REVA UNIVERSITY
Bengaluru, India

SCHOOL OF CIVIL ENGINEERING

HANDBOOK

M. Tech. in Computer Aided Structural Engineering

2022-24

Rukmini Knowledge Park,

Rukmini Educational
Charitable Trust

Kattigenahalli, Yelahanka, Bangalore - 560 064

Phone No: +91-080-66226622, Fax: 080-28478539

www.reva.edu.in

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'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centric 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 team-work 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 Centres" 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 endeavour 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 lots of 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. 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.

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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 fulfil 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 No. 80 dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 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.

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts, and Research Studies. REVA offers 28 Undergraduate Programmes, 22 Full-time and 2 Part-time Postgraduate Programmes, 18 Ph. D Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

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

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. 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 also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of seniorFaculty 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, Nana 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, Counsellors 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 recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal VikasYojana. 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, Oklahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC2, 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 IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of 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.

REVA organises 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 REVAMP 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 recognised 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 class's every day to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Vision

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

Mission

To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centres

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 endeavours. The Master's Degree programs focus on research and design in the core and Computer Aided Structural Engineering, Construction technology and management & 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 calibre, who would be committed to their profession with ethics, will be able to contribute to Civil Engineering and allied fields through research and innovation and optimizing usage of resources globally making the world eco-friendlier 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.

To provide student-centric learning environment through innovative pedagogy and education reforms

BOARD OF STUDIES COMMITTEE

BOS MEMBERS LIST FOR M TECH COMPUTER AIDED STRUCTURAL ENGINEERING			
Sl. No.	**Name, Designation & Affiliation**	**Status**	**Correspondence Address**
1	Dr. Y. Ramalinga Reddy Director, School of Civil Engineering, REVA University	Chairperson	Rukmini Knowledge park, REVA University, Yelahanka, Bengaluru-560064 (M): 9448508996 Email: ramalingareddy@reva.edu.in
2	Dr. V. Ramachandra Zonal Head, Technical Services, Ultra Tech Cement Ltd.,	Member	Zonal Head, Technical Services, Ultra Tech Cement Ltd., Industry House, 6th floor, #45, Race Course Road, Bangalore 560 001, (M)97432-47985 Email: ramachandra.v@adityabirla.com
3	Dr. G. Anand Director, APT Consulting Engineering Service,	Member	No. 55/2, 3rd floor, East Park Road, Malleshwaram, Bangalore- 560055 (M): 9845128153 Email: gananda36@gmail.com
4	Sri. N. Ranganath Managing Director, EIT Technology Pvt. Ltd.,	Member	35th 'C' Cross, 4th T block, Jaya nagar, Bangalore- 560041 (M): 9449021149 Email: nranganatha@eitech.in
5	Dr. R. V. Ranganath Professor, Department of Civil Engineering, BMS College of Engineering	Member	Professor, Dept. of Civil Engineering, BMS College of Engineering, Bull Temple Road, Bangalore-560 019 (M) 98450-86602 Email: rangarv@yahoo.com
6	Dr. K. M. Krishna Murthy RAASTA- Centre for Road Technology	Member	Volvo Equipment Campus, Phase-1, Peenya Industrial area, Bangalore-560058 (M): 9844119221 Email: group.rasta@raastaindia.com
7	Dr. Anil Kumar K S Highway design lead, WS Atkins India Pvt. Ltd.,	Member	#81, 2nd cross, Munnireddy layout, Banaswadi, Horamavu, Bengaluru-560043 (M): 8105555778 Email: anilgowda1985@gmail.com
8	Dr. Raghavendra Y.B Senior Manager – Quality Control & Research & Development, M/s Aparna Enterprises Limited.	Member	#4/2, Shri Kalabhyraveshwara Nilaya, 5th Cross, 3rd Main, Riffco Shantinikethan Layout, Medahalli, Virgonagar post, Bengaluru-560049 (M): 9886161233 Email: raghuyb82@gmail.com

9	Dr. Sunil Kumar Tengli Professor, REVA University	Member (Internal)	School of Civil Engineering, Rukmini Knowledge park, REVA University, Yelahanka, Bengaluru-560064 (M): 9844057122 Email: dr.sktengali@reva.edu.in
10	Dr. P. Shivananda Professor, REVA University	Member (Internal)	School of Civil Engineering, Rukmini Knowledge park, REVA University, Yelahanka, Bengaluru-560064 (M): 9448047250 Email: pshivananda@reva.edu.in
11	Dr. Seelam Srikanth Reddy Assistant Professor, REVA University	Member (Internal)	School of Civil Engineering, Rukmini Knowledge park, REVA University, Yelahanka, Bengaluru-560064 (M): 9491303992 Email: srikanths.reddy@reva.edu.in
12	Vinayaka B. Asst. Professor, REVA University	Member Alumni	Swathi Civil Consultancy (M): 9538959138 Email: vinayaka.b@reva.edu.in
13	Vishwas L Student, REVA University	Current Student	Rukmini Knowledge park, REVA University, Yelahanka, Bengaluru-560064 (M): 8197181425 Email: r19mce16@ce.reva.edu.in

Program Overview

M.Tech. Computer Aided Structural Engineering or Master of Technology in Computer Aided Structural Engineering is a two-year postgraduate course. Computer Aided Structural Engineering is an innovative program, focused on the combination of recent advances made in the field of structural engineering. This combination allows structural engineer the flexibility and freedom for a better understanding of structural behaviour with material and geometric non-linearity and loading uncertainties. The course provides an excellent grounding in the fundamentals of structural engineering subjects. The course is suitable for those who want to have in-depth knowledge of mathematical modelling and computational methods in the areas of non-linear, static and dynamic analysis of structures

Employment Areas, Academic Institutions, Design Consultancy, Airports, Highways, Railways, IT Companies, Government jobs and Entrepreneurship

Program Educational Objectives (PEO's)

The programme educational objectives of M. Tech CASE (Computer Aided Structural Engineering) of REVA University is to prepare graduates

PEO-1 To have successful professional careers in industry, government, academia and military as innovative engineers.

PEO-2 To successfully solve engineering problems associated with the lifecycle of Civil Engineering system, in particular structural engineering by communicating effectively either leading a team or as a team member with ethical practices.

PEO-3 To continue to learn and advance their careers through activities such as research and development, acquiring doctoral degree, participation in national level research programmes, teaching and research at university level etc.,

PEO-4 To be active members ready to serve the society locally and internationally, may take up entrepreneurship for the growth of economy and to generate employment; and adopt the philosophy of lifelong learning to be aligned with economic and technological development.

Program Outcomes (POs)

On successful completion of the program, the graduates of M. Tech CASE (Computer Aided Structural Engineering) program will be able to:

PO1. Demonstrate in-depth knowledge of computer aided structural Engineering, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PO2. Analyze complex engineering problems critically; apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

PO3. Think laterally and originally, conceptualize and solve structural engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in computer aided structural Engineering.

PO4. Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in computer aided structural Engineering.

PO5. Create, select, learn and apply appropriate techniques, resources, and structural engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.

PO6. Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

PO7. Demonstrate knowledge and understanding of structural Engineering principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

PO8. Communicate with the engineering community, and with society at large, regarding complex Structural engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

PO9: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PO10. Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PO11. Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback (SELF learning).

Programme Specific Outcomes (PSO's)

On successful completion of the program, the graduates M. Tech CASE (Computer Aided Structural Engineering) program will be able to:

PSO-1: Apply knowledge of Structural Engineering and management in real time.

PSO-2: Analyse a system, component or process in the knowledge areas of Structural Engineering in real time problems.

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

PSO-4: Conduct investigations and address complex Structural Engineering problems; Utilize and develop innovative tools and techniques that are appropriate in discipline. Structural Engineering.

GA1: Scholarship of knowledge

GA2: Critical thinking

GA3: Problem solving

GA4: Research skill

GA5: Usage of modern tools

GA6: Collaborative and multidisciplinary work

GA7: Project management and finance

GA8: Communication

GA9: Lifelong learning

GA10: Ethical practices and social responsibility

GA11: Independent and reflective learning.

REVA UNIVERSITY
Bengaluru, India

ACADEMIC REGULATIONS

M. Tech., (2 years/3 Years) Degree Programs
(Applicable for the programs offered from 2022-23 Batch)

Regulations – M Tech., Degree Program
Academic Year 2022-23 Batch
(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 – M Tech., Degree Program 2022-23 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 M Tech., Degree programs of REVA University offered during 2020-21

M Tech (Full Time) in:
Artificial Intelligence
Computer Science and Engineering
Computer Aided Structural Engineering
Construction Technology & Management
Cybersecurity
Digital Communication and Networking
Machine Design
Power Energy & Systems
Transportation Engineering and Management
VLSI and Embedded Systems

Also
M Tech (Part Time) in:
Computer Science and Engineering
VLSI and Embedded Systems

3. Duration and Medium of Instructions:

3.1 **Duration:** The duration of theM Tech degree program shall be **TWO years** comprising of **FOUR** Semesters. A candidate can avail a maximum of 8 semesters - 4 years as per double duration norm, in one stretch to complete M Tech degree. The duration for part time students is **THREE years** and a maximum of 6 years they are required to complete the program.

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: "Finite Element Method of Analysis" in M Tech Civil Engineering program, "Advanced Theory of Vibration" in M Tech., Mechanical program are examples of courses to be studied under respective programs.

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

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 (CC):** A course which should compulsorily be studied by a candidate choosing a particular program of study

4.2.2 **Foundation Course (FC):** 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 / analysing /exploring a real life situation / difficult problems to solve a multivariable or complex engineering problems.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to M Tech Program (Full Time) of 2 years (4 Semesters) and (Part Time) of 3 years (6 Semesters) are given below:

Sl. No.	Program	Duration	Eligibility
1	Masters of Technology (M Tech) in Artificial Intelligence	4 Semesters (2 years)	B E / B.Tech. in CSE / ISE / TE / MCA / M. Sc. in Computer Science or Mathematics or Information Science or Information Technology with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
2	M Tech in Computer Science and Engineering	**Full Time** – 4 Semesters (2 years) **Part Time** – 6 Semesters (3 years)	B E / B.Tech. in ECE / IT / EEE / CSE / ISE / TE / MCA / M.Sc. in Computer Science or Mathematics or Information Science or Information Technology with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.

3	M Tech in Computer Aided Structural Engineering Construction Technology & Management Transportation Engineering and Management	4 Semesters (2 years)	BE/ B.Tech. in Civil Engineering with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
4	M Tech in Power Energy & Systems	4 Semesters (2 years)	BE/ B.Tech. in EE/ EEE/ ECE/ CSE/ MS / M.Sc. in Mathematics/Physics/Electronics / Information Technology or Information Science with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
5	M Tech in Digital Communication and Networking	4 Semesters (2 years)	B E / B.Tech. in ECE /TE / EEE / CSE / ISE / Instrumentation Technology / Medical Electronics/M Sc in Electronics with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University/Institution or AMIE or any other qualification recognized as equivalent there to.
6	M Tech in VLSI and Embedded Systems	**Full Time** – 4 Semesters (2 years) **Part Time** – 6 Semesters (3 years)	B E / B.Tech. in ECE /TE / EEE / CSE / ISE / Instrumentation Technology / Medical Electronics/M Sc in Electronics with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University/Institution or AMIE or any other qualification recognized as equivalent there to.
7	M Tech in Machine Design	4 Semesters (2 years)	BE / B.Tech. in Mechanical/Aeronautical /Mechatronics,Industrial Engineering, Production Engineering,Production Engineering and Systems Technology. Automobile / Industrial Production Engineering with a minimum of 50% (45% in case of candidatebelonging to SC/ST category) marks in aggregate, of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
8	M Tech in Cybersecurity	**Full Time** – 4 Semesters (2 years)	B E / B.Tech. in ECE / IT / EEE / CSE / ISE / TE / MCA / M.Sc. in Computer Science or Mathematics or Information Science or Information Technology with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE 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 = 14 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
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. Minor Project
g. Major Project / Dissertation:

The credits for minor projects, major project/Dissertation will be decided by the respective Schools.

