REVA UNIVERSITY
Bengaluru, India

SCHOOL OF CIVIL ENGINEERING

HANDBOOK

M. Tech. in Computer Aided Structural Engineering

2018-20

Rukmini Knowledge Park,
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Chancellor's Message

Education during recent years has witnessed a great transformation. Today's society, termed as "Knowledge Society" has brought about unprecedented economic and social growth. This has propelled universities across the world to devise new ways of tapping human potential for different competencies and building a vibrant society with a win-win situation for all.

REVA University has seen the light of the day to imbibe this character of paradigm shift in academic pursuits to contribute to the knowledge society. REVA works hard to bring in you an exciting and rewarding educational experience, to discover new interests and to develop your career prospects. You will benefit from a unique approach to student-centered learning through group work and individual study tackling real world challenges alongside experienced practitioners and researchers.

REVA has excellent learning facilities including custom built teaching facilities designed specifically to emulate working conditions, air-conditioned library opened for your studies from early morning till midnight and facilities for variety of sports and cultural activities.

Our faculties have introduced socially relevant and market driven engineering courses after studying the requirements of industries in detail and consulting entrepreneurs, experts in different areas of commerce and industry and other stake-holders. I am glad that the Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) being adopted will facilitate learning environment under continuous guidance and monitoring by the faculty and equip you with competent skills to opt for different job prospects across the global.

I hope that the present scheme of instructions, continuous periodic progress assessments, course curriculum of M. Tech in **Computer Aided Structural Engineering** and other information provided in this hand book will guide you to choose appropriate courses of study and move ahead in the right direction in your chosen area of study. I hope you will enjoy and experience the curriculum, the student-centered teaching and learning ambience in developing your personality to become successful professionals, entrepreneurs and proud citizens of the country.

I wish you every success in your career.

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

MESSAGE FROM THE VICE CHANCELLOR

Higher education across the globe is opening doors of its academic disciplines to the real world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

All the programs in REVA University are designed with a great care and after detailed market survey of present requirements and job opportunities. Experts in respective areas of study from primary institutions, industries, research organizations, business sectors and such others have been involved in designing the curriculum of each program.

The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society. It provides students an opportunity to choose subject(s) of interest in other areas of study and learn courses with students of different subjects. It facilitates cross cultural learning. It further facilitates students to move in fast track and earn additional certificates and diploma.

The well qualified, experienced, committed teachers in REVA University will involve students in integrative learning and application environment within and outside the university. They will certainly mould them with knowledge, skill and ethical values and empower them to face the competitive world with courage and confidence.

This handy document containing a brief information about ***M Tech in Computer Aided Structural Engineering***, scheme of instruction, course content, CBCS-CAGP regulations and its advantages and calendar of events for the year will serve as a guiding path to students to move forward in a right direction. It is for the students to be disciplined, committed and to work hard and make use of enormous resources and expert faculties to accomplish all round development of their personalities and succeed with flying colors not only in earning degree but also in their future career as leaders and proud citizens of mother India.

Dr. S.Y.Kulkarni
Vice-Chancellor, REVA University

MESSAGE FROM THE DIRECTOR

The M. Tech in Computer Aided and Structural Engineering is an innovative program based on recent advances in the Computer Aided analysis and design of structures mainly encountered in Civil Engineering practice. It provides an excellent grounding in the fundamentals of structural engineering subjects. It also provides a comprehensive coverage of the recent developments in structural engineering and of the use of computers in the analysis and design of structures.

The program comprises of courses providing knowledge in core areas of structural engineering, such as Computational Structural mechanics, Computer Aided design of RC structures, Computer Aided Design of concrete bridges, Computational Structural dynamics etc. These are known as Hard Core courses. There are number of courses providing knowledge in specialized areas of Computer Aided design of industrial structures, Advanced solid mechanics, Reliability Analysis of structures, Design of masonry structures, Special concrete and so on facilitating students to choose specialized areas of their interest. These are termed as Soft Core courses. Apart from a minor project in the third semester, the fourth semester is completely devoted to Dissertation work to enable students to work in concerned industries / institutions and get exposed to practical situations. The lab programs being part of the curriculum in each semester of the program will certainly provide students the experience and confidence to work in challenging environment in their future career.

