repair , case study

**COURSE OUTCOMES (Cos)**
**After the completion of the course, the student will be able to:**

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Identify the causes of deterioration of structures, diagnosis of damaged structures by using various methods and capable of maintaining Quality assurance for concrete properties. | 1,2,12 | 1,2,4 |
| CO2 | Carryout analysis using NDT and evaluate structures | 1,2,4,12 | 1,2,4 |
| CO3 | Examine influence on serviceability and durability properties of concrete, should give preventive measures of corrosion control by various methods. | 1,2,12 | 1,2,4 |
| CO4 | Asses and evaluate the damaged structure by using suitable materials. | 1,2,3,5, 12 | 1,2,3,4 |
| C05 | Identify techniques for repair with the help of different case studies | 1,2,4,12 | 1,2,4 |
| CO6 | Carryout Physical evaluation and submit report on condition of the structure. | 1,2,3,4,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | | | | | | | | | | 3 | 2 | 2 | | 3 |
| CO2 | 2 | 2 | | 3 | | | | | | | | 3 | 3 | 2 | | 3 |
| CO3 | 3 | 3 | | | | | | | | | | 2 | 3 | 2 | | 3 |
| C04 | 3 | 3 | 3 | | 2 | | | | | | | 3 | 2 | 2 | 3 | 3 |
| CO5 | 2 | 2 | | 3 | | | | | | | | 2 | 2 | 3 | | 2 |
| CO6 | 3 | 2 | 3 | 2 | | | | | | | | 3 | 2 | 2 | 3 | 3 |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1 Introduction to Non- Destructive Testing :**<br>Cause of deterioration of concrete structures, Diagnostic methods and analysis, Preliminary investigations, Experimental investigations using NDT- Acoustical emission methods- Corrosion activity measurement- chloride content – Depth of carbonation- Impact echo methods- Ultrasound pulse velocity methods- Pull out tests, Load testing, Corrosion mapping, Core drilling, Partial destruction techniques and Other instrumental methods.<br>Quality assurance for concrete properties- Strength, Permeability, Thermal properties and Cracking |
| **UNIT-2: Deterioration of structures :**<br>Effects due to climate, Temperature, Chemicals, Wear and Erosion, Design and construction errors, Corrosion mechanism, Effects of cover thickness and Cracking, Methods of corrosion protection, Corrosion inhibitors, Corrosion resistant steels, Coatings, and Cathodic protection.<br>Maintenance and Repair Strategies: Definitions, Maintenance, Repair and rehabilitation, Facets of maintenance, Importance of maintenance, Protective measures on various aspects. Inspection, Assessment procedure for evaluating a damaged structure |
| **UNIT:3 Materials for Repair:**<br>Special concretes and mortars, Concrete chemicals, Special elements for accelerated strength gain, Expansive cement, Polymer concrete, Sulphur infiltrated concrete, Ferro-cement, Fibre reinforced concrete, Natural admixtures- Fibres- wraps- Glass and Carbon fibre wraps- Steel Plates. |
| **UNIT:4 Repair Techniques:**<br>Rust eliminators and polymer coating for rebar's during repair, foamed concrete, dry pack technique, vacuum concrete, Gunite and Shot Crete, Epoxy injection, Mortar repair for cracks, shoring and underpinning, Jacketing, Shotcreting, externally bonded plates, Nailing, Materials, Equipment, Precautions and Processes<br>Case studies of Repair to Structures: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering, wear, fire, leakage and marine exposure, engineered demolition techniques for dilapidated structures. |

**Text Book:**

1. "Deterioration, Maintenance and Repair of Structures" Sidney, M. Johnson, McGraw- Hill, London.
2. "Concrete Structures – Materials, Maintenance and Repair" Denison Campbell, Allen & Harold Roper, Longman Scientific and Technical, London.
3. "Repair of Concrete Structures", R.T.Allen and S.C. Edwards, Blakie and Sons, Hampshire.
4. "Rehabilitation of concrete structures" B.Vidiveli, Standard Publishers & Distributors, New Delhi.

**Reference Books**

1. "Maintenance Repair of Civil Structures" B.L Gupta &Amit Gupta, Standard Publishers & Distributors, New Delhi.
2. "Building Repair and Maintenance Management", P.S Gahlot& Sanjay Sharma, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
3. "Maintenance and Durability of concrete structures" P Dayaratnam, N.V Ramana Rao, Universities Press (India), 1997.

**Journals/Magazines**

1. Journal of Structural Engineering, American Society of Civil Engineers, USA
2. Journal of Structural Engineering, Chennai, India

**SWAYAM/NPTEL/MOOCs:**
http://www.nptel.iitm.ac.in
Project Based Learning
To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No | Suggested Project |
|---|---|
| 1 | Analyse a case study of reapir of defects in an old building nearby your own area and suggest the remedial measures required to be done if you are a rehabilitation engineer |

## COURSE PACK FOR: STRUCTURAL DYNAMICS

<table>
<tr><td>Course Title</td><td colspan="3">STRUCTURAL DYNAMICS</td><td colspan="2">Course Type</td><td colspan="2">Soft Core</td></tr>
<tr><td>Course Code</td><td>B20EDS717</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

This course will cover the theory of structural response to dynamic loads. Free vibration and forced (harmonic, periodic, arbitrary, impulse) vibration of single-degree-of-freedom (SDOF) and multi-degree-of-freedom (MDOF) systems are analyzed with examples. This course mathematically describes the response of SDOF and MDOF systems with and without damping to free vibration, harmonic, and arbitrary excitations.

**Course Objective**

**This course enables graduating students**

1. To understand the concepts and principles of structural mechanics
2. To frame mathematical models of SDOF and analyse the corresponding free vibration response of damped and undamped systems.
3. To frame mathematical models of MDOF systems and analyse the corresponding free vibration response of damped and undamped systems
4. To frame mathematical models of SDOF systems and analyse the corresponding forced vibration response of damped and undamped systems
5. To frame mathematical models of MDOF systems and analyse the corresponding forced vibration response of damped and undamped system.
6. To introduce the principle of vibration-measuring instruments and evaluation of damping.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Explain the concepts and principles of structural mechanics | 1,2,12 | 1,2,4 |
| CO2 | Frame mathematical models of SDOF systems and analyse the corresponding free vibration response of damped and undamped systems | 1,2,3,512 | 1,2,3,4 |
| CO3 | Frame mathematical models of MDOF systems and analyse the corresponding free vibration response of damped and undamped systems | 1,2,3,512 | 1,2,3,4 |
| C04 | Frame mathematical models of SDOF systems and analyse the corresponding forced vibration response of damped and undamped systems | 1,2,3,512 | 1,2,3,4 |
| C05 | Frame mathematical models of MDOF systems and analyse the corresponding forced vibration response of damped and undamped systems | 1,2,3,512 | 1,2,3,4 |
| C06 | Explain principle of vibration-measuring instruments and evaluation of damping | 1,2,12 | 1,2,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | | | | | | | | | | 2 | 2 | 1 | | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | | | | | | | 2 | 3 | 2 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 1 | | | | | | | 2 | 3 | 2 | 2 | 3 |
| C04 | 3 | 3 | 2 | 2 | 1 | | | | | | | 2 | 3 | 2 | 2 | 3 |
| C05 | 3 | 3 | 2 | 2 | 1 | | | | | | | 2 | 3 | 2 | 2 | 3 |
| C06 | 3 | 3 | | | | | | | | | | 2 | 2 | 1 | | 1 |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1 Introduction To Structural Dynamics:**<br>Introduction to dynamic problems in Civil Engineering, concept of degrees of freedom, D'Alembert's principle, principle of virtual displacement and energy principles.<br>Free Vibration of single degree of freedom systems: Mathematical models of single degree of freedom systems, free vibration response of damped and undamped systems, methods of evaluation of damping. |
| **UNIT:2 Free Vibration of Multi-degree freedom systems:**<br>Mathematical models of MDOF systems, free vibration of undamped MDOF systems - Natural frequencies and mode shapes – orthogonality conditions, Free vibration of damped MDOF systems. damping properties, Rayleigh's and Cauchey's damping methods |
| **UNIT:3 Forced Vibration of SDOF Systems:**<br>Response damped and un-damped systems to harmonic loading support motion, evaluation of damping, vibration isolation, transmissibility, response to periodic forces. Numerical methods applied to SDOF, Direct integration and Duhamel integral, principle of vibration-measuring instruments – seismometer and accelerometer. |
| **UNIT:4 Forced Vibration of MDOF Systems:**<br>Equations of Motion and Response to forced excitations, Modal analysis – free and forced vibration with and without damping. Dynamics of Continuous systems: Free longitudinal vibration of bars, flexural vibration of beams with different end conditions, forced vibrations – response of beams under moving loads, wave propagation in solids |

**Text Book:**
1. Mario Paz, “Structural dynamics–Theory and Computation”, CBS Publishers
2. R.W. Clough & J. Penzien, “Dynamics of Structures”, McGraw Hill
3. Anil K. Chopra, “Dynamics of Structures”, Prentice Hall of India

**Reference Books**

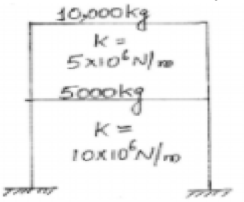
Timoshenko, S., “Vibration Problems in Engineering”, Van No strand Co.
Mukhopadhyaya, “Vibration and Structural Dynamics”, Oxford &IBH
William Thompson, “Theory of Vibration with Applications”

**Journals/Magazines**

1. International Journal of Structural Stability and Dynamics

SWAYAM/NPTEL/MOOCs:
http://nptel.ac.in/courses/105/106/105106151/

**Problem Based Learning**

<table>
<tr><th>No</th><th>Problem</th></tr>
<tr><td>1.</td><td>For the shear building shown in figure compute the natural frequencies and mode shapes. Draw the mode shapes.<br>
</td></tr>
</table>

Project Based Learning

To enhance the skill set in the integrated course, the students are advised to execute course-based design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | A machine weighing 600 N is supported by spring of stiffness k=20 N/mm and damper of coefficient<br>C = 0.01 N-sec/mm. A harmonic force of amplitude 20 N is applied. Compute the resonant amplitude. |

**COURSEPACKFOR:URBAN TRANSPORT PLANNING**

<table>
<tr><td>Course Title</td><td colspan="4">Urban Transport Planning</td><td colspan="2">CourseType</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EDS712</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">VII semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</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>Theory</td><td>3</td><td>5</td><td>5</td></tr>
<tr><td>Practice</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>Tutorial</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>5</td><td>5</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**CourseOverview**

Urban transportation planning course educates the students to understand the various concepts in urban system components. The course also introduces the students to the four-stage modelling and the various methods to evaluate.