8. Credit and Credit Distributions:

8.1 A candidate has to earn 72 credits for successful completion of M Tech degree with a distribution of credits for different courses as prescribed by the University.

8.2 A candidate can enroll for a maximum of 24 credits per Semester. However s/he may not successfully earn a maximum of 24 credits per semester. This maximum of 24 credits does not include the credits of courses carried forward by a candidate.

8.3 **Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to IV semester and complete successfully 72 credits in 4 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**.

9. Assessment and Evaluation

9.1 The assessment and evaluation process happens in a continuous mode. However, for reporting purpose, a Semester is divided into 3 components as IA1, IA2 and SEE. The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

(i) Component IA1:

The first Component (IA1), of assessment is for 25 marks. This will be based on test, assignment / seminar. During the first half of the semester (i.e. by 8th week), the first 50% of the syllabus (Unit 1&2) will be completed. This shall be consolidated during the first three days of 8th week of the semester. A review test based on IA1 will be conducted and completed in the beginning of the 9th week. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed in the beginning of the 9th week. The academic sessions will continue for IA2 immediately after completion of process of IA1.

The finer split - up for the award of marks in IA1 is as follows:

Assignments ……10 marks for first 50% of the syllabus (scaled down to 5 marks)
Seminars …….. 10 marks for first 50% of the syllabus (scaled down to 5 marks)
Test-1 ……30 marks for the first 50% of the syllabus (scaled down to 15 marks)
Total …….. 25 marks

(ii) Component IA2:

The second component (IA2), of assessment is for 25 marks. This will be based on test, assignment /seminar. The continuous assessment and scores of second half of the semester (9th to 16th week) will be consolidated during 16th week of the semester. During the second half of the semester the remaining units in the course will be completed. A review test based on IA2 will be conducted and completed during 16th week of the semester. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed during 16th week.

The 17th week will be for revision of syllabus and preparation for the semester – end examination.

The finer split - up for the award of marks in IA2 is as follows:

Assignments ……10 marks for second 50% of the syllabus (scaled down to 5 marks)
Seminars …….. 10 marks for second 50% of the syllabus (scaled down to 5 marks)
Test-1 ……30 marks for the second 50% of the syllabus (scaled down to 15 marks)
Total ……... 25 marks

(iii) Component SEE:

The Semester End Examination of 3 hours duration for each course shall be conducted during the 18th & 19th week. **This forms the third / final component of assessment**

(SEE) and the maximum marks for the final component will be 50.

9.2 The schedule of continuous assessment and examinations are summarized in the following Table below.

Component	Period	Syllabus	Weightage	Activity
IA1	1st Week to 8th Week	First 50%		Instructional process and Continuous Assessment
	Last 3 days of 8th Week		25%	Consolidation of IA1
IA2	9th week to 16th week	Second 50%		Instructional process and Continuous Assessment
	Last 3 days of 16th week		25%	Consolidation of IA2
SEE	17th and 18th week			Revision and preparation for Semester end examination
	19th week to 20th week	Entire syllabus	50%	Conduct of semester end examination and Evaluation concurrently
***Evaluation shall begin very first day after completion of the conduct of examination of the first course and both examination and evaluation shall continue concurrently. The examination results / final grades will be announced.**				

9.3 Evaluation of practicals (Lab components)

There can be two types of lab components: ***Integrated lab and Separate lab***

9.3.1 Evaluation of Separate lab

The 50 marks meant for internal assessment (IA) evaluation in case of separate lab course shall be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records / Activities /Models / charts etc	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**

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

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

9.3.2 Assessment of integrated lab course*

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

i	Conduction of regular practical / experiments throughout the semester	10 marks
ii	Maintenance of lab records and performance of internal lab test to be conducted after completion of all the experiments before last working day of the semester	10 marks
	Total	**20 marks**

*Note: For integrated lab course, no separate assignment or seminar marks will be allocated.

9.4 The Assessment of MOOC and Online Courses

MOOC and Online courses shall be decided by the concerned School Board of Studies (BOS).

9.4.1 For >= 2 credit courses

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

9.4.2 For 1 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**

10. Setting Questions Papers and Evaluation of Answer Scripts:

10.1 There shall be three sets of questions papers set for each course. Two sets of question papers shall be set by the internal and one set by external examiner for a course. The Chairperson of the BoE shall get the question papers set by internal and external examiners.

10.2 The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation.

10.3 There shall be double evaluation, viz, first valuation by the internal evaluator who has taught the course and second evaluation shall be an external examiner who is familiar with the course. The average marks of the two evaluations (internal examiner & external examiner) shall be the marks to be considered for declaration of results.

10.4 The examination for Practical work/ Field work/Project work will be conducted jointly by two examiners (internal and external). However, in case of non-availability of external examiner or vice versa, the Chairperson BoE at his discretion can invite internal / external examiners as the case may be, if required.

10.5 If a course is fully of (L=0):T: (P=0) type, then the examination for SEE Component will be as decided by the BoS concerned.

10.6 In case of a course with only practical component a practical examination will be conducted with two examiners and each candidate will be assessed on the basis of: a) Knowledge of relevant processes, b) Skills and operations involved, and c) Results / Products including calculation and reporting.

10.7 The duration for Semester-End practical examination shall be decided by the Controller of Examinations.

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	(IA1)	Periodic Progress and Progress Reports (25%)
Component – II	(IA2)	Results of Work and Draft Report (25%)
Component– III	(SEE)	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

Note: Candidate is eligible to submit project dissertation only after clearing all theory courses of the program.

12. 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.

13. **Requirements to Pass a Course**

13.1 A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50). A candidate who secures a minimum of 40% in the SEE and an overall 50% (IA1+IA2+SEE) in a course is said to be successful.

13.2 **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+
< 50	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=[(IA1+IA2)+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, i.e

SGPA (Si) = $\sum$(Ci x Gi) / $\sum$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.

b. 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**	**B**	**8**	**3X8=24**
Course 3	**3**	**C**	**7**	**3X7=21**
Course 4	**3**	**O**	**10**	**3X10=30**
Course 5	**3**	**D**	**6**	**3X6=18**
Course 6	**3**	**O**	**10**	**3X10=30**
Course 7	**2**	**A**	**9**	**2X 9 = 18**
Course 8	**2**	**B**	**8**	**2X 8 = 16**
	22			**184**

Thus, **SGPA = 184 ÷ 22 = 8.36**

c. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (72) for two year post graduate degree in a specialization 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.

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

Illustration:
CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	22	8.36	22 x 8.36 = 183.92
2	22	8.54	22 x 8.54 =187.88
3	16	9.35	16x9.35=149.6
4	12	9.50	12x9.50=114
Cumulative	**72**		635.4

Thus, **CGPA** = $\frac{22x8.36+22x8.54+16x9.35+12x9.50}{72}$ = 8.83

13.3 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 8.83 x 10=88.30

14. 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) G	Letter Grade	Performance	FGP Qualitative Index
>=9 CGPA 10	10	O	Outstanding	Distinction
>=8 CGPA < 9	9	A+	Excellent	
>=7 CGPA < 8	8	A	Very Good	First Class
>=6 CGPA < 7	7	B+	Good	
>=5.5 CGPA < 6	6	B	Above average	Second Class
>= 5 CGPA < 5.5	5.5	C+	Average	Pass
CGPA <5	5	F	Fail	Fail

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).This statement will not contain the list of DROPPED courses.

b. **Final Grade Card:** Upon successful completion of the Post Graduate Degree a Final Grade card consisting of grades of all courses successfully completed by the Candidate will be issued by the COE.

15. Attendance Requirement:

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

15.2 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 anyother such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

15.3 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

16. Re-Registration and Re-Admission:

16.1 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.

16.2 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.

17. **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.

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

18.1 Only those students who fulfill 75% attendance requirement and who secure minimum 30% marks in IA1 and IA2 together in a course are eligible to appear for SEE examination in that course.

18.2 Those students who have 75% of attendance but have secured less than 30% marks in IA1 and IA2 together in a course are not eligible to appear for SEE examination in that course. They are treated as dropped the course and they will have to repeat that course whenever it is offered.

18.3 In such a case wherein he / she opts to appear for just SEE examination, then the marks secured in IA1 and IA2 shall get continued. Repeat SEE examination will be conducted in respective semesters.

19. **Provision for Supplementary Examination**

In case a candidate fails to secure a minimum of 40% (20 marks) in Semester End Examination (SEE) and a minimum of 50% marks overall (IA and SEE together), such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

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

A candidate who secures a minimum of 40% in the SEE and an overall 50% (IA1+IA2+SEE) in a course is said to be successful otherwise considered that the candidate has failed the course. A candidate is required to successfully complete all the courses before submission of major project report or dissertation report.
(It means that the candidate has no restrictions on the number of courses that can be carried forward)

21. **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.

22. 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. Grievance committees will be formed by CoE in consultation with VC

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.

23. 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.

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

REVA UNIVERSITY
Bengaluru, India

Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru-560064

SCHOOL OF CIVIL ENGINEERING
M. Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
(2022-2024)
I SEMESTER

Sl. No	Course Code	Title of the Course	HC/SC/OE	Prerequisite	Credit Pattern & Credit Value				Contact Hours	Examination		
					L	T	P	Total		CIE Marks	SEE Marks	Total Marks
1	M22TB0101	Advanced Concrete Technology	HC	BE / B. TECH in Civil Engineering	2	1	-	3	4	50	50	100
2	M22TB0102	Advanced Design of RC Structures	HC		2	1	-	3	4	50	50	100
3	M22TB0103	Advanced Solid Mechanics	HC		2	1	-	3	4	50	50	100
4	M22TB0104	Computational Structural Dynamics	HC		2	1	-	3	4	50	50	100
5	M22TB0105	Computational Structural Mechanics	HC		2	1	-	3	4	50	50	100
6	M22TB0106	Finite Element Method of Analysis	HC		2	1	-	3	4	50	50	100
7	M22TB0108	Mini Project-I	Practical/ Report		1	-	1	2	3	25	25	50
TOTAL					**13**	**6**	**1**	**20**	**27**			
Practical												
8	M22TB0107	Structural Engineering Laboratory-I (Concrete Laboratory)	Practical		1	-	1	2	3	25	25	50
TOTAL					**14**	**6**	**2**	**22**	**30**	**350**	**350**	**700**
TOTAL SEMESTER CREDITS								**22**				
TOTAL CUMULATIVE CREDITS								**22**				
TOTAL CONTACT HOURS								**30**				

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SCHOOL OF CIVIL ENGINEERING
M. Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
(2022-2024)
II SEMESTER