The benefits of choosing M. Tech in Computer Aided and Structural Engineering are:

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

Students completing this program will have opportunities within the country as well as abroad to work and executive structural design projects of complex structures such as shells, folded plates, ribbed slabs, tall structures etc. They also have prospects of becoming entrepreneurs in structural consultancy. The field also has ample opportunities for advanced research as the students undergo preliminary research as a part of master's degree program.

I am sure the students choosing M Tech in Computer Aided and Structural Engineering in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. The cirruculum caters to and has relevance to local, regional, national, global developmental needs. We will strive to provide all needed comfort and congenial

environment for their studies. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, Gender, human values, environment and Sustainability. I wish all students pleasant stay in REVA and grand success in their career. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students pleasant stay in REVA and grand success in their career.

Dr. Y. Ramalinga Reddy
Director
School of Civil Engineering

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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, Commerce, Education, Engineering, Environmental Science, 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 Degree College (Evening), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Engineering, Commerce, Management, Education, Arts 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 notch 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 M. Phil and 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 11,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conductive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University established under the Government of Karnataka Act 80 of the year 2012 and notified in the Karnataka Gazette dated 7th Feb, 2013, is located 14 kms away from the Bangalore International Airport on the way to Bangalore city. The university has a sprawling lush green campus spread over 42 acres of land equipped with state-of-the-art infrastructure and conductive environment for higher learning.

The REVA campus has well equipped laboratories, custom-built teaching facilities designed specifically to emulate working conditions, fully air-conditioned library and central computer centre. The well planned sports facility for variety of sports activities, facilities for cultural programs and friendly campus lifestyle add to the overall personality development of students. The campus also has residential facility for students, faculty and other staff.

Currently, REVA University offers 18 Post Graduate programs and 15 Graduate and P.G Diploma programs in Engineering and Technology, Science, Commerce and Management in addition to research degrees leading to PhD in different disciplines. The University aims to offer many more PG and UG programs in Science, Arts, Commerce, Engineering & Technology, Management Studies, Education, in the years to come.

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.

ABOUT SCHOOL OF CIVIL ENGINEERING

The School of Civil Engineering is headed by highly experienced Professor of Civil Engineering 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 in Civil Engineering and M. Tech in Computer Aided Structural Engineering and M Tech in Transportation Engineering & Management. 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 M. Tech in Computer Aided Structural Engineering program aims to prepare human resources to play a leading role in the competitive construction field and excel in their endeavors. The program focuses on research and design in the core and Computer Aided Structural Engineering. The M.Tech in Transportation Engineering & Management aims to supplement and create a sustainable world and to enhance the global quality of life by adopting enhanced techniques of design and application. This is reflected in various core subjects offered within the program. Currently Civil Engineering teaching was limited to planning, analysis, design and execution of different types of infrastructure like buildings, roads, bridges, dams and power plants. However, due to increase of technological sophistication and demand for higher living standards geared up by economic growth and concerns about environmental impact have changed the scope of Civil Engineering. The challenges of today's Civil Engineering infrastructure are much more complex and interdependencies between resources.

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

Vision

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

Mission

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

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

ACADEMIC OBJECTIVES

- To prepare graduates and post graduates in CIVIL ENGINEERING who will excel in their professional career and contribute with commitment and dedication to the progress of the society and the nation.
- To enhance the understanding of the engineering principles of Civil Engineering systems.
- Graduates will be prepared with a solid foundation in mathematics, sciences, and technical skills needed to analyze and design civil infrastructure systems.
- The professional careers of our graduates will be distinguished with a high degree of awareness of moral, ethical, legal and professional obligations to protect human health, human welfare, and the environment.
- A commitment to continue assessment in continuing education.
- Our graduates will become team leaders, and will successfully address open-ended problems applying critical thinking.
- To promote faculty, researchers and students to participate in national and international conferences, seminars, workshops etc. and present their research outputs. Also research output to publish in journals of repute, publish books in relevant fields and popular articles for the benefit of the society at large.
- To organize conferences, seminars, workshops, special lectures, summer schools, technical talks, faculty development programmes etc. on emerging areas.
- To establish incubation centre and center of excellence in thrust areas in collaboration with industries.
- To organize and promote co-curricular and extra-curricular activities that inculcate among students concerned to the society.