**CourseObjective**

**Thiscourseenablesgraduating students**

1. To make students familiar with the basic definitions of urban system components; to give an idea about land use and traffic interpretations.
2. To educate students about the various surveys and their interpretation for collecting data.
3. To give students an overview of the various models used to know the trip generation
4. To make students familiar with trip distribution.
5. To make students understand the factors affecting modal split, traffic assignment techniques.
6. To educate students with economic evaluation in transportation

**COURSEOUTCOMES(Cos)**

**Afterthecompletionofthecourse,thestudentwillbeableto:**

| CO# | CourseOutcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Discuss the interdependence of land use and traffic, difficulties in transport planning and the system approach to urban planning | 1,6,8,10,12 | 1,4 |
| CO2 | Describe the stages involved in urban planning, procedure and suitability of various types of surveys | 1,2,5,7,8,9,10 | 1,2,4 |
| CO3 | Evaluate the methods of trip generation and distribution, | 1,2,4,5,6,7,9,10,11 | 1,2,3,4 |
| C04 | Compare the various models used to generate O-D matrix | 1,2,4,5,6,7,9,10,11 | 1,2,3,4 |
| C05 | Enumerate the different factors affecting modal split, traffic assignment techniques. | 1,2,4,5,6,7,8,10,12 | 1,4 |
| C06 | Evaluate the demand and supply in transportation and consideration of evaluation | 1,2,4,5,6,7,8,10,12 | 1,4 |

**Bloom'sLevel oftheCourseOutcomes**

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

**Course Articulation MatrixNote:1-Low,2-Medium,3-High**

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | **3** | | | | | **3** | | **2** | | **2** | | **2** | **3** | | | **1** |
| CO2 | **3** | **3** | | | **2** | | **2** | **2** | **3** | **3** | **1** | | **3** | **3** | | **1** |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3 | 3 | 3 | | 2 | 2 | 3 | 1 | | 3 | 1 | 2 | | 3 | 3 | 1 | 2 |
| CO4 | 3 | 3 | | 2 | 2 | 3 | 1 | | 3 | 1 | 2 | | 3 | 3 | 1 | 2 |
| C05 | 3 | 3 | | 2 | 2 | 1 | 2 | 3 | | 3 | | 2 | 3 | | | 2 |
| C06 | 3 | 3 | | 2 | 2 | 1 | 2 | 3 | | 3 | | 2 | 3 | | | 2 |

**Course Content Theory**

| **Contents** |
|---|
| **UNIT:1- Introduction**<br>Urban system components, scope of urban transport planning, concepts and definitions like related to transport Planning Process, Problem Definition, Solution, Generation, Solution Analysis, Evaluation and Choice, Implementation. Difficulties in transport planning. Interdependency of land use and traffic. Urban Transport planning for small and medium sized cities. Systems approach to urban planning. Any relevant case studies. |
| **UNIT:2 - Stages of Transport planning :**<br>Four stage Transport modelling-mass transit- types, classifications and advantages. Transport Surveys: Basic Movements-Study Area- Zoning – Surveys – home interview, commercial vehicle, roadside, post card method, and tag on vehicle method, data collection & sampling techniques. |
| **UNIT:3- Trip Generation and Distribution:**<br>Home based Trip & non-home based trips, trip purpose, Factors governing trip generation and attraction –Application of Regression Analysis- Category analysis. Methods of trip distribution: Growth Models and Synthetic Models- Numerical Examples. |
| **UNIT:4- Modal Split and Traffic Assignment:**<br>Factors affecting modal split, Modal split in transport planning, recent developments in modal split analysis. Traffic Assignment: goals, Principles of traffic assignment; assignment techniques like AON, multiple route assignment, Capacity & Diversion curves. Transport demand and supply, Economic evaluation. Numerical Examples. |

TextBook:


1. Khanna S K, Justo C E G and Veereragavan A, “Highway Engineering”, Nemchand and Bros, Roorkee.
2. Kadiyali, L.R., `Traffic Engineering and Transportation Planning' - Khanna Publication, New Delhi, 2009


ReferenceBooks


1. JotinKhisty and B. Kent Lall “Transportation Engineering –An Introduction”- PHI, New Delhi, 3rd Indian Edition, 2006.
2. Hutchinson, B.G., `Principles of Urban Transport System Planning' - McGraw Hill Book Co., London, UK, 1982.
3. Institute of Traffic Engineers - An Introduction to Highway Transportation Engineering’ New York., 1982
4. Introduction to Transportation Planning – M.J.Bruton; Hutchinson of London Ltd


**Journals/Magazines**

1. Journal of Landscape and Urban Planning, American Society of Civil Engineers, USA

**SWAYAM/NPTEL/MOOCs:**

https://nptel.ac.in/courses/105/107/105107067/

**Problem Based Learning**

<table>
<tr><th>No</th><th>Problem</th></tr>
<tr><td>1</td><td>The total trips produced in and attracted to the three zones A, B and C of a survey area in the design year are tabulated as<br><table><tr><td>Zones</td><td>Trips Produced</td><td>Trips attracted</td></tr><tr><td>A</td><td>2000</td><td>3000</td></tr><tr><td>B</td><td>3000</td><td>4000</td></tr><tr><td>C</td><td>4000</td><td>2000</td></tr></table>It is known that the trips between two zones are inversely proportional to the second power of the travel time between zones, which is uniformly 20minutes. If the trip interchange between zones B and C is known to be 600, calculate the trip interchange between zones A and B, A and C, B and A, C and B</td></tr>
<tr><td>2</td><td>The total trips produced in four residential areas A, B, C and D from home to work and two industrial estates are given below.<br>Zone A-1000, Zone B-2250, Zone C-1750 and Zone D-3200.There are 3700 and 4500 jobs in industrial estates X and Y respectively. The journey times in minutes from home to work given as below. Calculate and tabulate the inter zonal trips for journeys from home to work<br><table><tr><td>Zones</td><td>X</td><td>Y</td></tr><tr><td>A</td><td>15</td><td>20</td></tr><tr><td>B</td><td>15</td><td>10</td></tr><tr><td>C</td><td>10</td><td>10</td></tr><tr><td>D</td><td>15</td><td>20</td></tr></table></td></tr>
</table>

ProjectBasedLearning

Toenhancetheskillsetintheintegratedcourse,thestudentsareadvisedtoexecutecourse-based

**Designprojects.Somesampleprojectsaregivenbelow:**

| No | Suggested Project |
|---|---|
| 1 | To conduct different types of surveys to evaluate trip generation and trip generation any selected area |

## COURSE PACK FOR: CONSTRUCTION MATERIALS AND SUSTAINABILITY

<table>
<tr><td>Course Title</td><td colspan="3">Construction Materials and Sustainability</td><td colspan="2">Course Type</td><td colspan="2">Soft Core</td></tr>
<tr><td>Course Code</td><td>B20EDS719</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work load</td><td colspan="2" rowspan="2">Total Number ofClasses<br>Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

The objective of this course is to expose the students to the concepts of sustainability in the context of building and conventional engineered building materials, such as Concrete, Bricks, and achieving the same through lower Carbon cements, Superior brick kilns and Recycled aggregate minimizing consumption of natural resources including water. VOC and indoor air quality. Exposing the student to concepts of embodied, Operational and Life Cycle Energy, Minimizing Energy consumption by optimal design, use of BIPV. The course also intend to make student aware of ECBC, LEED, GRIHA etc.

**Course Objective:**

**This course enables graduating students to**

1. Define sustainability in their own words and relate how sustainability is defined in the context of new construction as well as renovation and rehabilitation.
2. Demonstrate concepts of life-cycle analysis including economic and sustainability aspects and apply these concepts to sustainable construction.
3. Identify key material properties important to the successful application of aggregates, asphalt concrete, Portland cement concrete, wood and metals to a variety of civil works.
4. Understand the importance of Embodied energy, Operational energy in Building and Life cycle energy. Ecological footprint, Bio-capacity and calculation of planet equivalent.
5. Learn the various Energy codes for ECBC requirement, Concepts of OTTV etc
6. Understand the importance of Green Performance rating, requirements of LEED, GRIHA etc.