Sl. No	Course Code	Title of the Course	HC/ SC/ OE	Prerequisite	Credit Pattern & Credit Value				Contact Hours	Examination		
					L	T	P	Total		CIE Marks	SEE Marks	Total Marks
1	M22TB0201	Advanced Design of Steel Structures	HC	BE / B. TECH in Civil Engineering	2	1	-	3	4	50	50	100
2	M22TB0202	Advanced Design of Prestressed concrete	HC		2	1	-	3	4	50	50	100
3	M22TB0203	Design of Earthquake Resistant Structures	HC		2	1	-	3	4	50	50	100
4	M22TBS211	Theory of Plates and Shells	SC		2	1	-	3	4	50	50	100
	M22TBS212	Design of Bridges	SC		2	1	-	3	4	50	50	100
	M22TBS213	Structural Health Monitoring	SC		2	1	-	3	4	50	50	100
5	M22TBS221	Structural Masonry	SC		2	1	-	3	4	50	50	100
	M22TBS222	Design of Multi Storied Structures	SC		2	1	-	3	4	50	50	100
	M22TBS223	Reliability Analysis of Structures	SC		2	1	-	3	4	50	50	100
6	M22TBS231	Design of foundation Structures	SC		2	1	-	3	4	50	50	100
	M22TBS232	Design of Electrical Transmission Structures and Foundations	SC		2	1	-	3	4	50	50	100
	M22TBS233	Repair and Rehabilitation of Structures	SC		2	1	-	3	4	50	50	100
7	M22TB0205	Mini Project-II	Practical/ Report		1	-	1	2	3	25	25	50
TOTAL					**13**	**6**	**1**	**20**	**27**			

Practical												
8	M22TB0204	Structural Engineering Laboratory-II(software Lab)	Practical		1	-	1	2	3	25	25	50
TOTAL					**14**	**6**	**2**	**22**	**30**	**350**	**350**	**700**
TOTAL SEMESTER CREDITS								**22**				
TOTAL CUMULATIVE CREDITS								**44**				
TOTAL CONTACT HOURS								**30**				

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SCHOOL OF CIVIL ENGINEERING
M. Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
(2022-2024)
III SEMESTER

Sl. No	Course Code	Title of the Course	Practical /Term Work / Sessions	Prerequisite	Credit Pattern & Credit Value				Contact Hours	Examination		
					L	T	P	Total		CIE Marks	SEE Marks	Total Marks
1	M22TB0N01	MOOC/SWAYAM Online Course	OE	BE / B. TECH in Civil Engineering	3	1	0	4	--	25	25	50
2	M22TB0301	Internship with Report	Practical/ Term Work and Viva - Voce		2	0	2	4	--	25	25	50
3	M22TB0302	Project Phase-I	Practical/ Report and Viva -Voce		2	0	6	8	--			
TOTAL					**7**	**1**	**8**	**16**				
TOTAL SEMESTER CREDITS								**16**				
TOTAL CUMULATIVE CREDITS								**60**				
TOTAL CONTACT HOURS								**--**				

REVA UNIVERSITY
Bengaluru, India

Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru-560064

SCHOOL OF CIVIL ENGINEERING

M. Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
(2022-2024)
IV SEMESTER

Sl. No	Course Code	Title of the Course	Practical /Term Work / Sessions	Pre requisite	Credit Pattern & Credit Value				Contact Hours	Examination		
					L	T	P	Total		CIE Marks	SEE Marks	Total Marks
1	M22TB0401	Dissertation Phase -II	Practical/ Thesis Submission and Viva-Voce	BE / B. TECH in Civil Engineering	2	0	8	10	--	50	50	100
2	M22TB0402	Technical Seminar With Report	Practical/ Term Work		0	0	2	2	--	25	25	50
TOTAL								**12**				
TOTAL SEMESTER CREDITS								**12**				
TOTAL CUMULATIVE CREDITS								**72**				
TOTAL CONTACT HOURS								**--**				

I SEMESTER

M22TB0101		L	T	P	C
Duration: 16weeks	**Advanced Concrete Technology**	2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Concrete Technology

COURSE OBJECTIVES: Student will be able

1. To explore special concrete constituents and their alternative materials.
2. To learn the development of concrete and its mix design.
3. To understand the properties of concrete.
4. To learn the testing procedures of concrete specimens.
5. To gain knowledge about the structure of concrete.
6. To familiarize about special types of concretes and their design.

COURSE OUTCOME:

After successful completion of this course, the student will be able

1. To identify the constituents of concrete, alternative materials and admixtures.
2. To design concrete mix of different grades.
3. To explain the properties of concrete.
4. To demonstrate the testing of concrete specimens.
5. To explain the structure of concrete.
6. To categorize and design special types of concretes.

UNIT-I	**12HOURS**

Concrete constituents and Mix Design: Components of modern concrete and developments in the process, constituent materials: Role of constituents, Alternate replacement materials, Manufacture of Concrete, Delivery of Concrete, Concrete Placing, Curing methods, Mix proportioning of Concrete: Principles and methods. IS 10262 Provisions.

UNIT-II	**12HOURS**

Fresh and Hardened Properties of Concrete : Early-Age Properties of Concrete, Factors influencing concrete properties, Fresh and Hardened concrete properties and Testing methods, Stress–Strain Relationship and Constitutive Equations, Dimensional Stability—Shrinkage and Creep.

UNIT-III	**12HOURS**

Structure of Concrete: Introduction: Concrete as a Structural Material, Characteristics and Types of Concretes, Structural Levels, Structure of Concrete in Nanometer Scale: C–S–H Structure, Transition Zone in Concrete, Micro-structural Engineering.

UNIT-IV	**12HOURS**

Advanced Composite Concrete: Self-Compacting Concrete: Mix design by IS code and Nansu methods, Fresh and hardened properties

Geo-polymer concrete: Mix Proportion, fresh and hardened properties

REFERENCE BOOKS

1. Neville A.M, "Properties of Concrete" 5 th Edition, Prentice Hall, 2011.
2. M. S. Shetty & Jain A.K., "Concrete Technology: Theory And Practice" S Chand Publishing, Eighth edition, 2019.
3. P. Kumar Mehta, Paul J.N.Monterio, "CONCRETE: Microstructure, Properties and Materials"-Tata McGraw Hill, New Delhi, 2006.
4. A.R.Santhakumar, (2007) "Concrete Technology"-Oxford University Press, New Delhi, 2007.
5. Gambhir "Concrete Technology" 6 th Reprint TMH., 2006.
6. Rixom.R. and Mailvaganam.N., "Chemical admixtures in concrete"- E and FN, Spon London 1999
7. IS 10262 : 2019, Concrete Mix Proportioning — Guidelines, B u r e a u O f I n d i a n S t a n d a r d s, New Delhi.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
M22TB0 101	**CO1**			3			2	2	1	1			3			1
	CO2	2	3			3	3	3			3		3			
	CO3	3		3		2	1		3	2		2	3	2		2
	CO4	3		3	3	2	1			3			3	2		2
	CO5	2	3			3	3	3			3		3			
	CO6	3		3	3	3		2	3				3			3

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TB0102		L	T	P	C
Duration: 16weeks	**ADVANCED DESIGN OF RC STRUCTURES**	2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Design of RCC Structural Elements

COURSE OBJECTIVES: Student will be able to learn

1. To design RC slabs by using yield line analysis by Specified methods.
2. To Analyze RC Slabs for Different shapes with different Edge Condition.
3. To design grid floors, continuous beams and flat slabs.
4. To design chimneys, silos and bunkers.
5. To learn the detailing of Earthquake Resistant Structures and
6. To design Elevated water tanks.

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Is able to design RC slabs by using yield line analysis.
2. Is able to Analyse and design Rectangular and circular RC Slabs for different edge conditions.
3. Is able to design grid floors, continuous beams and flat slabs.
4. Is able to design chimneys, silos and bunkers.
5. Has learnt about the detailing of earthquake resistant structures and.
6. Is able to Analyze and design elevated water tanks by LMS method.

UNIT-I	12 HOURS

Yield line theory for analysis of slabs: Equilibrium and virtual work methods of analysis, yield line patterns.
Analysis of Rectangular slabs with i) with simply supported on all four edge conditions
ii) With all edges fixed conditions
Analysis of Circular slabs with simply supported and fixed end conditions

UNIT-II	12 HOURS

Slabs : Design of floor/Roof Slab (Flat Slab and grid Slab)
Design of continuous beams with redistribution of moments

UNIT-III	12 HOURS

Containment Structures and Chimneys : Design of Containment Structures (Bunkers, and Silos)
Design of RC Chimneys

UNIT-IV	12 HOURS

Introduction to Detailing of Earthquake Structures and Water Tanks: Art of detailing earthquake resistant structures, Expansion and contraction joints.
Design of elevated water tanks by limit state method

REFERENCE BOOKS

1. Lin, TY and Burns, N H. "**Reinforced Concrete Design**".
2. Kong, KF and Evans, T H. "**Design of Prestressed Concrete Structures**
3. Varghese, "P.C. **Advanced Reinforced Concrete Design**", Prentice-Hall of India, New Delhi, 2005.

4. Punmia, B.C.Ashok Kumar Jain and Arun Kumar Jain, **"Comprehensive RCC Design**"
5. Bhavikatti, "**Advanced design of R C Structures**."

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	PS O1	PS O2	PS O3	PS O4
M22TB 0102	**CO1**	3	1	2		2		2	2	1		1	3	1	3	2
	CO2	3	1	2		3	3					3	3	3	1	1
	CO3	3		2		2		2	2	1		1	3	1	3	2
	CO4	3		2		2		2	2	1		1	3	1	3	2
	CO5	3		3				2	2			2	3	1	2	2
	CO6	3		2		2		2	2	1		1	3	1	3	2

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TB0103	ADVANCED SOLID MECHANICS	L	T	P	C
Duration: 16weeks		2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Strength of Materials

COURSE OBJECTIVES: Student will be able to learn

1. To evaluate stress and strain at a point in cartesian coordinate system and polar coordinate system.
2. To evaluate the principal stresses and strains in cartesian coordinate system.
3. To analyze the equilibrium equations, compatibility conditions and boundary conditions for two dimensional problems.
4. To solve 2D problems of elasticity by Airy's stress function approach in cartesian coordinate system.
5. To solve 2D problems of elasticity by Airy's stress function approach in polar coordinate system.
6. To analyze the yielding of elastic materials.

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Analyze the stress and strain at a point in cartesian and polar coordinate system.
2. Evaluate the principal stresses and principal strains in cartesian coordinate system.
3. Apply of equilibrium and compatibility equations and boundary conditions for two dimensional problems
4. Solve 2D problems of elasticity by Airy's stress function approach in cartesian coordinate system.
5. Solve 2D problems of elasticity by Airy's stress function approach in polar coordinate system.
6. Evaluate the failure of materials based on yield criteria.

UNIT-I	12 HOURS

Stresses: Introduction, The State of Stress at a Point, Stress Components on an Arbitrary Plane, Equality of Cross Shears, Principal Stresses, Stress Invariants, Octahedral Stresses, The State of Pure Shear, Decomposition into Hydrostatic and Pure Shear States, The Plane State of Stress, Differential Equations of Equilibrium, Boundary Conditions, Equations of Equilibrium in Cylindrical Coordinates

UNIT-II	12 HOURS

Strains: Introduction, Deformations, Deformation in the Neighbourhood of a Point, Change in Length of a Linear Element, Change in Length of a Linear Element—Linear Components, Rectangular Strain Components, The State of Strain at a Point, Change in Direction of a Linear Element, Change in the Angle between Two Line Elements, Principal Axes of Strain and Principal Strains, Plane State of Strain, Plane Strains in Polar Coordinates, Compatibility Conditions, Strain Deviator and its Invariants

UNIT-III	12 HOURS

Airy's stress function: Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Elementary problems of elasticity in three dimensions, stretching of a prismatic bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy.