ADVISORY BOARD

Sl. No.	Name of Members
1	**Dr. A. Veeraraghavan,** Professor, Department of Civil Engineering, IIT Madras, Room No:#234, Building Sciences Block, IIT Madras, Chennai-600036 (o) 044-22574272 Fax:044-22570509 Email: av@iitm.ac.in
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5	**Dr. R.V. Ranganath.** Dean (Academic), Principal Professor & HOD, Department of Civil Engineering, BMS College of Engineering, Bull Temple Road, Bangalore-560 019 Currently Principal BMSIT, Yelahanka, Bangalore (M) 98450-86602 Email: rangarv@yahoo.com

Program Educational Objectives (PEO's)

The programme educational objectives of the Civil 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
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)

After successful completion of the programme, the graduates shall 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 structural engineering , 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 modeling, 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)

1) Apply knowledge of Structural Engineering and management in real time.
2) Analyse a system, component or process in the knowledge areas of Structural Engineering in real time problems.
3) Design a system, component, or process in more than one areas of Structural Engineering.
4) Conduct investigations and address complex Structural Engineering problems; Utilize and develop innovative tools and techniques that are appropriate in discipline. Structural Engineering.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	P02	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
M18SE1010	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	3	1	2		2	1	1		1	3	3	1	2
M18SE1020	CO1	3	2	2		1		2	2	1	1	1	3	3	1	2
	CO2	3	2	2		1		2	2	1	1	1	3	3	1	2
	CO3	3	2	2		1		2	2	1	1	1	3	3	1	2
	CO4	3	2	2		1		2	2	1	1	1	3	3	1	2
M18SE1030	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
M18SE1040	CO1	3	2	2		1			1		1	1	3	3	1	2
	CO2	3	2	2		1			1		1	1	3	3	1	2
	CO3	3	2	2		1			1		1	1	3	3	1	2
	CO4	3	2	2		1			1		1	1	3	3	1	2
M18SE1051	CO1	3	2	2		2			1	1		1	3	3	1	2
	CO2	3	2	2		2			1	1		1	3	3	1	2
	CO3	3	2	2		2			1	1		1	3	3	1	2
	CO4	3	2	2		2			1	1		1	3	3	1	2
M18SE1052	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
M18SE1061	CO1	2	1		2	1	2	1	2		1	1	2	1	1	2
	CO2	2	1		2	1	2	1	2		1	1	2	1	1	2

	CO3	2			2	1	2	1	2		1	1	2	1	1	2
	CO4	2			2	1	2	1	2		1	1	2	1	1	2
M18SE1062	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
M18SE1070	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
M18SE2010	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	3	1	2		2	1	1		1	3	3	1	2
M18SE2020	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
M18SE2030	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
M18SE2040	CO1	2	1		2	1	2	1	2		1	1	2	1	1	2
	CO2	2	1		2	1	2	1	2		1	1	2	1	1	2
	CO3	2			2	1	2	1	2		1	1	2	1	1	2
	CO4	2			2	1	2	1	2		1	1	2	1	1	2
M18SE2051	CO1	2	1	1			1		1				2	1		2
	CO2	2	2	2		1	1		1		1		2	1	2	2
	CO3	2	2	2		1	1		1		1		2	1	2	2
	CO4	2	2	2		1	1		1		1		2	1	2	2
M18SE2052	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	3	1	2		2	1	1		1	3	3	1	2
M18SE2061	CO1	3	1	1		2	1	2	1				2	2		1
	CO2	3	2	2		2	1	2	1				2	2	2	1
	CO3	3	2	2		2	1	2	1				2	2	2	1
	CO4	3	2	2		2	1	2	1				2	2	2	1
M18SE2062	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
M18SE2070	CO1	2	3	3	2	3	1		1	1		1	3	3	3	2