**COURSE OUTCOMES (Cos):**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Learn the definition of sustainability and relate how sustainability is defined in the context of new construction as well as renovation and rehabilitation. | 1,7,8,10,12 | 2 |
| CO2 | Apply the concepts of life-cycle analysis including economic and sustainability aspects in sustainable construction. | 1,5,6,7,12 | 3,2 |
| CO3 | Identify the key material properties related to sustainability. | 2,4,4,4,7,8,9 | 3 |
| C04 | Apply the concepts of Embodied energy, Operational energy in Building, Life cycle energy and Ecological footprint in sustainable building construction. | 2,3,4,5,6,7,10,11,12 | 1,4 |
| C05 | Apply the various Energy codes for Bureau of Energy Efficiency ECBC requirement in sustainability | 2,3,4,5,6,7,8,9,11, | 3,4 |

| | | | |
|---|---|---|---|
| C06 | Learn the importance of Green Performance rating, requirements of LEED, GRIHA etc | 2,3,4,5,6,7,9, | 3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | 1 | 3 | 2 | | 2 | | 2 | 2 | | | 1 |
| CO2 | 2 | 1 | | | 3 | 3 | 3 | | 1 | | | 2 | 3 | 2 | | |
| CO3 | | 3 | | 2 | 2 | 2 | 3 | 3 | 2 | | 1 | 3 | | 1 | 3 | |
| C04 | | 2 | 3 | 2 | 2 | 2 | 3 | | 1 | 3 | 3 | 2 | 2 | | 1 | 3 |
| CO5 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | | 3 | 1 | 1 | | 3 | 2 |
| CO6 | | 2 | 3 | 2 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | | | 1 | 3 | 2 |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1- Engineering Sustainability.**<br>Introduction- Role of Civil Engineering materials, Embodied energy, Operational energy in Building and Life cycle energy. Ecological footprint, Bio-capacity, and calculation of planet equivalent. Role of Material: Carbon from Cement, alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission. Sustainability issues for concrete. Role of quality, minimization of natural resource utilization, High volume fly ash concrete, geo-polymer concrete etc. Concrete with alternative material for sustainability- Reduction in water consumption in concrete. |
| **UNIT:2 Alternative Building materials.**<br>Recycled aggregate, Energy for grinding crushing of cement aggregate etc. and reduction. Operational energy in building role of materials and thermal conductivity. Asphalt concrete, Clay Bricks, Types of kilns, Comparative energy performance emission performance and financial performance, Indoor air quality. Paints, Adhesive, and sealants for use in building, Volatile organic content (VOC) emission issues and indoor air quality for Sustainability and Health hazard. |

| |
|---|
| **UNIT: 3- Operational energy in construction**<br>Operational energy reduction and net zero building, Optimization for design of building for energy efficiency and example of optimization through use of Evolutionary genetic algorithm. Radiation budget, Surface water balance, Effects of trees and microclimatic modification through greening. |
| **UNIT: 4 Sustainable building performance indicators.**<br>Introduction, Sustainable building performance indicators Use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in buildings, basic concepts and efficiency. Energy codes ECBC requirement, Concepts of OTTV etc. Green Performance rating, requirements of LEED, GRIHA etc. |

**Textbook:**


1. J. K. Yates & Daniel Castro-Lacouture " Sustainability in Engineering Design and Construction". Publisher : CRC September 2015. ISBN-10 : 1498733913.
2. Daniel Vallero and Chris Brasier: Sustainable Design - The science of sustainability and Green Engineering; Wiley, 2008.
3. Margaret Robertson, Sustainability Principles and Practice, Routledge, 2014
4. Reference Books
5. Martin A. A. Abraham , Sustainability Science and Engineering: Defining Principles, Elsevier Science, 2005
6. Tony Clayton, Nicholas J. Radcliffe, Anthony M. H. Clayton, Sustainability: A Systems Approach, Routledge, 1996
7. Stephen M. Stephen, Stephen M. Wheeler, Climate Change and Social Ecology: A New Perspective on the Climate
8. Challenge, Routledge, 2012
9. Gursharan Singh Kainth, Climate Change, Sustainable Development and India, LAP Lambert
10. Academic Publishing, 2011Sam Kubba, Handbook of Green Building Design and Construction, Butterworth-Heinemann, 2012, ISBN 9780123851284,
11. https://doi.org/10.1016/B978-0-12-385128-4.00027-5. (https://www.sciencedirect.com/science/article/pii/B9780123851284000Sam Kubba, LEED
12. v4 Practices, Certification, and Accreditation Handbook Book • Second Edition • 2016 - ISBN 9780128038307,


**Journals/Magazines**


1. Materials Today Sustainability https://www.sciencedirect.com/journal/materials-today-sustainability
2. Sustainability, Energy and Architecture https://www.sciencedirect.com/book/9780123972699/sustainability-energy-and-architecture


**SWAYAM/NPTEL/MOOCs:**

SUSTAINABLE MATERIALS AND GREEN BUILDINGS, by Prof. Bishwajit Bhattacharje. IIT Delhi
NPTEL : https://nptel.ac.in/courses/105/102/105102195/#

## COURSE PACK FOR: ENVIRONMENTAL GEO-TECHNOLOGY

| Course Title | Environmental Geo-Technology | | | Course Type | | Theory | |
|---|---|---|---|---|---|---|---|
| Course Code | B20EDS720 | Credits | 4 | Class | | VII semester | |
| Course Structure | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | 0 | 0 | 0 | Theory | Practical | CIE | SEE |
| | Tutorial | 0 | 0 | 0 | | | | |
| | **Total** | **3** | **3** | **3** | **42** | **0** | **50%** | **50%** |

**COURSE OVERVIEW**

This course introduces the students to New approach entitled for analyzing soil behavior under various environmental conditions. The main purpose for developing this theory is to link unrelated phenomena into one system that reflects in situ conditions.

**COURSE OBJECTIVE**

**This course enables graduating students**

1. To explain the effects of pollutants in soil properties
2. To get awareness about the adverse effects of pollutants on soil.
3. To get awareness about Pollutants effects on ground water.
4. Analyses and apply the various techniques for remediation of the contaminants
5. To understand suitability of landfills for various kind of soils.
6. Solid waste disposal and using as soil admixture.

**COURSE OUT COMES (COs)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Need for contaminated site characterization. | 1, 2, 3 | 2, 3 |
| CO2 | Analyse the soil contamination concentration and type | 1, 2, 3 | 2, 3 |
| CO3 | Detection of polluted zone, Monitoring and Effectiveness of designed facilities. | 1, 2, 3 | 2, 3 |
| CO4 | Design the landfill site | 1, 2, 3 | 2, 3 |
| CO5 | Planning of phased operation, leachate collection facility, gas collection facility, stability aspects, environmental monitoring systems. | 1, 2, 3 | 1, 3 |
| C06 | Utilization of solid waste for soil improvement. | 1, 2, 3, 11 | 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 | | ✓ | ✓ | ✓ | ✓ | |

**COURSE ARTICULATION MATRIX**

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

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

**COURSE CONTENT THEORY**

| **Contents** |
|---|
| **UNIT – I Sources and Site Characterization:**<br>Introduction to Geo environmental engineering –Scope of Geo-environmental Engineering, Environmental cycle Various Sources of Contaminations, Classification of waste, Characteristics of different wastes and their management, Liquid waste characterization, Solid waste characterization, Hazardous waste characterization, Need for contaminated site characterization; Environmental Concerns with waste, Waste management strategies. Geotechnical properties of solid waste, Waste generation and disposal on land, Impact on environment. |
| **UNIT:2 Subsurface Contamination:**<br>Sources of ground water contamination, Contaminant transport in sub surface – advection – diffusion – dispersion – governing equations – contaminant transformation – absorption – biodegradation – ion exchange – precipitation ground water pollution – pollution of aquifers by mixing of liquid waste – protecting aquifers, Effect of subsurface contamination, Detection of polluted zone, Monitoring and Effectiveness of designed facilities. |

| |
|---|
| **UNIT:3 Land fill planning and design consideration:**<br>Introduction, types of landfills, site selection for landfills, shape and size of landfills, landfill layout, landfill section, landfill capacity Liner and liner system, Cover and cover system, Stability of landfills. Site characterization, Planning of phased operation, leachate collection facility, gas collection facility, stability aspects, environmental monitoring systems, construction schedule, material requirement, equipment requirement, environmental control during operation, landfill closure and post closure plan. |
| **UNIT:4 Remediation Techniques:**<br>Objectives of site remediation, various active and passive methods of remediation NAPL sites, Emerging Remediation Technologies. Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – Ex-situ and In-situ remediation – solidification, bio – remediation, incineration, soil washing, electro kinetics, soil heating, verification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well. Hazardous waste control and storage system – stabilization/ solidification of wastes mechanism of stabilization – organic and inorganic stabilization – utilization of solid waste for soil improvement. A case study. |

**Text Books:**
Sharma, H. D. and Reddy, K. R. - Geoenvironmental Engineering, John Wiley & Sons (2004)
Rowe, R. K. - Geotechnical &Geoenvironmental Engineering Handbook
Rowe, R. K. - Geotechnical &Geoenvironmental Engineering Handbook, Kluwer Academic, 2001
Reddi, L. N. and Inyang, H. I. - Geoenvironmental Engineering Principles and Applications, Marcel. Dekker, Inc., New York (2000).
**Reference Books:**
LaGrega, M. D., Buckingham, P. L. and Evans, J. C. - Hazardous Waste Management, New York: McGraw-Hill, 2001
Phillip B. Bedient, Refai, H. S. & Newell C. J. - Ground Water Contamination – Prentice Hall Publications, 4th Edition, 2008
Daniel, B.E., Geotechnical Practice for waste disposal, Chapman and Hall, London, 1993.
Westlake, K., (1995), Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.

Magazines: Civil Engineering and Construction Review
**SWAYAM/NPTEL/MOOCs:**
1. NPTEL :: Civil Engineering - NOC:Geoenvironmental Engineering (Environmental Geotechnology): Landfills, Slurry Ponds & Contaminated Sites (100%)
**PROBLEM BASED LEARNING**

| No | Problems |
|---|---|
| 1 | What are the sources of contamination? |
| 2 | How the landfills are designed? |
| 3 | What are the various active and passive methods of remediation NAPL sites? |
| 4 | How polluted zones are detected? |

**Project Based Learning – Integrated Course**
To Enhance the Skill Set in The Integrated Course, The Students Are Advised to Execute Course-Based
Design Projects. Some Sample Projects Are Given Below:

| No. | Suggested Projects |
|---|---|
| 1. | Determination of Index and engineering properties of contaminated soils. |
| 2. | Determination of Index and engineering properties of contaminated soils with admixtures. |

COURSE PACK FOR: ENVIRONMENTAL IMPACT ASSESSMENT AND LIFE CYCLE ANALYSIS

<table>
<tr><td>Course Title</td><td colspan="3">ENVIRONMENTAL IMPACT ASSESSMENT AND LIFE CYCLE ANALYSIS</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EDS721</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>TLP</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</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>Tutorial</td><td>0</td><td>-</td><td>-</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**

This course will introduce students to the theory and practice of environmental impact assessment (EIA), the systematic identification and evaluation of the potential effects on the physical, biological, cultural, and socioeconomic components of the environment of proposed actions—projects, plans, programs, legislation. The course will make students to be able to understand life cycle analysis like process, elements and green building.