UNIT-IV	12 HOURS

Theory of Plasticity: Introduction, Theories of Failure, Significance of the Theories of Failure, Use of Factor of Safety in Design Stress – strain diagram in simple tension, perfectly elastic, yield conditions, Tresca and Von-Mises criteria of yielding.

REFERENCE BOOKS

1. Timoshenko & Goodier, "Theory of Elasticity", McGraw Hill
2. Srinath L.S., "Advanced Mechanics of Solids", 10th print, Tata McGraw Hill Publishing Company, New Delhi, 1994.
3. Singh S., "Applied Stress Analysis", Khanna Publishers. Chakrabarty J., "Theory of Plasticity", Mc-Graw Hill Book Company, Singapore, 1987
4. Chenn W.P and Hendry D.J, "Plasticity for Structural Engineers", Springer Verlag

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
M22TB 0103	**CO1**	3	1		2							3		3	3		2
	CO2	3	1		2							3		3	3		2
	CO3	3	1		2							3		3	3		2
	CO4	3	3	3	2							3		3	3		2
	CO5	3	3	3	2							3		3	3		2
	CO6	3	1		2							3		3	3		2

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TB0104	COMPUTATIONAL STRUCTURAL DYNAMICS	L	T	P	C
Duration: 16weeks		2	1	-	3
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)				

Prerequisite: Engineering Mechanics, Structural Analysis II

Course Objectives: Student will be able to learn

1. To understand the concepts and principles of structural dynamics.
2. To understand the working principle to vibration measuring instruments
3. To enable students to frame mathematical models of damped and undamped SDOF systems subjected to free vibration and forced excitations
4. To enable students to frame mathematical models of damped and undamped MDOF systems subjected to free vibration and forced excitations.
5. To determine the responses of SDOF and MDOF systems subjected to free and forced vibrations.
6. To understand the dynamics of continuous systems.

Course Outcome: After successful completion of this course the student will be able to:

1. Ability to understand concepts and principles of structural dynamics.
2. Ability to understand the working principle of vibration measuring instruments.
3. Develop the mathematical models of SDOF systems subjected to free and forced excitations.
4. Develop the mathematical models of MDOF systems subjected to free and forced excitations.
5. Evaluate the responses of SDOF and MDOF systems subjected to free and forced vibrations.
6. Ability to determine the dynamic responses of continuous systems.

UNIT-I	12HRS

Dynamical in Civil Engineering: Sources of vibration, types of excitations, Spring action and damping; Degrees of freedom; Application of Newton's laws, D'Alembert's principle, principle of virtual displacement and energy principles. Mathematical model of physical systems; viscously damped systems; Coulomb damping, viscous damping. Structural damping. Principle of vibration-measuring instruments – seismometer and accelerometer

UNIT-II	12 HRS

Free Vibration of Single-degree-of-freedom systems: Mathematical models of SDOF system, Free vibration response of damped and undamped systems Forced Vibration of SDOF Systems: Response damped and undamped 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.

UNIT-III	12 HRS

Free Vibration of Multi-degree freedom systems: 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. Forced Vibration of MDOF Systems: Equations of Motion and Response to forced excitations, Modal analysis – free and forced vibration with and without damping.

UNIT-IV	12 HRS

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.

REFERENCE BOOKS:

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
4. Timoshenko, S., "**Vibration Problems in Engineering**", VanNostrand Co.,
5. Mukhopadhyaya, "**Vibration and Structural Dynamics**", Oxford &IBH
6. William Thompson, "**Theory of Vibration with Applications**"
7. William Seto, "**Mechanical Vibrations**", McGraw Hill Pub., (Schaum Series)

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
M22TB0104	**CO1**	3	2	1	1	2		2						3	3		2
	CO2	3			2			2						3			
	CO3	3	3	3	1			2						3	3		2
	CO4	3	3	3	1			2						3	3		2
	CO5	3	3	3	1			2					2	3	3		2
	CO6	3	3	3	1			2					2	3	3		2

M22TB0105	COMPUTATIONAL STRUCTURAL MECHANICS	L	T	P	C
Duration: 16weeks		2	1	-	3
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)				

Prerequisite: Structural Analysis I and II

Course Objectives: Student will be able to learn

1. To learn the concepts and principles of structural analysis, develop element stiffness and flexibility matrices.
2. To analyse framed structures, Trusses subjected to direct and indirect loadings by flexibility using force transformation matrices (element approach).
3. To analyse framed structures, Trusses subjected to direct and indirect loadings stiffness methods using displacement transformation matrices (element approach).
4. To learn the analysis of framed structures.
5. To analyse ideal building framed structure, trusses by Flexibilty and stiffness method.
6. To learn an entire system analysis of structures.

Course Outcome: After successful completion of this course the student will be able to:

1. Have learnt the concepts and principles of structural analysis and is able to compute element stiffness and flexibility matrices by elemental approach.
2. Be able to analyse framed structures, trusses subjected to direct and indirect loadings by flexibility method using force transformation matrices (element approach).
3. Be able to analyse framed structures, trusses subjected to direct and indirect loadings by stiffness method using displacement transformation matrices (element approach)
4. Be able to analyse framed structures, trusses by Flexibility and Stiffness system approach
5. Have learnt the analysis of framed structures.
6. Be able analyse every component of a structure

UNIT-I	12HOURS

Introduction : Static and Kinematic indeterminacy, Concepts of stiffness and flexibility, Energy concepts, Principles of minimum potential energy and minimum complementary energy.

Development of element flexibility and element stiffness matrices for bar, truss, beam, plane frame elements

UNIT-II	12 HOURS

Flexibility method: Force- transformation matrix – Development of global flexibility matrix for continuous beams, plane trusses and plane rigid frames (not more than 6 x 6 structure flexibility matrix)

Stiffness Method: Displacement- transformation matrix – Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames (not more than 6x6 structure stiffness matrix)

UNIT-III	12 HOURS

Analysis of Beams, Trusses and Rigid Frames by Flexibility Method: Analysis of continuous beams, plane trusses by flexibility method (not more than 3x3 structure flexibility matrix) using force-transformation matrix.

Analysis of Plane rigid frames by flexibility method (not more than 3x3 structure flexibility matrix)

Using flexibility-transformation matrix.

UNIT-IV	12 HOURS

Analysis of Beams, Trusses and Rigid Frames by Stiffness method: Analysis of continuous beams, plane trusses by Stiffness method (not more than 3x3 structure stiffness matrix) using displacement-transformation matrix.

Analysis of Plane rigid frames by Stiffness method (not more than 3x3 structure stiffness matrix) using displacement-transformation matrix.

REFERENCE BOOKS:

1. S.Rajasekaran, "Computational Structural Mechanics", PHI, New Dehi 2001.
2. C.S.Reddy, "Basic Structural Analysis", TMH, New Delhi 2001.
3. W.Weaver and J.H.Gere, "Matrix Analysis of Framed Structures", Van Nastran, 1980.
4. A.K.Jain "Advanced Structural Analysis with Computer Application", Nemchand and Brothers, Roorkee, India.
5. M.F.Rubinstein "Matrix Computer Methods of Structural Analysis "Prentice - Hall.
6. Devdas Menon, "Advanced Structural Analysis", Narosa Publishers

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	PS O1	PS O2	PS O3	PS O4
M22TB0105	**CO1**	3	3	3	1	2		2	2	1		1	3	3	1	2
	CO2	3	3	3	1	2		2	1	1		1	3	3	1	2
	CO3	3	3	3	1	2		2	1	1		1	3	3	1	2
	CO4	3	3	2	1	2		2	1				3	3	1	1
	CO5	3	3	3	1	2		2	1	1		1	3	3	1	2
	CO6	3	3	3	1	2		2	1	1		1	3	3	1	2

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TB0106	FINITE ELEMENT METHOD OF ANALYSIS	L	T	P	C
Duration: 16weeks		2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Structural Analysis, Theory of Elasticity

COURSE OBJECTIVES: Student will be able to learn

1. The basic concepts and principles of structural mechanics, FDM, RRM and GM.
2. About the advantages and disadvantages of FEM, for different types of problems in mechanics.
3. To formulate serendipity and Lagrangian family of elements for analysing bars and plane trusses.
4. To formulate Iso-parametric, sub parametric and super-parametric elements and numerical integration for different problems
5. To formulate quadrilateral element for the analysis of plates.
6. To apply the concept of non-linearity in the analysis of structures.

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Use the concepts and principles of structural mechanics, FDM, RRM and GM.
2. Understand the advantages and disadvantages of FEM, for different types of problems in mechanics.
3. Formulate serendipity and Lagrangian family of elements for analysing bars and plane trusses.
4. Formulate Iso-parametric, sub parametric and super-parametric elements and numerical integration for different problems
5. Formulate quadrilateral element for the analysis of plates.
6. Apply the concept of non-linearity in the analysis of structures.

UNIT-I	12HOURS

Basic concepts of Elasticity : kinematics and static variables for various types of structural problems – approximate method of structural analysis – Rayleigh-Ritz method – Difference between Finite Difference Method and Finite Element Method – variational method and minimization of energy approach for element formulation – principles of finite element method – advantages & disadvantages – finite element procedure

UNIT-II	12HOURS

Nodal displacement Parameters: Shape function – polynomial form of displacement function – generalized and natural coordinates – Lagrangian interpolation function.

Serendipity and Lagrangian family of Elements – Shape functions for one, two and three dimensional first and second order elements – Hermite shape function for beam formulation – Numerical problems to interpolate nodal variables using shape function. Formulation of one-dimensional bar element, two- and three-noded using Lagrangian shape function – numerical analysis of simple bars and plane trusses

UNIT-III	12HOURS

Two Noded beam elements: Formulation using Hermite shape function – Jacobian transformation matrix – strain-displacement matrix – stiffness matrix – consistent load vector – Gauss quadrature for numerical integration – numerical analysis of simple beams. Iso-parametric elements – sub-parametric and super- parametric elements – Formulation of two-dimensional three-noded triangular (CST).

UNIT-IV	12HOURS

Four-Noded quadrilateral Elements: Formulation of four-noded quadrilateral element, and its application to plane stress, plane strain and axis- symmetric problems – application of Gauss quadrature for numerical integration – Numerical problems. Element aspect ratio – mesh refinement vs. higher order elements – numbering of nodes to minimize bandwidth – static condensation technique – introduction to non-linear analysis – geometric and material non-linearity with examples (bars).

REFERENCE BOOKS

1. Finite element analysis Theory and Programming, C S Krishnamurthy, McGraw Hill
2. Concepts and applications of finite element analysis, R D Cook, DS Malkus, ME Plesha and RJ Witt, 2002, Wiley.
3. Finite Element Procedures, KJ Bathe, 2002, Prentice Hall, ISBN 978-546-439-982
4. An introduction to the finite element method, J.N. Reddy, 3rd edition, McGraw Hill.
5. The Finite Element Methods Its Basis and Fundamentals , Zienkiewicz & Taylor, Elsevier Publications

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	PSO1	PSO2	PSO3	PSO4
M22TB0106	CO1	3	3	3	1	1							3	3	1	2
	CO2	3	3	3	1	1							3	3	1	2
	CO3	3	3	3	1	1							3	3	1	2
	CO4	3	3	3	1	2							3	3	1	2
	CO5	3	3	3	1	2							3	3	1	2
	CO6	2	2	2	2	3	1	2	1	2	1		3	3	2	3

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TB0107	STRUCTURAL ENGINEERING LABORATORY-I (CONCRETE LABORATORY)	L	T	P	C
Duration: 16weeks		1	0	1	3
Internal Assessment: 20 Marks	Semester End Examination: 30 Marks (Minimum 8 Marks)				

Prerequisite: Concrete Technology, Chemical admixtures

COURSE OBJECTIVES: Student will be able to learn

1. To gain experience regarding the determination of properties of different building materials.
2. To provide an opportunity to learn how to measure the parameters, prevailing the quality of the materials.
3. To impart knowledge of mix design of concrete.
4. To gain experience regarding testing quality of produced concrete in Fresh and hardened state.
5. To gain experimental knowledge of testing specimens in loading frame and Self-Compacting concrete Properties
6. To gain experimental knowledge of testing specimens subjected to vibration/dynamics.