	CO2	**2**	**3**	**3**	**2**	**3**	**1**		**1**	**1**		**1**	**3**	**3**	**3**	**2**
	CO3	**2**	**3**	**3**	**2**	**3**	**1**		**1**	**1**		**1**	**3**	**3**	**3**	**2**
	CO4	**2**	**3**	**3**	**2**	**3**	**1**		**1**	**1**		**1**	**3**	**3**	**3**	**2**
M18SE3010	**CO1**	**3**	**2**		**2**	**2**	**1**		**1**			**1**	**3**	**1**	**3**	**2**
	CO2	**3**	**2**		**2**	**2**	**1**		**1**			**1**	**3**	**1**	**3**	**2**
	CO3	**3**	**2**		**2**	**2**	**1**		**1**			**1**	**3**	**1**	**3**	**2**
	CO4	**3**	**2**		**2**	**2**	**1**		**1**			**1**	**3**	**1**	**3**	**2**

Mapping of PEOS with Respect to POs

	PO1	P2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3
PEO1	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO2	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO3	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO4	√	√	√	√	√	√	√	√	√	√	√	√	√	√

CBCS (CHOICE BASED CREDIT SYSTEM) AND CAGP (CONTINUOUS ASSESSMENT AND GRADING PATTERN) OF EDUCATION AND ITS ADVANTAGES

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Degree / Master's Degree program. It is more focused towards the student's choice in providing a wide range of Units available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher-student participation.

Studying under CBCS has following advantages:

- Students may undergo training in cross-disciplinary and multi-disciplinary subjects and acquire more focused and preferred knowledge.
- Students may get more skills from other subject(s) which are required for the career path in addition to their regular subject knowledge.
- Students may get ample opportunities to use the laboratories and gain practical exposure to the much needed Units available in other departments/schools for want of scientific inputs.
- Courses are conducted by subject experts identified on the basis of their experiences. Courses taught by such experts may provide in-depth information and clear understanding of the Units.

- Students may get an opportunity to study courses with other students of different programs and exchange their views and knowledge in a common class room.
- CBCS provides a cross-cultural learning environment.
- Students may benefit much from selecting the right options to successfully face the public service examinations like UPSC, KPSC, IES wherein the knowledge of additional subjects become mandatory for general or optional papers.
- Students are exposed to the culture of universal brotherhood during their campus life.
- Students are allowed to practice various methods of learning a subject.

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Post Graduate Degree Program

1.0 Teaching and Learning Process

The teaching and learning process under CBCS-CAGP of education in each course of study will have three components, namely-

(i) L= Lecture (ii) T= Tutorial (iii) P= Practice, where:

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

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

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

2.0. A course shall have either or all the three components. That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

2.1. Various course of s**tudy** are labeled and defined as: (i) Core Course (CC) (ii) Hard Core Course (HC), (iii) Soft Core Course (SC), (iv) Foundation Core Course (FC) and (v) Open Elective Course (OE).

(i) **Core Course:** A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course.

(ii) **Foundation Course (FC):**

The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

(iii) **Hard Core Course (HC):**

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.

(iv) **Soft Core Course (SC):**

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.

(v) O**pen Elective Course:**

An elective course chosen generally from other discipline / subject, with an intention to seek exposure is called an O**pen Elective Course.**

2.2. Project Work:

Project work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem.

2.3. Minor Project:

A project work up to **Six to Eight credits** is called **Minor Project** work. A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned.

2.4. Major Project / Dissertation:

A project work of **EIGHT, TEN, TWELVE, SIXTEEN or TWENTY** credits is called **Major Project** work. The Major Project / Dissertation shall be Hard Core.

3.0. Minimum Credits to be earned:

3.1. A candidate has to earn 96 credits for successful completion of M Tech degree with a distribution of credits for different courses as prescribed by the university.

3.2. A candidate can enroll for a maximum of 26 credits per Semester. However he / she may not successfully earn a maximum of 26 credits per semester. This maximum of 26 credits does not include the credits of courses carried forward by a candidate.

3.3. 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 96 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.

4.0. Add- on Proficiency Certification:

In excess to the minimum of 96 credits for the M. Tech Degree program, a candidate can opt to complete a minimum of 4 extra credits either in the same discipline/subject or in different discipline / subject to acquire **Add on Proficiency Certification** in that particular discipline / subject along with the M .Tech degree.

4.1. Add on Proficiency Diploma:

In excess to the minimum of 96 credits for the M. Tech degree program, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline/subject or in different discipline / subject to acquire Add on Proficiency Diploma in that particular discipline / subject along with the B. Tech degree. The A**dd - on Proficiency Certification / Diploma** so issued to the candidate contains the courses studied and grades earned.