**Course Objective**

**This course enables graduating students**

1. To provides instruction in the theory and methods of environmental impact assessment (EIA).
2. To Gain a critical understanding of the use and strengths.
3. To understand the limitations of EIA, and develop working familiarity with EIA methods and analytic techniques.
4. To use for professional planning for different ways which includes evaluation of proposed public and private development projects, government policies and programs.
5. Appreciate the purpose and role of EIA in the decision-making process
6. Understand the purpose of developing follow-up procedures, and options for designing these procedures.

**COURSE OUTCOMES (Cos)**

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

| **CO#** | **Course Outcomes** | **POs** | **PSOs** |
|---|---|---|---|
| CO1 | Strengthen understanding of the impacts related to developing projects on Environment, culture and socio-economic environment | 1,2,3,4,5, 9,12 | 1,2,3,4 |
| CO2 | Understanding the methodology for preparation of a systematic EIA report. | 1,2,3,4,5, 9,12 | 1,2,3,4 |
| CO3 | Learn to discuss adaptive management and monitoring as follow up activities | 1,2,3,4,5, 9,12 | 1,2,3,4 |
| C04 | To familiarise students with a variety of professional tools used in predicting environmental impacts. | 1,2,3,4,5, 7,9,12 | 1,2,3,4 |
| CO5 | To examine a range of environmental impact assessments. | 1,2,3,4,5, 12 | 1,2,3,4 |
| C06 | Explain cleaner production and life cycle assessment | 1,2,3,5,9, 12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 3 | - | - | - | 2 | - | - | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 2 | - | - | - | 2 | - | - | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 2 | - | - | - | 2 | - | - | 3 | 3 | 3 | 1 | 3 |
| C04 | 3 | 3 | 2 | 1 | 2 | - | 2 | - | 2 | - | - | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 | 2 | 3 | 3 |
| CO6 | 3 | 3 | 2 | - | 2 | - | - | - | 2 | - | - | 3 | 3 | 2 | 3 | 3 |

### Course Content Theory

| **Contents** |
|---|
| **UNIT:1 Introduction:** Environmental Impact Assessment (EIA), Historical development of Environmental Impact Assessment - Environmental Impact Statement (EIS) - Environmental Risk Assessment (ERA) - Legal and Regulatory aspects in India - Types and limitations of EIA - Terms of Reference in EIA- Issues in EIA - national - cross sectorial - social and cultural. |
| **UNIT:2 Components and Methods & Quality Control:** Components - screening - setting - analysis - prediction of impacts - mitigation. Matrices - Networks - Checklists. Importance assessment techniques - cost benefit analysis - analysis of alternatives - methods for Prediction and assessment of impacts - air - water - soil - noise - biological - cultural - social - economic environments.<br>Standards and guidelines for evaluation, Public Participation in environmental decision making, Trends in EIA practice and evaluation criteria - capacity building for quality assurance, International Environmental Standards, ISO 14001 |
| **UNIT:3 Documentation and Monitoring:** Expert System in EIA - use of regulations and AQM. Document planning - collection and organization of relevant information - use of visual display materials – team writing - reminder checklists. Environmental monitoring - guidelines - policies - planning of monitoring programs. Environmental Management Plan, Post project audit. |
| **UNIT:4 Life Cycle Analysis:** Cleaner Production and Life Cycle Assessment: Definition, Importance, Source Reduction Techniques, Process and equipment optimization, reuse, recovery, recycle, raw material substitution, Elements of LCA, Life Cycle Costing, Eco-labelling ,Alternative energy resources- wind turbines, hydroelectric, bio-fuels, solar power. Life Cycle assessment and Green buildings. |

**Text Book:**

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., 1997
2. David P. Lawrence, Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, 2003
3. Prasad Modak, C.Visvanathan and Mandar Parasnis (1995) ‘Cleaner Production Audit’, Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok.

Reference Books:

1. UNESCO, Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development, UNESCO/UNEP, Paris, 1987.
2. Paul L. Bishop, “Pollution Prevention: Fundamentals and Practice”, McGraw-Hill International, 2000.

**Journals/Magazines**

Journal of Environmental Impact assessment review

Journal of Environmental Assessment Policy and Management

**SWAYAM/NPTEL/MOOCs:**

https://onlinecourses.swayam2.ac.in/nou21_bt02/preview

https://nptel.ac.in/courses/120/108/120108004/ Problem Based Learning

| No | Problem |
|---|---|
| 1 | Environmental clearance for different engineering projects which will effect the environment lifecycle and also all the attributes. |

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based

| No. | Suggested Projects |
|---|---|
| 1. | EIA for Water resource developmental projects |
| 2. | EIA for Highway projects |
| 3. | EIA for Nuclear- Power plant projects |
| 4. | EIA for Mining project (Coal, Iron ore) |
| 5 | EIA for Thermal Power Plant |
| 6 | EIA for Infrastructure Construction Activities. |

Design projects. Some sample projects are given below:

## COURSE PACK FOR: FINITE ELEMENT ANALYSIS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Title** | **FINITE ELEMENT ANALYSIS** | | | | **Course Type** | | **Integrated** | |
| **Course Code** | **B20EDS722** | **Credits** | **3** | | **Class** | | **IV semester** | |
| **Course Structure** | TLP | Credits | Contact Hours | Work Load | Total Number of Classes Per Semester | | Assessment in Weightage | |
| | Theory | 3 | 3 | 3 | | | | |
| | Practice | - | - | - | Theory | Practical | CIE | SEE |
| | Tutorial | - | - | - | | | | |
| | **Total** | **3** | **3** | **3** | **48** | **-** | **50%** | **50%** |

**Course Overview**

The Finite Element Method (FEM) is a procedure for the numerical solution of the equations that govern the problems found in nature. ... When referred to the analysis of structures the FEM is a powerful method for computing the displacements, stresses and strains in a structure under a set of loads.

**Course Objective**

**To describe the significance and importance of finite element method of analysis**

1. To understand displacement functions & derive element properties
2. To understand the approximate methods of analysis
3. To understand Isoparametric formulation
4. To Analyse continuous beams and frames
5. To understand nonlinearity in structural analysis & FEA software packages

This course enables graduating students

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | To get the confidence in the application of finite element analysis | 1,2,12 | 1,2,4 |
| CO2 | To derive displacement functions and implementation | 1,2,12 | 1,2,4 |
| CO3 | To apply approximate methods of analysis for problem solving | 2,4,12 | 1,2,3,4 |
| CO4 | To implement Isoparametric formulation for specific cased | 1,2,3,5, 12 | 1,2,3,4 |
| CO5 | Solve the problems on continuous beams and frames | 2,4,12 | 1,2,3,4 |
| C06 | Apply the software for analyzing the structures | 2,4,12 | 1,2,3,4 |

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

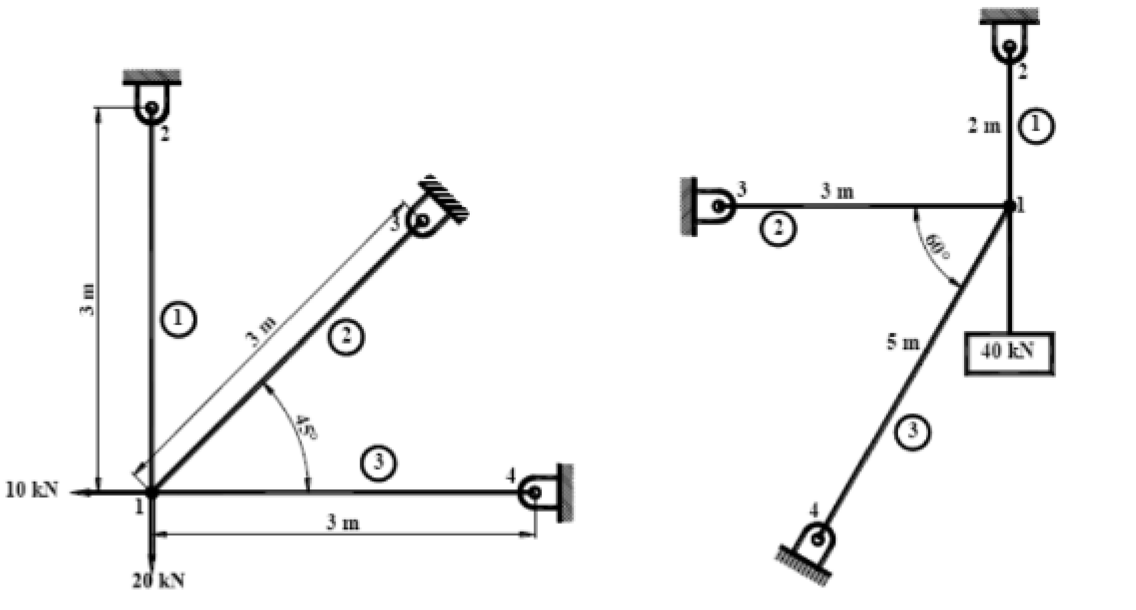
| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO3 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C04 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| CO6 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |