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Implement good quality construction techniques.
2. Identify quality of Concrete for Construction practices and implement changes if essential.
3. Identify the quality of the materials used for construction by testing as per IS specifications
4. Identify the proportion of the mix design
5. Perform testing on loading frame and Self-Compacting concrete
6. Perform testing of specimens on shake Table.

EXPERIMENTS TO BE CARRIED OUT

1. Mix design of concrete: design for a particular strength and verify whether the desired strength is achieved at 28 days
2. Determination of workability of concrete by Slump Cone Test
3. Determination of flow properties concrete and mortar by Flow Table Test
4. Determination of degree of workability of concrete by Compaction Factor Test
5. Determination of workability of concrete by Vee-Bee Consistometer
6. Determination of Compressive Strength of Cement Concrete
7. Determination of Splite and Flexure Test on Hardened Concrete
8. Determination aggregate properties by Shape Test (Elongation Index)
9. Determination of aggregate properties by Shape Test (Flakiness Index)
10. Impact Test on coarse aggregates
11. Water Absorption Test on Coarse Aggregate
12. Demonstration on Loading frame
13. Demonstration on Shake Table
14. Demonstration of SCC Properties.

REFERENCE BOOKS

1. "Laboratory Manual on Concrete Technology" Sood, Hemant, Mittal L N and Kulkarni P D, CBS Publishers, New Delhi, 2002.
2. Gambhir M L Concrete Manual Laboratory testing for quality control of concrete 4th edition Dhanpat Rai and Sons Delhi 1992
3. IS 10262-2012 Code for Mix design of concrete

Mapping of Course Outcomes with programme Outcome

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	PS O1	PS O2	PS O3	PS O4
M22TB0107	CO1	3	2		2	2	1		1			1	3	1	2	2
	CO2	3	2		2	2	1		1			1	3	1	2	2
	CO3	3	2		2	2	1		1			1	3	1	2	2
	CO4	3	2		2	2	1		1			1	3	1	2	2
	CO5	3	2		2	2	1		1			1	3	1	2	2
	CO6	3	2		3	3	1		1			1	2	3		3

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TB0108	**Mini Project-I**	**Practical/ Report**		0	0	2		2	2

The student is required to carry out individually a mini Project which is essentially an experimental investigation on special concretes. This mini project will enhance the knowledge on material characteristics

II SEMESTER

M22TB0201	ADVANCED DESIGN OF STEEL STRUCTURES	L	T	P	C
Duration: 16weeks		2	1	-	3
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)				

Prerequisite: Design of Steel structures

COURSE OBJECTIVES: Student will be able to learn

1. To plan for the functional requirements of an industrial building based on NBC: 2016.
2. To design industrial structures such as gantry girders.
3. To analyse and design bracket connections.
4. To design storage structures such as bunkers and silos.
5. To design of self-supporting chimneys.
6. To analyse and evaluate the design requirements of a transmission tower.

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Plan for the functional requirements of an industrial building based on NBC: 2016.
2. Design industrial structures such as gantry girders.
3. Analyse and design bracket connections.
4. Design storage structures such as bunkers and silos.
5. Design of self-supporting chimneys.
6. Analyse and evaluate the design requirements of a transmission tower.

UNIT-I	12HOURS

Planning and Functional Requirements: Classification of buildings based on NBC:2015, planning for layout requirements regarding Lighting, Ventilation and Fire Safety based on NBC: 2015, Protection against noise and vibration.

UNIT-II	12HOURS

Industrial Buildings: Design of steel gantry girders, design of bolted and welded bracket connections.

UNIT-III	12HOURS

Power Plant Structures: Types of power plants, design of bunkers and silos based on IS 9178:1979.

UNIT-IV	12HOURS

Transmission Line Structures And Chimneys: Analysis and design requirements of transmission towers, Sag and Tension calculations, Design of self-supporting chimney.

REFERENCE BOOKS

1. Subramanian N., "Design of Steel Structures", Oxford University Press, December 2015.
2. Duggal S. K., "Limit State Design of Steel Structures," McGraw Hill Education (India) Ltd., New Delhi, 2014.
3. Duggal S.K., "Design of Steel Structures," McGraw Hill Education (India) Ltd., New Delhi, 2009.
4. Chandra R., "Design of steel structure Vol-2", Standard Book House, New Delhi, 2018.
5. IS 800: 2007

6. IS 9178: 1979
7. IS 6533: 1989
8. SP 6: 1964
9. IS 875:2015
10. IS 1893 (Part-4): 2015
11. NBC: 2016

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	PO 12	PSO1	PSO2	PSO3	PSO4
M22TB0201	CO1	3	2	3	3	1						3		3	3	2	3
	CO2	3	2	3	3	3						3		3	3	3	3
	CO3	3	2	3	3	3						3		3	3	3	3
	CO4	3	2	3	3	3						3		3	3	3	3
	CO5	3	2	3	3	3						3		3	3	3	3
	CO6	3	2	3	3	1						3		3	3	2	3

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

M22TB0202	ADVANCED DESIGN OF PRESTRESSED CONCRETE	L	T	P	C
Duration: 16weeks		2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Design of Prestressed Concrete Structures

COURSE OBJECTIVES: Student will be able to learn

1. To impart the knowledge about behavior, analysis and design of end blocks of post tensioned members.
2. To study the shear and Torsional resistance of pre stressed members
3. To analyze and design the pre stressed concrete tension, compression members and composite beams for subjected to flexure and shear.
4. To develop an understanding of the design of continuous beams and simple portal frames.
5. To study the analysis and design of pre stressed slabs and grid floors.
6. To study the precast elements such as pre stressed concrete poles, railway sleepers and wall panels.

COURSE OUTCOME:

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

1. Design anchorage zones of pre stressed concrete members.
2. Calculate the shear and Torsional resistance of pre stressed members
3. Develop skills in the analysis and design of pre-stressed tension and compression members and as well as composite beams.
4. Design the pre stressed statically indeterminate structures.
5. Analyse and design the pre stressed slabs and grid floors.
6. Understand the concepts and techniques of various precast elements.

UNIT-I	12HOURS

Anchorage zone stresses in post-tensioned members: Introduction, stress distribution in end block, investigations on Anchorage zone stresses, Magnel and Guyon's Methods, Comparative Analysis, Anchorage zone reinforcement.

Shear and torsion resistance: Shear and principal stresses, ultimate shear resistance, design of shear reinforcement, Torsion, Design of reinforcement for torsion.

UNIT-II	12HOURS

Tension members: Introduction, Ties, Pressure pipes – fabrication process, analysis, design and specifications. Cylindrical containers- construction techniques, analysis, design and specifications.

Compression members: Introduction, Design specifications.

Composite beams: Introduction, types of composite beams, analysis for stresses, differential shrinkage, serviceability limit state. Design for flexural and shear strength.

UNIT-III	12HOURS

Statically indeterminate Structures: Introduction, Advantages of continuous members, effect of pre-stressing in indeterminate structures, methods of analysis for secondary moments, concordant cable profile, Guyon's theorem, Ultimate load analysis, Design of continuous beams and portal frames.

Types of floor slabs, Design of one way, two way and flat slabs- Prestressing Force, eccentricity and design of end Blocks .

UNIT-IV	12HOURS

Precast elements: Introduction, Prestressed concrete poles manufacturing techniques, shapes and cross sectional properties, design loads, design principles. Railway sleepers-classification and Manufacturing techniques, design loads, analysis and design principles. Prestressed concrete pavements, slab and wall panels.

REFERENCE BOOKS

1. Design of Prestressed concrete structures - Lin T.Y. and H. Burns- John Wiley & Sons, 1982.
2. Prestressed Concrete- N. Krishna Raju - Tata McGraw Hill, 3rd edition, 1995.
3. Prestressed Concrete Structures- P. Dayaratnam - Oxford & IBH, 5th Edition, 1991.
4. Prestressed Concrete- G.S. Pandit and S.P. Gupta – CBS Publishers, 1993.
5. Prestressed concrete- N. Rajagopalan; Narosa Publishing House.2nd edition, 2005.
6. Design of Prestressed Concrete- A. Nilson; John Willey & Sons.2nd edition, 1987.
7. IS : 1343 : 1980.
8. IS: 1343
9. IS:15916
10. IS:15917

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
M22TB0202	CO1	3	1	2		2		2	2	1		1	3	1	3	2
	CO2	3		2		2		2	2	1		1	3	1	3	2
	CO3	3		2		2		2	2	1		1	3	1	3	2
	CO4	3		2		2		2	2	1		1	3	1	3	2
	CO5	3		2	1	2		2	2	2		1	3	1	3	2
	CO6	3		2	1	2		2	1	1		1	3	1	3	2

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TB0203	DESIGN OF EARTHQUAKE RESISTANT STRUCTURES	L	T	P	C
Duration: 16weeks		2	1	-	3
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)				

Prerequisite: Design of RCC

COURSE OBJECTIVES: Student will be able to learn

1. To understand the causes of earthquakes and its history.
2. To understand the seismic effects on structures and principles of seismic design.
3. To review various design codes for analysis and design of structures.
4. To evaluate seismic forces on buildings as per the latest IS Specifications.
5. To understand the behaviour of masonry structures subjected to earthquake excitations.
6. To design earthquake resistant RC structural members.

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Ability to understand the history and causes of earthquakes.
2. Capable to understand the seismic design philosophy to design earthquake resistant structures.
3. Ability to understand the provisions of Indian code to seismic analysis and design.
4. Capable to analysis the seismic forces in building as per provisions given in Indian standards.
5. Capable to design earthquake resistant structures in accordance with the provisions of Indian Building Codes.
6. Ability to understand the seismic failures and strengthening techniques of masonry structures.

UNIT-I	12HOURS

Elements of Seismology - Earthquakes -Structure of the Earth -History of the Earth -Earthquake Mechanism -Propagation of Seismic Waves -Earthquake Phenomena -Earthquake Measurements -Definitions of magnitude, intensity, epicentre, Plate tectonics, seismographs, liquefaction, Types, effects and controlling factors seismic zoning map of India, Peak ground motion parameters.

UNIT-II	12HOURS

Principles of Seismic Design: Codal provision for design – IS 1893-2016 - aspects in planning and layout - Principles of design – choice of materials – ductility-based design –Effect of Structural Irregularities on seismic performance of RC buildings-Vertical irregularity and plan configuration problems, Seismic resistant building architecture – lateral load resistant systems, building characteristics.

UNIT-III	12HOURS

Earthquake Resistant Analysis of Buildings: Principles of Earthquake Resistant Design - Response spectrum theory. Time – Acceleration method Application of response spectrum theory to seismic design of structures.

Computation of seismic forces in multi-storied buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS-1893: 2016.

UNIT-IV	12HOURS

Earthquake Resistant Design of Buildings: Codal provision for detailing for earthquake resistance- IS 13920-1993 – Design of Beams, Beam-Column, Shear wall with ductile detailing. Earthquake resistant design philosophy of masonry buildings. Failure pattern of masonry structures, seismic performance of masonry structures. Methods to enhance the performance of masonry structures subjected to earthquakes.