5.0. Continuous Assessment, Earning of Credits and Award of Grades.

5.1. The assessment and evaluation process happen in a continuous mode. However, for reporting purpose, **a semester is divided into 3 components as C1, C2, and C3.**The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

(i) Component C1:

The first Component (C1), 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 C1 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 C2 immediately after completion of process of C1.

The finer split - up for the award of marks in C1 is as follows:

Assignment ……..…….. 05 marks for Unit 1&2

Seminar ……..……. 05 marks for Unit 1&2

Test (Mid-Term) ……..……..15 marks for Unit 1&2

Total ……..…… ……..25 marks

(ii) Component C2:

The second component (C2), 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 C2 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 C2 is as follows:

Assignment ……..……... 05 marks for Unit 3 & 4

Seminar ……..……..……..05 marks for Unit 3 & 4

Review Test (Mid-Term) ……..…….15 marks for Unit 3 & 4

Total ……..……..25 marks

(iii) Component C3:

The end semester examination of 3 hours duration for each course shall be conducted during the 18th & 19th week. **This forms the third / final component of assessment (C3) and the maximum marks for the final component will be 50.**

5.2. Setting Questions Papers and Evaluation of Answer Scripts:

5.2.1. 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.

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

5.2.3. There shall be single valuation for all theory papers by internal examiners. In case, the number of internal examiners falls short, external examiners may be invited. The answer scripts evaluated both by internal and external examiners shall be moderated by the external examiner / moderator.

5.2.4. 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.

5.2.5. If a course is fully of (L=0): T: (P=0) type, then the examination for C3 Component will be as decided by the BOS concerned.

5.2.6. In case of a course with only practical component a practical examination will be conducted with two examiners (ref: 6.3.4 above) 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.

5.2.7. The duration for semester-end practical examination shall be decided by the School / Council.

5.3. 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	(C1)	Periodic Progress and Progress Reports (25%)
Component – II	(C2)	Results of Work and Draft Report (25%)
Component– III	(C3)	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

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

Component	Period	Syllabus	Weightage	Activity
C1	1st Week to 8th Week Last 3 days of 8th Week	First 50% (two units)	25%	Instructional process and Continuous Assessment
	1st Week to 8th Week Last 3 days of 8th Week	First 50% (two units)	25%	Consolidation of C1
C2	9th week to 16th week	Second 50% (remaining two units)	25%	Instructional process and Continuous Assessment
	Last 3 days of 16th week	Second 50% (remaining two units)		Consolidation of C2
C3	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
	21st week			Notification of Final Grades
***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 be announced latest by 21st week**				

Note: 1. Practical examination wherever applicable shall be conducted before conduct of C2 Examination. The calendar of practical examination shall be decided by the respective School.

2. Finally**, awarding the Grades** be announced latest by 5 days after completion of the examination.

6.0 Requirements to Pass a Course

6.1. 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 30% in C1 and C2 together, and 40% and above in aggregate of C1, C2 and C3 in a course is said to be successful.

6.2. **Eligibility to Appear for C3 (Semester - end) Examination and Provision to Drop the Course.**

Only those students who fulfill 75% attendance requirement and who secure minimum 30% marks

in C1 andC2 together in a course are eligible to appear for C3 examination in that course.

6.3. Those students who have 75% of attendance but have secured less than 30% marks in C1 and C2 together in a course are not eligible to appear for C3 examination in that course. They are treated as dropped the course and they will have to repeat that course whenever it is offered.

Teachers offering the courses will place the above details in the School Council meeting during the last week of the Semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Director of the School before commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

6.4. In case a candidate secures more than 30% in C1 and C2 together but less than 40% in aggregate of C1, C2 and C3 in a course is considered as unsuccessful and such a candidate may either opt to DROP that course or appear for C3 examination during the subsequent semesters / years within the stipulated period.

In such a case wherein he / she opts to appear for just C3 examination, then the marks secured in C1 and C2 shall get continued. Repeat C3 examination will be conducted in respective semesters.