## Course Content Theory

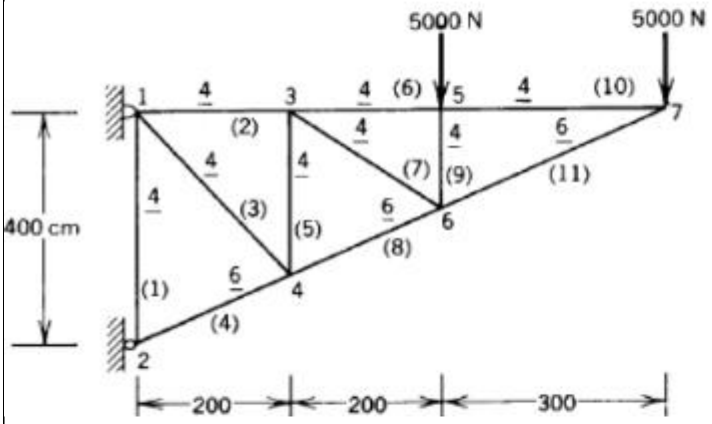
| **Contents** |
|---|
| **UNIT:1** Introduction and Fundamentals of FEA: Basic concepts of energy theorems, theory of elasticity, matrix displacement formulation, approximate methods of analysis – Finite Difference Method, Rayleigh-Ritz Method and Galerkin’s Method – simple applications in structural analysis, Principles, advantages & disadvantages of FEA, procedure involved, coordinate systems, static & kinematic variables, different types of elements – their characteristics & suitability of application. |
| **UNIT:2** Displacement Functions and Element Properties: Pascal’s triangle, compatibility & convergence requirements, derivation of element properties for 1D and 2D elements in natural and Cartesian coordinates (shape functions, strain-displacement matrix & stiffness matrix) – for first order & higher order elements, Lagrange interpolation function & Hermitian polynomials. |
| **UNIT:3** Isoparametric Formulation and Analysis of 1D & 2D structures: Concept of Isoparametric, sub parametric & super parametric elements, convergence requirements for Isoparametric elements, Analysis of continuous beams, rigid jointed plane frames and pin jointed plane frames using FEA (not more than 3 unknowns). |
| **UNIT:4** Introduction to Non-linear FEA and Software Packages: Types of non-linearity in structural problems, modelling considerations, mesh generation & refinement, common mistakes in modelling, organization of software package for FEA – flowcharts, desired features of Pre and Post Processors, commonly used commercial software packages. |

**Text Book:**
1. Krishnamoorthy C S, “Finite Element Analysis – Theory & Programming”, Tata McGraw Hill Co. Ltd., New Delhi.
2. Chadrupatla & Ashok Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall India, New Delhi
3. Abel J F & Desai C S, “Introduction to the Finite Element Method”, Affiliated East West Press Pvt. Ltd., New Delhi
4. Zienkeiwicz O C, “The Finite Element Method”, Tata McGraw Hill Co. Ltd., New Delhi.
**Reference Books**
1 P. Seshu, “Finite Element Analysis” PHI Learning Pvt. Ltd. New Delhi
2. J. N. Reddy, “Introduction to Finite Element Method”, McGraw-Hill Education
**Journals/Magazines**
1. An International Journal for Innovations in Computational Methodology and Application
2. Journal of Structural Engineering ASCE, USA
**SWAYAM/NPTEL/MOOCs:**
http://www.nptel.iitm.ac.in
https://www.coursera.org/courses?query=finite%20element

**Problem Based Learning**

| No | Problem |
|---|---|
| | For the plane trusses shown in Figure, determine the horizontal and vertical displacements of node 1 and the stresses in each element. All the elements have E = 210 GPa and A = 10 × 10-4 m2.<br><br><br>(a) (b) |
| | |

**Project Based Learning**
To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Each joint of the structural system shown in Figure is a pinned joint. The cross-sectional area of each member in cm2 is underlined. Each member is made of steel, E = 20 × 106 N/cm2. All lengths are given in centimeters. Calculate the unknown nodal displacements and the axial force in each member.<br><br>Such problems can be frames for a batch of students so that students get confidence to solve problems |



**COURSE PACK FOR: INTELLIGENT TRANSPORATION SYSTEM**

<table>
<tr><td>Course Title</td><td colspan="4">INTELLIGENT TRANSPORATION SYSTEM</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EDS723</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>TLP</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

Intelligent Transportation System is contemporary need of most of metropolitan cities across the countries. ITS provides the solution for efficient management of transportation complexities through usage of various advanced technologies like detectors, sensors, computing technologies.

**Course Objective**

**This course enables graduating students**

1. To provide an insight on various terminologies, historical context, current market for ITS, benefits and data collection techniques by using ITS technologies.
2. To explain the application of sensors for various purposes in transportation, telecommunication systems, route guidance & navigation system, information management.
3. To describe various sub systems of ITS and user requirement like real time information, traffic management, vehicular technologies, public transportation systems, commercial vehicle systems.

4. To provide an insight about ITS in rural transportation system.
5. To describe the ITS architecture, application in terms of electronic payments, road pricing, road network operation, sustainability in transportation.
6. To describe the automated highway systems, overview of ITS across the developing & developed nations.

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Understand the components of various term, market perspective, benefits and different data collection techniques. | 1,2,5,11 | 1,2,3 |
| CO2 | Identify different application of sensors for various user services. | 1,2,5,6 | 2,3,4 |
| CO3 | Identify different sub systems their integration for effective transportation management system. | 1,2,5,6,7 | 1,3,4 |
| C04 | Understand the ITS implementation in Rural transportation frame | 1,2,3,7,12 | 1,2,4 |
| C05 | Ability to recognize available technologies for toll collection, road pricing and sustainability in transportation. | 1,2,5,6,7 | 1,3,4 |
| C06 | Understanding the various challenges of ITS technologies around the world | 1,2,5,6 | 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 | | ✓ | ✓ | ✓ | | |
| C05 | ✓ | ✓ | ✓ | ✓ | | |
| C06 | | ✓ | ✓ | | | |

**Course Articulation Matrix Note: 1-Low, 2-Medium, 3-High**

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | | | 2 | | | | | | 3 | | 3 | 3 | 2 | |
| CO2 | 3 | 2 | | | 3 | 3 | | | | | | | | 3 | 3 | 2 |
| CO3 | 2 | 3 | | | 3 | 3 | 3 | | | | | | 2 | | 3 | 3 |
| C04 | 2 | 2 | 3 | | | | 3 | | | | | 3 | 3 | 2 | | 3 |
| C05 | 2 | 3 | | | 3 | 2 | 2 | | | | | | 3 | 3 | | 2 |
| C06 | 3 | 2 | | | 3 | 2 | | | | | | | 2 | 3 | 3 | |

**Course Content Theory**

| **Contents** |
|---|
| **UNIT:1 Fundamentals Of ITS:** Definition, objectives, the historical context from both public policy and market economic perspectives, Applications of ITS, Types of ITS, Benefits of ITS, data collection techniques- Detectors, Automatic vehicle location, automatic vehicle identification, geographic Information system, video data collection, ITS case studies. |
| **UNIT: 2 Sensor Technologies and Data Requirements of ITS:** Importance of telecommunications in the ITS. Information Management, Traffic Management Centres (TMC), Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centres; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts. |
| **UNIT:3 ITS User Needs and Services:** Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveller Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS), travel and traffic management, public transportation management. |
| **UNIT:4 ITS Applications:** Traffic and incident management systems; sustainable mobility, travel demand management, electronic toll collection, road-pricing.; Transportation network operations; regional strategic transportation planning, including regional architectures: Automated Highway Systems- Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries. |

**Text Book:**

1. Fundamentals of intelligent transportation systems planning By Mashrur A. Chowdhury, Adel Wadid Sadek.
2. Lawrence A. Klein, Sensor technologies and Data requirements of ITS.
3. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

Reference Books

1. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
2. National ITS Architecture Documentation, US Department of Transportation, 2007.

**Journals/Magazines**

1. IET Intelligent Transport Systems,UK
2. IEEE Open Journal of Intelligent Transportation Systems

**SWAYAM/NPTEL/MOOCs:**

An Introduction to Intelligent Transportation Systems: ( https://ocw.mit.edu/)
Introduction to Smart Urban Infrastructures and Smart Cities (Coursera)

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based Case studies . Some sample projects are given below:

| No | Suggested Project |
|---|---|
| 1 | Case Studies from<br>Dublin, Ireland<br>Florence, Italy<br>Izmir, Turkey<br>Prince William County, USA<br>Zurich, Switzerland<br>Johannesburg, South Africa<br>Mysore, India<br>Accra, Ghana<br>Cebu, Philippines<br>Sri Lanka |

**COURSE PACK FOR: THEORY OF ELASTICITY**

<table>
<tr><td>Course Title</td><td colspan="4">THEORY OF ELASTICITY</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EDS724</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

The theory of elasticity treats the relationship between forces applied to an object and the resulting deformations. In practice, the analysis of the elastic behaviour of a material is reduced to the study of simple deformations and the determination of the corresponding elastic constants.

**Course Objective**

1. To analyze stress at a point and principles of Analysis of Stress.
2. To know the formulations of invariants of stress
3. To analyze strain at a point and principles of Analysis of strain.
4. To determine the invariants of strain
5. To solve 2D problems of elasticity by Airy's stress function approach
6. To analyze Plastic analysis of structures

**This course enables graduating students**

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Determine stress at a point and apply the principles of Analysis of Stress. | 1,2,12 | 1,2,4 |
| CO2 | To formulate invariants of stress Octahedral stresses, Hydrostatic and deviatoric stress. | 1,2,12 | 1,2,4 |
| CO3 | Determine the strain at a point and apply the principles of Analysis of strain. | 2,4,12 | 1,2,3,4 |

| | | | |
|---|---|---|---|
| CO4 | Determine the invariants of strain, Octahedral strains, Hydrostatic and deviatoric strains, | 1,2,3,5, 12 | 1,2,3,4 |
| CO5 | Solve two dimensional problems of elasticity by Airy's stress function approach | 2,4,12 | 1,2,3,4 |
| C06 | Apply Plastic analysis to determine the solutions to the problems related to structural engineering | 2,4,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO1 | PO1 | PO1 | PSO | PSO | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | 3 | 3 | 3 | | 3 |
| CO3 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| C04 | | 3 | | | 3 | | | | | | | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |
| CO6 | 3 | 3 | 2 | | 3 | | | | | | | 2 | 3 | 2 | 3 | 3 |

**Course Content Theory**

| Contents |
|---|
| **UNIT:1 Introduction:**<br>Introduction Assumptions, Applications and Concept of Theory of Elasticity, Stress at a point, Components of stress at a point in Cartesian co-ordinates in 2-D and 3-D cases, Equilibrium equations, Stress on an oblique plane ,Transformation of stress, Principal stresses and their planes, Invariants of stress, Octahedral stresses, Hydrostatic and deviatoric stress. |
| **UNIT:2 Strain at a point**<br>Strain at a point, strain on an oblique plane, Transformation of strain, Principal strains and their planes, Invariants of strain, Compatibility equations of strain, Octahedral strains, Hydrostatic and deviatoric strains,<br>Strain rosettes. |
| **UNIT:3 Plane stress and plane strain:**<br>Classification of problems of solid mechanics into plane stress, Plane strain, Axi- symmetric problems with illustrations. Equations of equilibrium for plane stress and plane strain. Boundary conditions, Generalized Hooke's laws (orthotropic, an-isotropy, and isotropy). |

| |
|---|
| Plane stress and plane strain: Airy's stress function approach to 2-D problems of elasticity, Biharmonic equations, Simple problems of bending of beams. |
| **UNIT:4 Theory of Plasticity**<br>Stress – strain diagram in simple tension, perfectly elastic, Rigid – Perfectly plastic, Linear work – hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials, Failure theories, Rankine's theory, Tresca's theory, Maximum elastic strain theory, Octahedral shearing stress theory, Maximum elastic energy theory and Mohr's failure theory. |