REFERENCE BOOKS

1. Earthquake Resistant Design of Structures, Pankaj Agrawal, Manish Shrikhande, PHI Learning
2. Dynamics of Structures: Theory and Applications to Earthquake Engineering, AK Chopra, Prentice Hall
3. Dynamics of Structures, R.W. Clough and Joseph Penzien, McGraw-Hill Education
4. Structural Dynamics by Mario & Paz, Springer.
5. Earthquake Resistant Design by David J. Dowrick, Wiley India Pvt Ltd
6. Elements of Earthquake Engg by Jai Krishna, A.R. Chandrasekaran, Brijesh Chandra, South Asian Publishers.
7. IS 1893-2002 Indian Standard Criteria for Earthquake Resistant Design of Structures.
8. IS 4326-1993 2002 Indian Standard for Earthquake Resistant Design and Construction of Buildings.
9. IS 13920-1993 2002 Ductile detailing of Reinforced Concrete Structures subjected to Seismic Forces.

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	PO10	PO11	PSO 1	PSO 2	PSO 3	PSO 4
M22TB0203	CO1	3	1		1		2	1								1
	CO2	3	1			2		2					2	1	3	1
	CO3	3	1			2		2					2	1	3	1
	CO4	3	3	2	1	2		2					3	3	3	2
	CO5	3	3	2	1	2		2					3	3	3	2
	CO6	3	1	2	1	2		2					3	1	1	3

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TBS211	Theory of Plates and Shells	L	T	P	C
Duration: 16weeks		2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Design of RC Structures

COURSE OBJECTIVES: Student will be able to learn

1. Concepts of plate theory and its applications.
2. The Energy concepts for different geometrical shaped plates.
3. Concepts of Shear Deformation theory
4. Behaviour of curved surfaces and Membrane theory.
5. Bending theory of cylindrical shells.
6. Beam theory of cylindrical shells.

COURSE OUTCOME: After successful completion of this course the student will be able to

1. Achieve Knowledge on plate theory and its applications.
2. Understand the Energy concepts for different geometrical shaped plates.
3. Understand moment-curvature relationship for First Order Shear Deformation Theory
4. Attain the knowledge on curved surfaces and Membrane theory.
5. Apply knowledge of bending theory to pipes and pressure vessels.
6. Apply knowledge of beam theory to cylindrical roof shells.

UNIT-I	12 HOURS

Introduction to plate theory: Small deflection of laterally loaded thin rectangular plates for pure bending. Navier's and Levy's solution for various lateral loading and boundary conditions, Numerical examples.

UNIT-II	12 HOURS

Introduction to Energy methods: Energy methods for rectangular and circular plates with clamped edges subjected to symmetric loadings.

Introduction to shear deformation theories. Reissener - Mindlin Theory, Moment curvature relationship for First order shear deformation theory.

UNIT-III	12 HOURS

Introduction to curved surfaces and classification of shells: Membrane theory of spherical shells, cylindrical shells, hyperbolic paraboloids, elliptic paraboloid and conoids, Axially symmetric bending of shells of revolution.

UNIT-IV	12 HOURS

Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell, various boundary conditions. Application to pipes and pressure vessels.

Beam theory of cylindrical shells: Principles of Lundgren's beam theory, beam analysis, arch analysis, and application to cylindrical roof shells.

REFERENCE BOOKS

1. Timoshenko, S. and Woinowsky-Krieger, W., "Theory of Plates and Shells" 2nd Edition, McGraw-Hill Co., New York, 1959

2. Ramaswamy G.S. – "Design and Constructions of Concrete Shell Roofs" – CBS Publishers and Distributors – New Delhi – 1986.

3. Ugural, A. C. “Stresses in Plates and Shells”, 2nd edition, McGraw-Hill, 1999.
4. R. Szilard, “Theory and analysis of plates - classical and numerical methods”, Prentice Hall,1994
5. Chatterjee.B.K. – “Theory and Design of Concrete Shell”, – Chapman & Hall, New York-third edition, 1988
6. Chandrashekhara K., Analysis of Concrete Shells, New Age International Edition
7. Chandrashekhara K., Analysis of Plates, New Age International Edition

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
M22TBS211	CO1	3	3	3		1							2	3	3	3	2
	CO2	3	3	2	2	2							2	3	3	3	2
	CO3	3	3	2	2	2							2	3	3	1	2
	CO4	3	2	3	3	2							2	3	3	2	3
	CO5	3	3	3		3							2	3	3	1	3
	CO6	3	3	3									3	3	3	2	3

M22TBS212	DESIGN OF BRIDGES	L	T	P	C
Duration: 16weeks		2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Design of RC Structural Elements, Design of Prestressed Concrete Structures

COURSE OBJECTIVES: Student will be able to learn

1. To learn about the Basics and Historical developments, Site Selection for bridges and IRC Loading cases
2. To learn about the design of Slab Culvert
3. To learn about the design of T beam slab
4. To learn about T Beam Longitudinal and Cross girder
5. Concepts of PSC and design the Pre-Stressed slab culvert
6. Concepts and design Balanced Cantilever Bridges

COURSE OUTCOME:

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

1. Has learnt about the historical developments, site selection for bridges, forces acting on bridges classification, Components and IRC Loadings
2. Has learnt about the design of Slab Culvert
3. Has learnt design of T beam slab
4. Has learnt T Beam Longitudinal and Cross girder
5. Is able to design the Pre-Stressed slab culvert
6. Is able to design Balanced Cantilever Bridges

UNIT-I	12HOURS

Introduction: Historical Developments, Site Selection for Bridges, Classification of Bridges Forces on Bridges. Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, Abutments, Piers and Wing walls

Slab Culvert: Design of a slab culvert for Class AA tracked and Class A wheeled loading

UNIT-II	12HOURS

Box Culvert: Working out the worst combination of loading, moment distribution, calculation of BM & SF, structural design of slab culvert with reinforcement details.

T Beam Bridge Slab Design: Proportioning of Components Analysis of interior Slab & Cantilever Slab Using IRC Class AA Tracked, Wheeled Class A Loading, Structural Design of Slab, with Reinforcement Detail.

UNIT-III	12HOURS

T Beam Bridge Cross Girder Design: Analysis of Cross Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading, Structural Design of Beam, with Reinforcement Detail.

T Beam Bridge Main Girder Design: Analysis of Main Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading Using COURBON'S Method, Analysis of Main Girder

Using HENDRY-JAEGER and MORICE-LITTLE Method for IRC Class AA Tracked vehicle only, BM & SF for different loads, Structural Design of Main Girder With Reinforcement Details

UNIT-IV	12HOURS

PSC Bridges: Introduction to Pre and Post Tensioning, Proportioning of Components, analysis and structural design of slab, analysis of main girder using COURBON's Method for IRC Class AA tracked vehicle, Calculation of pre-stressing force, cable profile and calculation of stresses, Design of End block and detailing of main girder.

Balanced Cantilever Bridge: Introduction and proportioning of components, Design of simply supported portion and design of cantilever portion, design of articulation.

REFERENCE BOOKS

1. **"Essentials of Bridge Engineering**"- D Johnson Victor, Oxford & IBH Publishing Co New Delhi
2. **"Design of Bridges"-** N Krishna Raju, Oxford & IBH Publishing Co New Delhi
3. **"Principles and Practice of Bridge Engineering"-** S P Bindra Dhanpat Rai & Sons New Delhi
4. IRC 6 –"**Standard Specifications And Code Of Practice For Road Bridges"-** Section II Loads and Stresses, The Indian Road Congress New Delhi
5. IRC 21 "**Standard Specifications And Code Of Practice For Road Bridges"-**Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
6. IS 456 – "**Indian Standard Plain and Reinforced Concrete Code of Practice"-** (Fourth Revision) BIS New Delhi
7. IS 1343 – "**Indian Standard Prestressed Concrete Code of Practice"-** BIS New Delhi
8. Raina V.K., "**Concrete Bridge Practice**"- Tata McGraw Hill
9. Bakht B & Jaeggar, "**Bridge Analysis Simplified**"- McGraw Hill
10. Ponnuswamy . S, "**Bridge Engineering**"- Tata McGraw Hill.

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	PSO4
M22TBS212	CO1	3	1	2		2		2	2	1		1	3	1	3	2
	CO2	3		2		2		2	2	1		1	3	1	3	2
	CO3	3		2		2		2	2	1		1	3	1	3	2
	CO4	3		2		2		2	2	1		1	3	1	3	2
	CO5	3		2		2		2	2	1		1	3	1	3	2
	CO6	3		2		2		2	2	1		1	3	1	3	2

M22TBS213		L	T	P	C
Duration: 16weeks	**STRUCTURAL HEALTH MONITORING**	2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Design of Reinforced Concrete Structures

COURSE OBJECTIVES: Student will be able to learn

1. The distress in the structure understanding the causes and factors.
2. Safety aspects of a structure in Structural Health Monitoring.
3. The components and materials used in Structural Health Monitoring.
4. To assess the health of structure using static field methods.
5. To assess the health of structure using dynamic field tests.
6. To analyse behaviour of structures using remote structural health monitoring

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Diagnose the distress in the structure understanding the causes and factors.
2. Understand safety aspects of a structure in Structural Health Monitoring.
3. Understand the components and materials used in Structural Health Monitoring.
4. Assess the health of structure using static field methods.
5. Assess the health of structure using dynamic field tests.
6. Analyse behaviour of structures using remote structural health monitoring

UNIT-I	**12HOURS**

Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.
Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration.

UNIT-II	**12HOURS**

Materials: Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.
Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT-III	**12HOURS**

Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods

UNIT-IV	**12HOURS**

Remote Structural Health Monitoring: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring

REFERENCES

1. Balageas D., Fritzen C.P., Güemes A., (2006), "Structural Health Monitoring", John Wiley and Sons.
2. Adams D.E., (2007), "Health Monitoring of Structural Materials and Components Methods with Applications", John Wiley and Sons.
3. Ou J. P., Li H. and Duan Z. D., (2006) "Structural Health Monitoring and Intelligent Infrastructure", Taylor and Francis Group, London, UK.
4. Giurglutiu V., (2007) "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
M22TBS213	**CO1**	3	2		2							3		3	3		2
	CO2	3	2	3								3		3	3		3
	CO3	3	2	3								3		3	3		3
	CO4	3	3	3	2							3		3	3		3
	CO5	3	3	3	2							3		3	3		3
	CO6	3	3	3	2							3		3	3		3

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TBS221		L	T	P	C
Duration: 16weeks	**STRUCTURAL MASONRY**	2	1	-	3
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)				

Prerequisite: Knowledge of Alternate Building Materials and Concrete Technology

Course Objectives: Student will be able to learn

1. The varieties of Masonry units and mortar joint characteristics.
2. Behaviour of masonry under compression.
3. Behaviour of masonry under Shear, Flexure and standard test procedures.
4. Load Bearing Masonry structure design.
5. Earthquake resistant design of masonry building, confined masonry,
6. special structures like Masonry arches, domes and vaults

Course Outcome: After successful completion of this course the student will be able to:

1. Classify various masonry units and can characterise mortar joint properties.
2. Understand the behaviour of masonry under compression.
3. Evaluate the behaviour of masonry under Shear, Flexure and know standard test procedures.
4. Design Load bearing masonry structure.
5. Design masonry building and confined masonry for Earthquake loads.
6. Summarise special structures like Masonry arches, domes and vaults.