6.5. In case a candidate opts to drop the course he / she has to re-register for the dropped course only in subsequent semesters whenever it is offered if it is Hard Core Course and he / she may choose alternative course if it is Soft Core Course or Open Elective course or Skill Development Course. **The details of any dropped course will not appear in the Grade Card.**

6.6. **Provision to Withdraw Course:**

A candidate can withdraw any course within ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is soft core/open elective. **A DROPPED course is automatically considered as a course withdrawn.**

7.0. Provision for Make- up Examination:

For those students who have secured less than 40% marks in C1, C2 and C3 (end semester examination) together; the university shall conduct a make-up C3 examination within three weeks after the end of each semester.

Such of those students who have secured more than 30% marks in C1 and C2 together and less than 40% marks in C1, C2, and C3 together in a course shall appear for make-up examination in that course. This make-up examination is only for C3examination.

A student who is absent to End Semester Examination (C3) due to medical emergencies or such other exigencies and fulfills the minimum attendance and performance requirements in C1 & C2 shall appear for make-up examination.

7.1 The candidate has to exercise his/her option immediately within 10 days from the date of notification of results. A MAKE-UP examination will be conducted within 25 days from the date of notification of results. If the candidate still remains unsuccessful after MAKE-UP examination he/she is said to have DROPPED that course

7.2 **Re-Registration and Re-Admission:**

A candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University and is considered as dropped the semester and is not allowed to appear for end semester examination (C3) shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

In case a candidate fails in more than 2 courses in odd and even semesters together in a given academic year, he / she may either drop all the courses and repeat the semester or reappear (C3 semester end examination) to such of those courses where in the candidate has failed during subsequent semester / year within a stipulated period.

7.3 In such a case where in a candidate drops all the courses in 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.

7.4 **Requirements to Pass the Semester and Provision to Carry Forward the Failed Subjects / Courses:**

7.4.1 A candidate who secures a minimum of 30% in C1 and C2 and 40% and above in aggregate of C1, C2 and C3 in all the courses with credits prescribed in a semester is said to have passed that semester.

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

A student who has failed in 4 courses in 1st and 2nd semesters together shall move to 3rd semester. And he / she shall appear for C3 examination of failed courses of the said semesters concurrently with 3rd semester end examinations (C3) and 4th semester end examinations (C3) of second year of study.

8.0 **Attendance Requirement:**

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

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

8.3. Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the end semester (C3) examination.

8.4. Teachers offering the courses will place the above details in the School / Department meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Head of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

8.5. **Absence during mid-semester examination**

In case a student has been absent from a mid-semester examination 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 Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and permit such student to appear for make-up mid semester examination.

8.6. Absence during end semester examination:

In case a student is absent for end semester examination on medical grounds or such other exigencies, the student can submit request for make-up examination, with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School. The Director of the School may consider such request depending on the merit of the case and after consultation with class teacher, course instructor and permit such student to appear for make-up mid semester examination

9. **Provisional Grade Card:**

The tentative / provisional Grade Card will be issued by the Registrar (Evaluation) 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.

9.1 **Challenge Valuation:**

A student who desires to apply for challenge valuation shall obtain a Xerox copy of the answer script 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 Registrar (Evaluation) within 15 days after the announcement of the results. This challenge valuation is only for C3 component.

The answer scripts for which challenge valuation is sought for shall be sent to another external examiner. The marks awarded will be the higher of the marks obtained in the challenge valuation and in maiden valuation.

9.2 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 Registrar (Evaluation).

9.3 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	B
60-69	7	v*7	C
50-59	6	v*6	D
40-49	5	v*5	E
0-39	0	v*0	F

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F - Fail;

Here, P is the percentage of marks (P=[(C1+C2)+M] 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.