**Text Book:**

1. Timoshenko & Goodier, "Theory of Elasticity", McGraw Hill
1. Srinath L.S., Advanced Mechanics of Solids, 10th print, Tata McGraw Hill Publishing company, New Delhi, 1994
2. Sadhu Singh, "Theory of Elasticity", Khanna Publishers
3. Verma P.D.S, "Theory of Elasticity", Vikas Publishing Pvt. Ltd

**Reference Books**

1. 1 Chenn W.P and Hendry D.J, "Plasticity for Structural Engineers", Springer Verlag
2. Valliappan C, "Continuum Mechanics Fundamentals", Oxford IBH Publishing Co. Ltd.
3. Sadhu Singh, "Applied Stress Analysis", Khanna Publishers
4. Govindaraju L and Sitharam G, "Applied Elasticity", Interline Publishers
5. Journals/Magazines

**1 Journal of Structural Engineering ASCE, USA**

**SWAYAM/NPTEL/MOOCs:**
http://www.nptel.iitm.ac.in

**Problem Based Learning**

| No | Problem |
|---|---|
| | Show that $$\phi = \frac{q}{8c^3}\left[x^2\left(y^3 - 3c^2y + 2c^3\right) - \frac{1}{5}\,y^3\left(y^2 - 2c^2\right)\right]$$ **is a stress function, and find what problem it solves when applied to included in $y = \pm c$, $x = 0$, on the side $x$ positive.** |
| | |

**Project Based Learning**

To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Effect of Circular holes on stress distribution of Plates |
| 2. | Bending of a Cantilever loaded at the end |
| 3. | A simply supported beam loaded uniformly throughout the span |

## COURSE : Applications of Remote sensing and Geographical Information System

<table>
<tr><td>Course Title</td><td colspan="4">Applications of Remote sensing and Geographical Information System</td><td>Course Type</td><td colspan="2"></td></tr>
<tr><td>Course Code</td><td>B20EDS725</td><td>Credits</td><td colspan="2">3</td><td>Class</td><td colspan="2">VII semester</td></tr>
<tr><td rowspan="4">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td rowspan="2">Total Number of Classes Per Semester</td><td rowspan="2" colspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</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>IA</td><td>SEE</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>50%</td><td>50%</td></tr>
</table>

**COURSEOVERVIEW:** The course familiarizes students with applications of Remote sensing and Gegraphic Information System (GIS). It deals with satellite data products, Data modeling in GIS, GIS data management & applications of Remote sensing

**COURSE OBJECTIVE::**

**The objectives of this course are to:**

1. To educate students about the Electromagnetic spectrum & resolutions
2. To make students familiar satellite data products and concepts of image processing
3. To impart the knowledge Data modeling in GIS
4. To educate students about GIS data management.
5. To make students familiar raster and vector-based data processing
6. To impart the knowledge of application of Remote sensing in civil engineering

**COURSEOUTCOMES (COs)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Understand about the Electromagnetic spectrum & resolutions | 1,2,3, 4,5 | 1,2,3 |
| CO2 | Familiarize with satellite data products and concepts of image processing | 1,2,3, 4,5 | 1,2,3 |
| CO3 | Gain the knowledge Data modeling in GIS | 1,2,3, 4,5 | 1,2, 3 |
| C04 | understand about GIS data management | 1,2,3, 4,5, | . |
| CO5 | Gain Knowledge of raster and vector-based data processing | 1, 2, 3, 4, 5 | 1, 2, 3 |
| CO6 | Familiarize the application of Remote sensing in civil engineering | 1,2,3,4.12 | 1,2,3 |

**BLOOM'SLEVELOFTHECOURSEOUTCOMES**

| **CO#** | **Bloom's Level** | | | | | |
|---|---|---|---|---|---|---|
| | Remember(L 1) | Understand(L 2) | Apply(L 3) | Analyze(L 4) | Evaluate(L 5) | Create(L 6) |
| **CO1** | ✓ | ✓ | ✓ | ✓ | | |
| **CO2** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **CO3** | ✓ | ✓ | ✓ | ✓ | | ✓ |

| | | | | | | |
|---|---|---|---|---|---|---|
| C04 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**COURSEARTICULATIONMATRIX**

| 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 | 2 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 3 | 3 |
| C04 | 2 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 2 | | | | | | | | 3 | 3 | 3 |
| CO6 | 3 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 3 | 3 |

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

Course Content

| **Contents** |
|---|
| **Unit-I: Introduction** :<br>Introduction to Electromagnetic Spectrum (EMR), interaction of EMR with atmosphere and target, Resolutions: Spatial, temporal, spectral and radiometric, sensor characteristics<br>Satellite data products, digital imaging, digital image processing, visual image interpretation, digital image interpretation. microwave remote sensing. |
| **UNIT–II: Data modeling in GIS**<br>Introduction, Stages of GIS data modeling, Graphic representation of spatial data- Raster & Vector, Spatial data models, Raster GIS model- simple raster arrays, Hierarchical raster structures<br>Types of raster GIS model, Compact raster data model, Vector GIS model- Spaghetti model, topological model, shape file, Copact vector data model, Comparison of raster and vector model |
| **Unit-III: GIS data management**<br>GIS data models, database management systems, Geographic Data Representation, Storage, Quality and Standards, Assessment of data quality, Managing data errors, Geographic data standards.<br>Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation–Quadrant counts, and nearest neighbor analysis – Network analysis – Surface modeling – DEM. |
| **Unit-IV: Applications of RS & GIS**<br>Applications in Civil Engineering: Applications in Water resources, Environmental applications, Agricultural applications, Geologic & Soil mapping, Natural disaster assessment, Land use/Land cover mapping, urban and regional planning, Land form identification & evaluation. Q-GIS and BHUVAN (Demo). |

**REFERENCES BOOKS:**


1. Anji Reddy, "Remote Sensing and Image Interpretation", John Wiley and Sons Inc., New York,1987.
2. M.G.Srinivas, "Remote Sensing Applications", Narosa Publishing House,2001.
3. Burrough P.A, "Principles of GIS for Land Resources Assessment", Oxford Publication,1994.
4. Jeffrey Star and John Ester, Geographical Information System – An Introduction, Prentice Hall Inc., Englewood Cliffe,1990.

5. Marble, D.F, Calkins, H.W and Penquest, Basic Readings in GIS, Speed System Ltd., New York,1984.

**Reference Books:**
1. Remote Sensing Principles and Interpretation" by Sabins
2. Remote Sensing & GIS and Image Interpretation" by Lillesand T M and Kieffer R WA.
3. Remote Sensing and GIS Technology" by KataraPratibha
4. "Text Book of Remote Sensing and Geographical Information Systems" by M Anji Reddy

**Journals/Magazines**
1. Journal of Remote Sensing & GIS, STM Journals
2. International Journal of Advanced Remote Sensing & GIS, ISSN 2320-0243, Cloud publications
3. International Journal of Remote Sensing, ISSN 0143-1161, official journal of RS & photogrammetry society, Taylor & Francis group
4. https:// satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309
5. https://www.grss-ieee.org/wp-content/uploads/2014/07/EN_TUTORIAL_COMPLETO.pdf
6. https://puguhdraharjo.wordpress.com/tutorial-remote-sensing-gis/

**SWAYAM/NPTEL/MOOCs:**
https://nptel.ac.in/courses/105/108/105108077/Remote sensing
https://nptel.ac.in/courses/105/102/105102015/GIS
https://www.itc.nl;
http://52north.org/ilwis
http://nptel.ac.in/courses/105108077/24
http://nptel.ac.in/courses/105102015/

**Self-LearningExercises:**
GPS use, Using of open source software for GIS & and analysis of Raster images of Remote sensing
IOT in Remote sensing and GIS

**COURSE PACK FOR: DISASTER PREPAREDNESS, PLANNING AND MANAGEMENT(B20ED0703)**

<table>
<tr><td>Course Title</td><td colspan="4">Disaster Preparedness, Planning and Management</td><td colspan="2">Course Type</td><td colspan="2">OE</td></tr>
<tr><td>Course Code</td><td>B20ED0703</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>TLP</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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</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>Tutorial</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>48</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

**Course Prerequisite: Environmental Engineering**

**Course Objective**
**This course enables graduating students**
1. To create awareness on various natural and man-made disasters occurrence.
2. To learn vulnerability assessment for various disasters.

3. To learn preparedness for various disasters
4. To learn about the various measures of disaster mitigation and disaster management.
5. To learn the importance of public awareness and rehabilitation.
6. To learn the application of remote sensing, information system and decision-making tools for disaster management.