UNIT-I	12HOURS

Introduction to Masonry unit and types: Introduction, Definition of terms used in Masonry, materials used, History of masonry, Characteristics of Brick, Types of Masonry units – material Characteristics such as strength, modulus of elasticity and water absorption. Classification and properties of mortars.

Masonry under Compression: Behaviour of Masonry prism, wallette under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context. IS code 1905 correction, factors effect of rate of absorption, Failure theories of masonry under compression. Effects of slenderness and eccentricity, effect of curing, effect of ageing, workmanship on compressive strength.

UNIT-II	12 HOURS

Flexural and shear bond, flexural strength and shear strength: Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating flexural and shear strength.

Test Procedures for Masonry under compression, shear and Flexure: BIS 1905 procedure, ASTM procedures for casting, rate of testing standard Masonry prism. Test procedure for masonry walls under compression, shear.

UNIT-III	12 HOURS

Permissible stresses: Permissible compressive stress, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses.

Design of load bearing masonry buildings: Permissible compressive stress, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings up to 3 to 8 storeys using BIS codal provisions.

UNIT-IV	12 HOURS

Confined Masonry, Infill Masonry: Masonry Infill in RC frames, Diagonal strut concept.

Earthquake resistant masonry buildings: Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions.

Masonry arches, domes and vaults: Components and classification of masonry arches, domes and vaults, historical buildings, construction procedure.

REFERENCE BOOKS:

7. A. W. Hendry, Structural Masonry, Macmillan Ltd., 1998
8. A. W. Hendry, B. P. Sinha and S. R. Davies, An introduction to load bearing brickwork design.
9. Sven Sahlin, Structural Masonry, Prentice-Hall Inc., 1971
10. Miha Tomezevic, Earthquake resistant design of masonry buildings, Imperial College Press, 1999, 693.852N99 5.
11. Robert Drysdale and A A Hamid, Masonry structures behaviour and design, Publisher: The Masonry Society, Boulder, Colorado USA, 3rd Ed. 2008
12. Sinha B.P & Davis S.R., "Design of Masonry structures"- E & FN Spon
13. Dayaratnam P, "Brick and Reinforced Brick Structures"- Oxford & IBH
14. Curtin, "Design of Reinforced and Prestressed Masonry"- Thomas Telford
15. KS Jagadish, "Structural Masonry" – Wiley Publishers.

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	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
M22TBS221	**CO1**	3		2	3		2	3	2	1				1			2
	CO2	3	3	3	1	2		2	1	1		1		3	3	1	2
	CO3	3	3	3	1	2		2	1	1		1		3	3	1	2
	CO4	3	3	2	1	2		2	1					3	3	1	1
	CO5	3	3	3	1	2		2	1	1		1		3	3	1	2
	CO6	3	3	3	1	2		2	1	1		1		3	3	1	2

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TBS222	Design of Multi Storied Structures	L	T	P	C
Duration: 16weeks		2	1	-	3
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)				

Prerequisite: Analysis and Design of RCC and Steel Structures

COURSE OBJECTIVES: Student will be able to learn

1. To introduce various systems of Tall buildings.
2. To obtain the Knowledge on materials for Tall buildings.
3. To know about different types of loads, materials for the design of tall structures.
4. To understand the behaviour of structural members and frames.
5. To impart knowledge about static, dynamic and stability analysis of various systems.
6. To evaluate Secondary Effects on tall structures.

COURSE OUTCOME:

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

1. Develop various systems of Tall buildings.
2. Understand the materials for Tall buildings.
3. Understand different types of loads, materials for the design of tall structures.
4. Understand the behaviour of structural members and frames.
5. Analyse stable structures.
6. Evaluate Secondary Effects on tall structures.

UNIT-I	12HOURS

INTRODUCTION

Design Philosophy - advantages and disadvantages - Vertical city concepts - essential amenities, structural and foundation systems. Factors affecting height, growth and form.

Loads And Materials: Gravity loading - Dead and Live load, Impact and construction loads. Wind loading - static and dynamic approach. Materials for tall buildings.

UNIT-II	12HOURS

Structural Systems: Behaviour of High Rise structures - Different system for load distribution in steel and concrete - Vertical and horizontal load resistant systems - Rigid frames - braced frames - infilled frames - shear walls - wall frames - tubular systems - Moment resistant frames

UNIT-III	12HOURS

Analysis of multi framed Structures: Analysis and Design principles of various horizontal load transfer systems - approximate methods - Member forces - displacements. Analysis for various secondary effects – Creep and shrinkage. Stability Analysis - Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity loading, P -Δ effect.

UNIT-IV	12HOURS

Methods of Analysis - influence of foundation instability - Elastic Deformations. Dynamic Analysis - Principles of design of tall braced frames for earthquake resistant design.

REFERENCE BOOKS

1. Taranath .B.S., "Structural Analysis and Design of Tall Buildings", Mc Graw Hill Co. 1988
2. Schuller.W.G., "High Rise Building Structures", John Wiley & sons, 1977
3. Lynn.S. Beedle, "Advances in Tall Buildings", CBS Publishers and Distributors, New Delhi, 1996
4. LinT.Y. and Burry D.Stotes, " Structural Concepts and Systems for Architects and Engineers ", John Wiley, 1994.
5. Gupta.Y.P.,(Editor), "Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities", New Age International Limited, New Delhi,1995.
6. Lecture Notes on "Tall Buildings" - Short Term Course organized by Civil Engineering Department, SRM Engg college, Kattankulathur. June 2002
7. Smith .B.S. and Coull .A., "Tall Building Structure", 'Analysis and Design', John Wiley & Sons, Inc., 1991

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	PS O1	PS O2	PS O3	PS O4
M22TBS222	**CO1**	3	1	2		2		2	2	1		1	3	1	3	2
	CO2	3	2		1		2						2	1	1	2
	CO3	3		2		2		2	2	1		1	3	1	3	2
	CO4	3		2		2		2	2	1		1	3	1	3	2
	CO5	3		2		2		2	2	1		1	3	1	3	2
	CO6	3	3	2		2	3	3		2	2		3	2	3	3

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TBS223	RELIABILITY ANALYSIS AND DESIGN OF STRUCTURES	L	T	P	C
Duration: 16weeks		2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Basic Concepts of Probability and Statistics

COURSE OBJECTIVES: Student will be able to learn to

1. To apply the basic concepts of probability and statistics
2. To apply the basic concepts of random phenomena
3. To interpret the measure of probability
4. To apply the formulation of Mathematical Modeling using uncertainties
5. To know the application of reliability measures to a structure
6. To know how to simulate reliability measures and use as a modeling tool

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Apply the basic concepts of probability and statistics
2. Apply the basic concepts of random phenomena
3. Interpret the measure of probability
4. Apply the formulation of Mathematical Modeling using uncertainties
5. Know the application of reliability measures to a structure
6. Know how to simulate reliability measures and use as a modeling tool

UNIT-I	12HOURS

Introduction: Probability mass function, probability density function, mathematical expectation, Chebyshev's theorem. Probability distributions: discrete distributions- binomial and poison distributions, continuous distributions- normal, lognormal distributions

UNIT-II	12HOURS

Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability analysis-first order second moment method (FOSM), point estimate method (PEM)

UNIT-III	12HOURS

Advanced first order second moment method: (Hasofer-Lind's method), Simulation Techniques: Monte Carlo simulation- statistical experiments, confidence limits, sample size and accuracy, generation of random numbers- random numbers with standard uniform distribution, continuous random variables, discrete random variables.

UNIT-IV	12HOURS

Reliability Sysytems: System Reliability of series, parallel and combined systems, evaluation of probability of survival for determinate and redundant structural system.

REFERENCE BOOKS

1. Ranganathan, R. (1999) "Structural Reliability Analysis and Design", Jaico Publishing House,

Mumbai, India.
2. Devaraj V. & Ravindra R., (2017), "Reliability based Analysis and Design for Civil Engineers", I.K. International Publishing House Pvt. Ltd. India
3. Ang, A. H. S., & Tang, W. H., (1984) "Probability Concepts in Engineering Planning and Design, Volume –I & II", John Wiley and Sons, Inc, New York
4. Haldar A. & Mahadevan S., (2000), "Probability, Reliability and Statistical Methods in Engineering Design", John Wiley and Sons. Inc.
5. Nathabdndu, T., Kottegoda, Rosso A.R., (1998), "Statistics, Probability and Reliability for Civil and Environmental Engineers", Mc Graw Hill International Edition, Singapore.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
M22TBS223	CO1	3	2	2								3		3	3		
	CO2	3	2	2								3		3	3		
	CO3	3	3	1								3		3	3		
	CO4	3	2	2								3		3	3		
	CO5	3	2	2								3		3	3		
	CO6	3	2	2								3		3	3		

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TBS231	DESIGN OF FOUNDATION STRUCTURES	L	T	P	C
Duration: 16weeks		2	1	-	3

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Geotechnical Engineering

COURSE OBJECTIVES: Student will be able to learn

1. To learn method of estimating bearing capacity and design of shallow foundations
2. To learn to design different types of footing
3. To learn design of raft and pile foundations
4. To learn caisson types and stability of caissons
5. To learn types of machines and foundations
6. To learn the mechanism of liquefaction and design of block foundation

COURSE OUTCOME:

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

1. Estimate bearing capacity and design of shallow foundations
2. Design different types of footing
3. Design of raft and pile foundations
4. Stabilize the caisson foundations with different types
5. Design the machine foundations
6. Implement the mechanism of liquefaction for designs

UNIT-I	12HOURS

Shallow Foundations: Methods for bearing capacity estimation, total and differential settlements of footing and raft, code provisions. Design of individual footings, strip footing, combined footing, rigid and flexible mat, buoyancy raft, basement raft, underpinning.

UNIT-II	12HOURS

Pile Foundations: Estimation load carrying capacity of single and pile group under various loading conditions. Pile load testing (static, dynamic methods and data interpretation), settlement of pile foundation, code provisions, design of single pile and pile groups, and pile caps.

UNIT-III	12HOURS

Well Foundations: Types, components, construction methods, design methods (Terzaghi, IS and IRC approaches), check for stability, base pressure, side pressure and deflection.

UNIT-IV	12HOURS

Machine Foundation: Types of Machines and Foundations, Soil-Foundation Interaction: Idealized soil, foundation and interface behaviour. Elastic models of soil behaviour; Elastic-plastic and time dependent behaviour of soil. Beams and plates on elastic foundation; numerical analysis of beams and plates resting on elastic foundation.

REFERENCE BOOKS

1. A.P.S. Selvadurai, "Elastic Analysis of Soil-Foundation Interaction", Elsevier Scientific Publishing Company.
2. Braja M. Das, "Principles of Foundation Engineering", PWS Publishing Company.
3. Joseph Bowles, "Foundation Analysis and Design", McGraw-Hill Book Company.
4. V.N.S. Murthy, "Advanced Foundation Engineering", CBS Publishers and Distributors. A joint venture by IISc and IITs, funded by MH

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	PS O1	PS O2	PS O3	PS O4
M22TBS231	**CO1**	3	1	2		2		2	2	1		1	3	1	3	2
	CO2	3		2		2		2	2	1		1	3	1	3	2
	CO3	3		2		2		2	2	1		1	3	1	3	2
	CO4	3		2		2		2	2	1		1	3	1	3	2
	CO5	2	1	3				2				2		1	3	2
	CO6	1	2	3		2								1	3	2

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TBS232	Design of Electrical Transmission Structures and Foundations	L	T	P	C
Duration: 16weeks		2	1	-	3
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)				

PREREQUISITE: Structural Analysis, Design of Reinforced Concrete, Steel and Prestressed Concrete Structures

COURSE OBJECTIVES:

1. To become familiar with the history and importance of electrical transmission structures and systems.
2. To become familiar with the American and Indian Codes of Practice applicable to electrical transmission towers and foundations.
3. To be able to analyze electrical transmission structures by the various methods including the use of computer program (software).
4. To be able to design electrical transmission structures in accordance with American and Indian Practices.
5. To be able to select the appropriate type of foundation for transmission structures and design it in accordance with American and Indian Practices.
6. To become familiar with the process of assembling the design deliverables for a project and the current research relevant to transmission structures.