9.4 **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) = ∑(Ci x Gi) / ∑Ci

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA
Illustration No. 1

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade)
Course 1	**4**	**A**	**9**	**4X9=36**
Course 2	**4**	**B**	**8**	**4X8=32**
Course 3	**4**	**C**	**7**	**4X7=28**
Course 4	**4**	**O**	**10**	**4X10=40**
Course 5	**4**	**D**	**6**	**4X6=24**
Course 6	**4**	**O**	**10**	**4X10=40**
	24			**200**

Thus, **SGPA = 200 ÷ 24 = 8.33**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	**5**	**A**	**9**	**5X9=45**
Course 2	**5**	**C**	**7**	**5X7=35**
Course 3	**5**	**A**	**9**	**5X9=45**
Course 4	**5**	**B**	**8**	**5X8=40**
Course 5	**4**	**O**	**10**	**4X10=40**
	24			**205**

Thus, **SGPA = 205 ÷ 24 = 8.54**

9.5 Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for two year post graduate degree in Computer Science & Engineering 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	24	8.33	24 x 8.33 = 199.92
2	24	8.54	24 x 8.54 =204.96
3	24	9.35	24x9.35=224.4
4	24	9.50	24x9.50=228.0
Cumulative	96		857.28

Thus, **CGPA** = $\frac{24x8.33+24x8.54+24x9.35+24x9.50}{96}$ = 8.93

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 8.93 x 10=89.30

9.6 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	Numerical Index	FGP Qualitative Index
> 4 CGPA < 5	**5**	SECOND CLASS
5 > = CGPA < 6	6	
6 >= CGPA < 7	7	FIRST CLASS
7 >= CGPA < 8	8	
8 >= CGPA < 9	9	DISTINCTION
9 >= CGPA 10	10	

Overall percentage=10*CGPA

10.0. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1 and C2 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of 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 taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

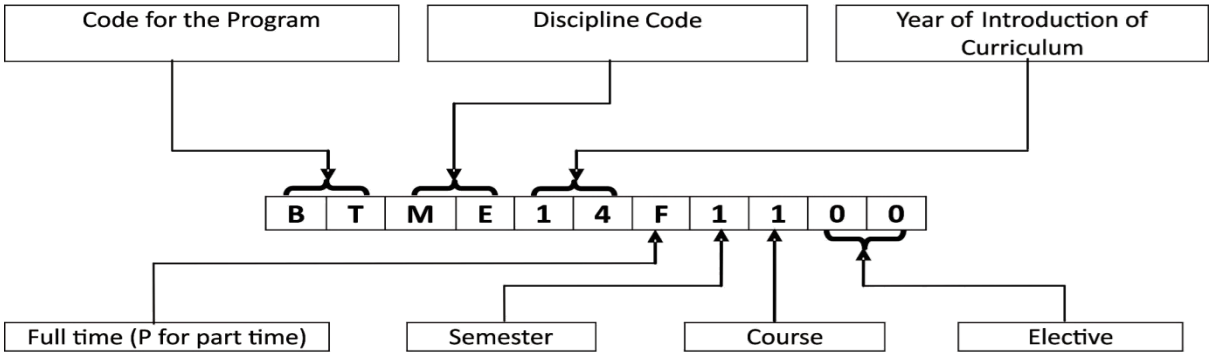
11.0. Grievance Cell

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

- The Registrar (Evaluation) - 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.

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

Course Numbering Scheme



List of Codes for Programs and Disciplines / Branch of Study

Program Code	Title of the Program	Discipline Code	Name of the Discipline / Branch of Study
BA	Bachelor of Arts	AE	Advanced Embedded Systems
BB	BBM (Bachelor of Business	AI	Advanced Information Technology
BC	B.Com (Bachelor of Commerce)	AP	Advanced Power Electronics
BR	B. Arch (Bachelor of Architecture)	CA	Computer Aided Structural Engineering
BS	B Sc, BS (Bachelor of Science)	CE	Civil Engineering
BT	B.Tech (Bachelor of Technology)	CH	Chemistry
BP	Bachelor of Computer Applications	CO	Commerce
BL	LLB (Bachelor of Law)	CS	Computer Science and Engineering /
MA	Master of Arts	DE	Data Engineering and Cloud
MB	MBA (Master of Business Administration)	EC	Electronics and Communication Engineering
MC	M.Com (Master of Commerce)	EN	English
MS	M.Sc / MS (Master of Science)	MD	Machine Design and Dynamics
MT	M Tech (Master of Technology)	ME	Mechanical Engineering
MC	Master of Computer Applications	EE	Electrical & Electronics Engineering

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SCHOOL OF CIVIL ENGINEERING
M. Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
(2018-2020)
I SEMESTER