**COURSE OUTCOMES (CO's)**
**After the completion of the course, the student will be able to:**

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Learn the usefulness of integrating management principles in disaster mitigation work and awareness of various disasters. | 1,6,7,8,9,10,11,12, | 1,2,3,4 |
| CO2 | Study distinction between the different approaches needed to manage pre, during& post disaster periods and examine the vulnerability, preparedness of disasters. | 1,2,3,4,6,7,8,9,11,12 | 1,2,3,4 |
| CO3 | Learn the preparation of for various disasters | 1,2,3,4,6,7,8,9,11,12 | 1,2,3,4 |
| CO4 | Learn the strategies of disaster management and explain the various mitigation measures | 1,3,4,5,7,8,9,11,12 | 1,2,3,4 |
| C05 | Learn the various safety programmes, rehabilitation programmes and general awareness on disasters | 1,2,3,4,5,8,9,10,12 | 1,2,3,4 |
| CO6 | Study space technology and understand decision tools of disaster management. | 1,2,3,4,5,8,9,10,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO1 | PO1 | PO1 | PSO | PSO | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 3 | 2 | 1 | 2 |
| CO2 | 2 | 2 | 2 | 1 | | 2 | 3 | 1 | 3 | | 2 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 2 | 2 | 2 | 1 | | 2 | 3 | 1 | 3 | | 2 | 3 | 3 | 2 | 3 | 2 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C04 | 2 | | 3 | 2 | 3 | | 3 | 1 | 3 | | 1 | 3 | 3 | 2 | 2 | 2 |
| CO5 | 2 | 2 | 3 | 1 | 2 | | | 3 | 3 | 2 | | 3 | 3 | 2 | 1 | 2 |
| C06 | 2 | 2 | 3 | 1 | 2 | | | 3 | 3 | 2 | | 3 | 3 | 2 | 1 | 2 |

**Course Content Theory**

| **Contents** |
|---|
| **UNIT:1 Introduction to Disasters:** Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters; Principles of Disaster Management; Types of Disasters- floods, Landslides, earthquakes, Tsunamis, and Drought- Classification, causes, impacts including social, economic, environmental, psychological; Significance of earth processes in natural disasters, Hazards, Risks and Vulnerabilities; Human induced disasters; Global trends in disaster- pandemics, Climate change- case studies. |
| **UNIT:2 Vulnerability Assessment and Preparedness: Definition:** Vulnerability; Assessment of Disaster Vulnerability of a location and vulnerable groups; Vulnerability assessment for floods, earthquakes, tsunamis, landslides.<br>Preparation of Disaster Management Plans- Roles and responsibilities of community, Panchayat Raj Institutions/Urban local Bodies (PRIs/ULBs); Framework at State and Central Level-State Disaster Management Authority (SDMA)- Early warning system-Advisories from Appropriate Agencies for Earthquake, Landslide, Flood, Drought |
| **UNIT:3** Mitigation Measures and Disaster Management: Disaster mitigation planning of human settlements and townships for earthquakes, floods/Flash floods, Fire, tsunamis, Landslides, drought; Issues in Environmental Health, Water, Food & Sanitation, Post disaster Relief & Logistics Management; Basic principles of disaster Management, Emergency Support Functions, Resource & Material Management, Management of Relief Camp, Information systems & decision-making tools, Voluntary Agencies & Community Participation at various stages of disaster management. |
| **UNIT:4** Rehabilitation and Awareness: School Awareness & Safety Programme; Integration of Rural Development Programmes with disaster reduction and mitigation activities; Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment; Role of Remote Sensing, Science & Technology Information systems and decision-making tools in disaster management, Rehabilitation Programmes; New initiatives, Disaster management in India. |

**Text Book:**


1. R.B.Singh, Environmental Geography, Heritage Publishers New Delhi,1990
2. Savinder Singh Environmental Geography, PrayagPustakBhawan, 1997
3. Kates,B.I& White, G.F The Environment as Hazards, oxford, New York, 1978
4. R.B. Singh,Disaster Management, Rawat Publication, New Delhi, 2000
5. H.K. Gupta, Disaster Management, Universiters Press, India, 2003
6. R.B. Singh, Space Technology for Disaster Mitigation in India (INCED) University of Tokyo, 1994
7. Dr.Satender , Disaster Management in Hills, Concept Publishing Co., New Delhi, 2003
8. A.S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994
9. R.K. Bhandani An overview on Natural & Manmade Disaster & their Reduction, CSIR, New Delhi
10. M.C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster
11. Abbott, P.L, Natural Disasters. 3rd Ed., McGraw Hill Company, 2001.


**Journals:**

https://www.sciencedirect.com/journal/disaster-management-and-response

https://www.igi-global.com/journal/international-journal-disaster-response-emergency
https://www.journals.elsevier.com/international-journal-of-disaster-risk-reduction
International Journal of Earthquake and Impact Engineering
**SWAYAM/NPTEL/MOOCs:**
https://onlinecourses.swayam2.ac.in/cec19_hs20/preview
https://nptel.ac.in/courses/105/104/105104183/
https://onlinecourses.swayam2.ac.in/ugc19_ar02/preview
https://onlinecourses.swayam2.ac.in/cec20_ge35/preview
https://mooc.es/course/disaster-preparedness
https://www.cssteap.org/documents/MOOC_GeospatialDRR_Brochure.pdf

**Project Based Learning**
To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

| No. | Suggested Projects |
|---|---|
| 1. | Assessment of natural disaster and proposals for mitigation measures |
| 2. | Effective ways of School awareness program on preparedness of disasters |
| 3. | Risk assessment & measures to prevent the disaster |
| 4. | Management of Relief camps and logistics. |
| 5 | Remote Sensing and GIS application in disaster management |
| 6 | Application of Space Technology & Decision tools in disaster management |

**COURSE PACK FOR: STRUCTURAL DESIGN, AND DETAILING (RCC AND STEEL)**

<table>
<tr><td>Course Title</td><td colspan="4">Structural Design, Drawing and Detailing (RCC and Steel)</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0703</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>TLP</td><td>Credits</td><td>Contac tHours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weight age</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>4</td><td>4</td><td></td><td></td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview:**
This course in structures design and drawing (RCC and Steel) is intended to develop a fundamental ability to evaluate and design of RCC and Steel members, compression members, trusses, columns bases and connections. It also deals with design and drawing of various RCC and steel structures. This subject is an applied engineering subject wherein the students are required to design simple structural elements, make changes in design depending upon availability of materials. Students must

be able to read and interpret structural drawings of different elements using design principles as per IS code of practice and their relevant drawings.

**Course Prerequisite:** Knowledge Design of RCC Structural Elements, Design of Steel Structures

**Course Objectives:** Student will be able to learn

1. The general layout of buildings
2. Design and detailing of staircase and column footings
3. Design and detail cantilever type Retaining walls,
4. Design and detailing of circular and rectangular water tanks resting on ground
5. The detailing of steel connections
6. The design and detailing of column splices and column bases

**COURSE OUTCOMES (Cos)**

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

| CO# | Course Outcomes | POs | PSOs |
|---|---|---|---|
| CO1 | Be familiar and draw the general layout of buildings | 2,5,7 | 1 |
| CO2 | To Analyze, design and detail drawing staircase and column footings for execution | 1,2,3,6,9,12 | 1,2,4 |
| CO3 | To Analyze, design and detail drawing of cantilever type retaining walls for execution | 1,2,3, ,6,8,9,11 | 1,2,4 |
| C04 | To Analyze, design and detail drawing circular and rectangular water tanks resting on ground for execution. | 1,2,3,4,5,6,7,8,10,12 | 1,2,3,4 |
| C05 | Compute Design and detailing of steel connections. | 1,2,3,6,9,12 | 1,2,3,4 |
| C06 | Compute Design and detailing column splices, lacing and battens ,column bases for steel structures | 1,2,3,4,6,7,8,10,12 | 1,2,3,4 |

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

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | 2 | | 2 | | | | | | | | 3 | | | |
| CO2 | 3 | | | 3 | | | | 2 | 2 | 2 | | 3 | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 2 | | | 2 | | 2 | 2 | | 2 | | 2 | 2 | 3 | 3 |
| C04 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| C05 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| C06 | 2 | 2 | 3 | 2 | | 2 | | 2 | | 2 | 2 | 3 | 2 | 2 | 3 | 3 |

**Course Content Theory:**

| Contents |
|---|
| **UNIT: 1 Layout Drawing, Detailing of Staircase and Column Footings:**<br>General layout of building showing position of columns, footings, beams and slabs with standard notations, Detailing of Beam and Slab floor system, continuous beams.<br>Detailing of Staircases: Dog legged and Open well, Column - footing (Square and Rectangle), Detailing of Rectangular Combined footing slab and beam type. |
| **UNIT: 2 Retaining Wall and Water Tanks:**<br>Design and Detailing of Cantilever Type Retaining walls.<br>Design and detailing of Circular water tanks resting on ground (Flexible base and Rigid base) using IS: 3370 (Part IV) only. |
| **UNIT: 3 Detailing of Steel Connections:**<br>Bolted and welded, beam-beam, Beam-column, seated, stiffened and un-stiffened.<br>Column-column connection of same and different sections, Detailing of Lacing and battens |
| **UNIT: 4 Column Bases and BIM Concept :**<br>Design and detailing of Slab base and gusseted base<br>BIM fundamentals – Definition of BIM, necessity of BIM, analysis & design of structures using BIM, construction planning & management using BIM, Life Cycle Assessment, various software tools available for BIM, case studies. |

**REFERENCE BOOKS**


1. Structural Design & Drawing Reinforced Concrete & Steel- N. Krishna Raju, University Press, Delhi
2. Structural Design and Drawing Krishnamurthy -, (Concrete Structures), CBS publishers, New Delhi. Tata Mc-Graw publishers.
3. Reinforced Concrete Structures - B.C. Punmia – Laxmi Publishing Co.
4. Reinforced Concrete Design – S.N.Sinha, Mc-GrawHill Education,
5. Design of steel structures - S.K. Duggal, Tata Mcgraw Hill, New Delhi

6. Design of Steel Structures - N. Subramanian: Oxford University, Press.
7. Design of Steel Structures - Negi - Tata McGraw Hill Publishers.
8. Design of Steel Structures - Arya and Ajaman- Nem Chand &Bros. Roorkee.
9. Reinforced Concrete Design- S Unnikrishna Pillai & Devadas Menon. Tata McGraw-Hill, New Delhi
10. IS: 456-2000, IS: 800 – 2007, SP(16)-1980, SP 6 (1) – 1984

**SWAYAM/NPTEL/MOOCs:**
http://www.nptel.iitm.ac.in

**COURSE PACK FOR: Project Phase I**

<table>
<tr><td>Course Title</td><td colspan="4">Project Phase I</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0704</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>4</td><td>4</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>4</td><td>4</td><td></td><td>48</td><td>50%</td><td>50%</td></tr>
</table>