COURSE OUTCOMES:

After successful completion of the course, the student is

1. Familiar with the history and importance of electrical transmission structures and systems.
2. Familiar with the American and Indian Codes of Practice applicable to electrical transmission towers and foundations.
3. Able to analyze electrical transmission structures by the various methods including the use of computer program (software).
4. Able to design electrical transmission structures in accordance with American and Indian Practices.
5. Able to select the appropriate type of foundation for transmission structures and design it in accordance with American and Indian Practices.
1. Familiar with the process of assembling the design deliverables for a project and the current research relevant to transmission structures.

UNIT-I	12 HOURS

INRODUCTION: History of transmission line structures, General design criteria - Structural and Geotechnical – associated with transmission structures, Various Codes and Standards and Specifications governing material and construction of transmission structures (American and Indian Practices), computer programs. Current state of art.

UNIT-II	12 HOURS

STRUCTURAL ANALYSIS: Importance of form, function, material type and purpose of structural configuration. Design loads, Modelling, Structural analysis of transmission structures of wood, steel (lattice and polygonal poles), concrete and FRP. Numerical Examples.

STRUCTURAL DESIGN: Design of transmission structures of wood, steel (lattice and polygonal poles), concrete and FRP in accordance with American and Indian Practices. Numerical Examples.

UNIT-III	12 HOURS

FOUNDATION DESIGN: Geotechnical data, Foundation types for transmission structures, Design philosophy, Design models and Computer programs. Numerical Examples

UNIT-IV	12 HOURS

NOTE: For units II, demonstration of structural analysis and design of transmission structures using software to be done in CAD Lab for 4 hours.

TEXT BOOK:

1. Dr. Sriram Kalaga and Dr. Prasad Yenumula, "Design of Electrical Transmission Lines – Structures and Foundations", Volume I, CRC Press, Taylor &Francis Group, London, UK, 2017

REFERENCES:

1. RUS Bulletins 1724E-200, 1724E-205, 1724E-214, 1724E-216, 1724E-300.
2. American Codes of Practice
3. ACI-318-2015, ACI-336-3R-93.
4. Alcoa (2001), *SAG10™ Ver. 3.0, Users' Manual*.
5. *LRFD Manual*, AISC, 2nd Edition
6. *Allowable Stress Design Manual*, AISC
7. *Steel Construction Manual*, AISC
8. *Anchor Rod and Base Plate Design*, AISC Steel Design Guide
9. ASCE Manual 7-16
10. ASCE Manual 48-11
11. ASCE Manual 74
12. ASCE Manual 91
13. ASCE Standard 10-15
14. ASCE Manual 104
15. ASCE Manual 111
16. ASCE Manual 113
17. ASCE Manual 123
18. ANSI O5.1 (2008)
19. ASCE-PCI (1987)
20. ASCE-PCI (1997)
21. Indian Codes of Practice- IS 802 (P1/S1), IS 875, IS 5613 (P2/S1), IS 4759, IS 2062:2011, IS 12427:2001, IS 1367, IS 456, IS 800, IS 1343
22. CBIP Manual 323
23. IEEE Codes of Practice- IEEE-691 (2001), IEEE-1724 (2011), NESC (2012), *National Electrical Safety Code*, ANSI C-2

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	PO 12	PS O1	PS O2	PS O3	PS O4
M22T BS232	CO1	2	3		3	3			2	3			3	3	3		2
	CO2	2	3	3	3	3			2	3			3	3	3		2
	CO3	3	3	2	3	3				2			3	3			3
	CO4	3	3	3	1	3	1					1	3	3			3
	CO5	3	3	3	1	3	1	5	5		5	1	3	3	5	5	3
	CO6	3	3	3	1	3	1	5	5		5	1	3	3	5	5	3

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TBS233	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
Duration: 16weeks		2	1	-	3

Prerequisite:

COURSE OBJECTIVES: Student will be able to learn

1. Behaviour of structures during deterioration
2. Mechanism of damage and types
3. corrosion of steel reinforcement and causes
4. Inspection and diagnosis of distress and NDT equipment
5. Common types of repairs in concrete structures
6. Guniting and Shotcreting and underpinning

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Solution and application of methodology during deterioration
2. decision for repairs of damage for different types
3. Prevention of corrosion of reinforcement
4. Analysing the distress and prevention
5. Decision for repairs in underwater structures
6. Strengthening of structures by retrofitting and/or Jacketing

UNIT-I	12HOURS

Introduction: Deterioration of Structures, Distress in Structures, Causes and Prevention. Mechanism of Damage and Types of Damage.

UNIT-II	12HOUR

Corrosion of Steel Reinforcement: Causes, Mechanism and Prevention. Damage of Structures due to Fire, Fire Rating of Structures, Phenomena of Desiccation.

UNIT-III	12HOURS

Inspection and Testing – Symptoms and Diagnosis of Distress, Damage assessment, NDT. Health Monitoring of Structures, Use of Sensors, Building Instrumentation

UNIT-IV	12HOURS

Repair of Structure : Common Types of Repairs, Repair in Concrete Structures, Repairs in Under Water Structures, Guinting, Shotcreting, Underpinning, Strengthening of Structures, Strengthening Methods, ,Retrofitting and Jacketing.

REFERENCE BOOKS

1. Concrete Technology by A. R. Santhakumar, Oxford University press
2. Defects and Deterioration in Buildings, E F & N Spon, London
3. Non-Destructive Evaluation of Concrete Structures by Bungey – Surrey University Press
4. Maintenance, Repair & Rehabilitation and Minor Works of Buildings by P. C. Varghese, PHI.
5. Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.
6. Concrete Repair and Maintenance Illustrated, RS Means Company Inc W. H. Ranso, (1981)
7. Building Failures: Diagnosis and Avoidance, EF & N Spon, London, B. A. Richardson, (1991)

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	PS O1	PS O2	PS O3	PS O4
M22TES233	**CO1**			3			2	2	1	1			3			1
	CO2	2	3			3	3	3			3		3			
	CO3	3		3		2	1		3	2		2	3	2		2
	CO4	3		3	3	2	1			3			3	2		2
	CO5	2	3			3	3	3			3		3			
	CO6	3		3	3	3		2	3				3			3

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M22TB0204	STRUCTURAL ENGINEERING LABORATORY-II (SOFTWARE LAB)	L	T	P	C
Duration: 16weeks		0	0	2	2

Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)

Prerequisite: Structural analysis and design

COURSE OBJECTIVES: Student will be able to learn

1. Basics of STAAD-Pro with creation of nodes, elements, members, loads, support.
2. Modelling and analysis of beams and frames using STAA-Pro
3. Analysis and design of steel structures using STAAD-Pro
4. Basics of ETABS with creation of nodes, elements, members, loads, supports
5. Modelling of building structures using ETABS
6. Analysis & design of building structures using ETABS

COURSE OUTCOME: After successful completion of this course the student will be able to:

1. Create nodes, elements & members with loads & supports using STAAD-Pro
2. Analyse beams and frames using STAAD-Pro
3. Analyse and design steel structures using STAAD-Pro
4. Model elements and members with loads and supports using ETABS
5. Model building structures using ETABS
6. Analyse and design building structures using ETABS

EXPERIMENTS TO BE CARRIED OUT

STAAD PRO

1. Overview of Structural Analysis and Design Calculating Shear Force and Bending Moment values for various supports and load types
2. Introduction- Co-ordinate Systems, Global Vs Local Model Generation, Creating Nodes & Members Select Menu
3. Model Editing Tools, Connect Beams Along, Stretch Selected Members, Intersect Selected Members, Merge Selected Members, Renumber, Split Beam, Break Beams at Selected Nodes Creating Models by using Structure Wizard, Mini Project
4. Support Specification- Member Property Specification, Member Offset, Material Specification, Group Specification Loading, Creating a Primary Load, Adding Self weight
5. Loading, Nodal Load, Member Load, Uniform Force and Moment, Concentrated Force and Moment
6. General Guidelines for Design, Concrete Design in STAAD.PRO, Column Design, Beam Design

ETABS

1. Basics about the ETABS.
2. Introduction to various commands of ETABS and their applications in detail.
3. 2D model, analysis and design for Trusses, Beams and Frames
4. 3D model and analysis for Steel and RC Buildings.
5. Earthquake load application to RC and steel structures along with the design.
6. Members grouping
7. Design Grouping in Steel structures
8. Application of different building codes in the design of concrete and steel structures

REFERENCE BOOKS

1. Manual of STAAD PRO

2. Manual of ETABS

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	PSO1	PSO2	PSO3	PSO4
M22TB0204	**CO1**	3	3	3	2	3	1		1	1	1		3	3	3	1
	CO2	3	3	3	2	3	1		1	1	1		3	3	3	1
	CO3	3	3	3	2	3	1		1	1	1		3	3	3	1
	CO4	3	3	3	2	3	1		1	1	1		3	3	3	1
	CO5	3	3	3	2	3	1		1	1	1		3	3	3	1
	CO6	3	3	3	2	3	1		1	1	1		3	3	3	1

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO.

M20TB0204	**Mini Project-II**	**Practical/ Report**		0	0	2	2	2

The student is required to carry out a mini project individually on Analysis and Design of Special structures using STAAD PRO, ETABS

III SEMESTER

Sl. No	Course Code	Title of the Course	Practical /Term Work / Sessions	Pre requisite	Credit Pattern & Credit Value				Contact Hours
					L	T	P	Total	
1	M22TB0N01	MOOC/SWAYAM Online Course	OE	BE / B. TECH in Civil Engineering	3	1	0	4	--
2	M22TB0301	Internship with Report	Practical/ Term Work and Viva - Voce		2	0	2	4	--
3	M22TB0302	Project Phase-I	Practical/ Report and Viva -Voce		2	0	6	8	--

1. Students will have to choose an online course offered in MOOC/SWAYAM/COURSERA, this course will enhance additional knowledge studying online course of student's choice

2. Students have to undergo Internship in reputed companies for a minimum period of three months and gain the field related challenges and make himself/herself industry ready

3. During third semester students will be allotted Supervisor/Guide for carrying out dissertation for the full fourth semester term. Identification of dissertation topic, deciding the objectives and Literature review will be done with the discussion with their supervisor/guide.

IV SEMESTER

Sl. No	Course Code	Title of the Course	Practical /Term Work / Sessions	Pre requisite	Credit Pattern & Credit Value				Contact Hours
					L	T	P	Total	
1	M22TB0401	Dissertation Phase-II	Practical/ Thesis Submission and Viva-Voce		2	0	8	10	--
2	M22TB0401	Technical Seminar With Report	Practical/ Term Work		0	0	2	2	--

1. The student is required to deliver a seminar and submit a report on the latest development in Structural Engineering

2. Elaborate studies on their dissertation work with regard to experimental/analytical/software based investigations, preparing the dissertation report as per university regulations and publication of a paper in reputed journals