**Course Outcomes:**

**At the end of the course, the student will be able to:**

1. Conceptualize, design and implement solutions for specific problems.
2. Develop knowledge in the field of Civil Engineering and other disciplines through independent learning and collaborative study.
3. Synthesize self-learning, team work and ethics.
4. Identify and discuss the current real time issues and challenges in engineering and technology
5. Apply principles of ethics and respect in interaction with others
6. Develop the skills to enable the long learning

**Mapping of Course Outcomes with programme Outcomes**

| Course Code | POs/COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **B20ED0704** | CO1 | 2 | 2 | 3 | 3 | 3 | | | 2 | | 3 | 3 | 3 | 2 | 1 |
| | CO2 | | | | | 3 | | | 3 | 3 | 3 | 1 | 2 | 2 | 2 |
| | CO3 | 3 | 3 | 2 | | 2 | 2 | 3 | | | 2 | 3 | 2 | 2 | 3 |
| | CO4 | | 2 | | | | 3 | 2 | 2 | 2 | 3 | | 2 | 2 | 3 |
| | CO5 | 3 | 3 | 2 | | 3 | 3 | 3 | | | 3 | | 3 | 3 | 2 |
| | CO6 | 3 | 2 | 3 | | | 2 | 2 | | | 2 | | 2 | 3 | 2 |

**Course Content:**

**The Project phase should include following:**

1. Literature Survey
2. Identification of Problem statement
3. Objectives and methodology
4. Reconnaissance Survey and Identification of Study area
5. Pilot Studies
6. Presentation of Project Work
7. Submission of Report of Project Phase-1

**Readings and References:**

1. Research Articles / Reports available on Internet
2. Civil Engineering Journals
3. Civil Engineering Textbooks and Handbooks

**SEMESTER VIII**
**COURSE PACK FOR: TECHNICAL SEMINAR**

<table>
<tr><td>Course Title</td><td colspan="4">TECHNICAL SEMINAR/<br>INTERNSHIP/MINI-PROJECT</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0802</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>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes<br>Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td></td><td>16</td><td>50%</td><td>50%</td></tr>
</table>

**Course Outcomes:**
**At the end of the course, the student will be able to:**

1. Develop knowledge in the field of Civil Engineering and other disciplines through independent learning and collaborative study
2. Identify and discuss the current real time issues and challenges in engineering and technology
3. Develop written and oral communication
4. Explore concepts in larger diverse social and academic contents
5. Apply principles of ethics and respect in interaction with others
6. Develop the skills to enable the long learning

**Course Content:**
**The Technical Seminar/ Internship/Mini-Project Should Include Following:**

1. Identification of Industry for Internship and undergoing training thoroughly for a minimum period of four weeks
2. Literature Survey/ Selection of Title for seminar work based on internship project
3. Presentation of seminar work
4. Submission of Report on seminar work along with Internship certificate

## COURSE PACK FOR: ROAD SAFETY AND MANAGEMENT (B20EDO804)

<table>
<tr><td>CourseTitle</td><td colspan="4">ROAD SAFETY AND MANAGEMENT</td><td colspan="2">CourseType</td><td colspan="2">SC</td></tr>
<tr><td>CourseCode</td><td>B20EDO804</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VIIsemester</td></tr>
<tr><td rowspan="5">CourseStructure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">TotalNumberofClasses PerSemester</td><td colspan="2" rowspan="2">Assessment inWeightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</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>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>36</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

**Course Overview**

The vehicle population in India is growing at an exponential rate. This phenomenon is bringing in its wake a host of health related, environmental, safety and behavioral problems in the society. The problem is compounded due to absence of effective means of mass transportation system in most big cities in India. Introduction of this course at Undergraduate level is an attempt to inculcate road sense, discipline and social consciousness and prevent a large number of preventable accidents and save precious lives.

**Course Objective**

**This course enables graduating students**

1. To educate students about the road and its effect on accident, analysis of accidents and the counter measures for accident prevention.
2. To make students familiar with the safety measures, traffic signs, safety practices for road users.
3. To give students an overview of black spots identification, corrective measures, preparation of checklist for road safety audit.
4. To educate students about traffic management measures and use of ITS in road safety.
5. To educate students about Safer road users through training, learning and awareness raising
6. To encourage to developing an effective road safety culture for the better society.

**COURSEOUTCOMES(Cos)**

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

| CO# | Course Out comes | POs | PSOs |
|---|---|---|---|
| CO1 | Discuss safety issues, measures of improving the road safety, traffic signs and precautionary measures to be taken for road user safety | 1,2,3 | 1,2,3 |
| CO2 | Describe counter measures at hazardous location by investigating and analyzing the accident; prepare checklists for road safety audits | 2,3,6 | 1,2,3 |
| CO3 | Enumerate the different types of traffic management measures, evaluate the effectiveness of the suggested measures; describe the safety practices for road users at and during construction | 1,2,3,4 | 2,3 |
| C04 | Illustrate the use of ITS in preventing road accidents. | 2,3,4,5 | 1,2,3,4 |

| | | | |
|---|---|---|---|
| CO5 | Illustrate the accident analysis and its effects | 1,2,3,4, 5 | 1,2,3 |
| C06 | To massage the traffic system from road safety point of view. | 2,3,4,5, 12 | 1,2,3,4 |

**Bloom'sLeveloftheCourseOutcomes**

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

**Course Articulation MatrixNote:1-Low,2-Medium,3-High**

| CO#/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | 2 | 2 | 2 | 2 | 3 |
| CO2 | 3 | 2 | 2 | 2 | | | 2 | | | | | 2 | 3 | 3 | 2 | 3 |
| CO3 | 3 | 2 | 2 | 2 | | | 2 | | | | | 2 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 2 | 2 | | | | | | | 2 | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | 2 | 3 | | 2 | | | | | 2 | 3 | 2 | 3 | 3 |
| CO6 | | 3 | 2 | 2 | 3 | | 2 | | | | | 3 | 3 | 2 | 3 | 3 |

**CourseContentTheory**

| Contents |
|---|
| **UNIT:1 Road accidents and safety:**<br>Road accidents: Causes - Collection of data, Standard definitions, Condition and Collision Diagram, influence of road and its effects on accidents; Analysis of individual accidents to arrive at real causes-Simple Problems - Economic evaluation of improvement measures by "before and after studies" Counter measures at hazardous locations<br>Road safety issues and various measures for road safety- Engineering, education and enforcement measures for improving road safety- Safety in road construction zones, traffic control devices, signs, precautions to be taken for workmen safety, road user safety-innovative ideas in road safety- Safety for pedestrian and cyclist |

| |
|---|
| **UNIT: 2**<br>Management of Road Safety- Meaning and interpretation of various road signs, management of speed limits and enforcement of safety rules, fundamentals of vehicle maintenance for better safety on the road. Vehicle parking rules, overtaking rules, stringent penalties for repeated violations, participation of public in ensuring safe driving conditions on the road, prevention of driving under influence of alcohol, drugs and intoxicants. counseling and its role accident prevention. |
| **UNIT:3**<br>Accident investigation- problem diagnosis, development of counter measures, checklists for counter measures- Operating the road network for safety, highway operation and counter-measures, road safety audit, principles- procedures and practice, code of good practice and checklists. |
| **UNIT:4**Traffic management techniques- Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety |

**TextBook:**

Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers
Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India.
Transportation Engineering – An Introduction, C.Jotin khisty, B. Kent Lall
Fundamentals of Traffic Engineering, Richardo G Sigua
Road Safety by NCHRP.

**ReferenceBooks :**

Handbook of Road Safety measures, second Edition, Rune Elvik, Alena Hoye, Truls Vaa, Michael Sorenson

**Journals/Magazines**

IRC-SP:28-1984, SP-32-1988, SP-44-1994, SP-55-2001

**SWAYAM/NPTEL/MOOCs:**

http://www.nptel.iitm.ac.in
Problem Based Learning

**ProjectBasedLearning**

Analyze the accident reasons and solutions on black-spots

**COURSE PACK FOR: PROJECT WORK PHASE II**

<table>
<tr><td>Course Title</td><td colspan="4">Project Work Phase II</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ED0802</td><td>Credits</td><td colspan="2">6</td><td colspan="2">Class</td><td colspan="2">VIII semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</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>Theory</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>5</td><td>10</td><td>10</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>6</td><td>12</td><td>12</td><td></td><td></td><td>50%</td><td>50%</td></tr>
</table>

**Course Outcomes:**

**At the end of the course, the student will be able to:**

1. Identify and discuss the current real time issues and challenges in engineering and technology
2. Develop written and oral communication
3. Synthesize self-learning, team work and ethics.
4. Explore concepts in larger diverse social and academic contents
5. Apply principles of ethics and respect in interaction with others
6. Develop the skills to enable the long learning

**Mapping of Course Outcomes with programme Outcomes**

| Course Code | POs/COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B20ED0802 | CO1 | 3 | 3 | 3 | 3 | 3 | | | 2 | | 2 | 3 | 3 | 3 | 1 |
| | CO2 | | | | | 3 | | | 3 | 3 | 3 | 1 | 2 | 2 | 2 |
| | CO3 | 3 | 2 | 3 | | 2 | 2 | 3 | | | 2 | 3 | 2 | 3 | 2 |
| | CO4 | | 2 | | | | 3 | 2 | 2 | 2 | 3 | | 2 | 1 | 3 |
| | CO5 | 3 | 2 | 2 | | 3 | 3 | 3 | | | 3 | | 3 | 3 | 2 |
| | CO6 | 3 | 2 | 3 | | | 2 | 2 | | | 2 | | 2 | 3 | 2 |

## Course Contents

**The Project Phase -2 is continuation of Project Phase -1 and should include following:**

1. Experimental setup/programs/ methods
2. Analysis of data
3. Design / Modelling /Simulation
4. Analysis and inferences of Results
5. Summery and conclusion of work
6. Project Report writing
7. Presentation of Project work
8. Submission of Final Project Report

**Readings and References:**

1. Research Articles / Reports available on Internet.
2. Civil Engineering Journals.
3. Textbooks and Handbooks of Civil Engineering.