Sl. No	Course Code	Title of the Course	HC/SC/OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours
					L	T	P	Total	
1	M18SE1010	Computational Structural Mechanics	HC	BE / B. TECH in Civil Engineering	3	1	-	4	5
2	M18SE1020	Computational Structural Dynamics	HC		3	1	-	4	5
3	M18SE1030	Advanced Design of RC Structures	HC		3	1	-	4	5
4	M18SE1040	Advanced Solid Mechanics	HC		3	1	-	4	5
5	M18SE1051	Advanced Structural Analysis	SC		3	1	-	4	5
	M18SE1052	Design of Bridges	SC		3	1	-	4	5
6	M18SE1061	Special Concretes	SC		3	1	-	4	5
	M18SE1062	Design of Tall Structures	SC		3	1	-	4	5
TOTAL								**24**	**30**
Practical									
7	M18SE1070	Structural Engineering Laboratory-I (Concrete Laboratory)	HC		0	0	4	4	3
TOTAL								**04**	**03**
TOTAL SEMESTER CREDITS								**28**	
TOTAL CUMULATIVE CREDITS								**28**	
TOTAL CONTACT HOURS								**33**	

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II SEMESTER

Sl. No	Course Code	Title of the Course	HC/SC /OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours
					L	T	P	Total	
1	M18SE2010	Finite Element Method of Analysis	HC	BE / B. TECH in Civil Engineering	3	1	-	4	5
2	M18SE2020	Advanced design of foundations	HC		3	1	-	4	5
3	M18SE2030	Advanced Design of Steel Structures	HC		3	1	-	4	5
4	M18SE2040	Structural Health Monitoring	HC		3	1	-	4	5
5	M18SE2051	Design of Earthquake Resistant Structures	SC		3	1	-	4	5
	M18SE2052	Stability Analysis of Structures	SC		3	1	-	4	5
6	M18SE2061	Reliability Analysis and Design of Structures	SC		3	1	-	4	5
	M18SE2062	Advanced Design of Prestressed concrete	SC		3	1	-	4	5
TOTAL								**24**	**30**
Practical									
7	M18SE2070	Structural Engineering Laboratory-II (Software Lab)	HC		0	0	4	4	3
TOTAL								**04**	**03**
TOTAL SEMESTER CREDITS								**28**	
TOTAL CUMULATIVE CREDITS								**56**	
TOTAL CONTACT HOURS								**33**	

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(2018-2020)
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	M18SE3010 / M18TE3010	Roads and Building Structures	OE	BE / B. TECH in Civil Engineering	4	0	0	4	4
2	M18SE3020	Internship with Report	Term Work and Viva - Voce		0	0	0	12	
3	M18SE3030	Project Phase-I	Report and Viva -Voce		0	0	0	04	
TOTAL								**20**	
TOTAL SEMESTER CREDITS								**20**	
TOTAL CUMULATIVE CREDITS								**76**	
TOTAL CONTACT HOURS								**-**	

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SCHOOL OF CIVIL ENGINEERING

M. Tech in COMPUTER AIDED STRUCTURAL ENGINEERING (2018-2020)

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	M18SE4010	Technical Seminar With Report	Term Work		0	0	0	4	
2	M18SE4020	Dissertation Phase-II	Thesis Submission and Viva-Voce		0	0	0	16	
TOTAL								**20**	
TOTAL SEMESTER CREDITS								**20**	
TOTAL CUMULATIVE CREDITS								**96**	
TOTAL CONTACT HOURS								**-**	

Note: 1) OPEN ELECTIVE Courses are offered for the students of other Schools. The students of the School of Civil Engineering have to **choose ONE Open Elective offered by other schools**.

2) Open elective Classes will be conducted on Saturdays only

Open Elective:M18SE3010/M18TE3010- Roads and Building Structures

FIRST SEMESTER

M18SE1010	COMPUTATIONAL STRUCTURAL MECHANICS	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
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 and develop element stiffness and flexibility matrices.
2. To analyze framed structures subjected to direct and indirect loadings by flexibility and stiffness methods using force/displacement transformation matrices (element approach).
3. To learn the analysis of framed structures using standard structural analysis software
4. 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
2. Be able to analyze framed structures subjected to direct and indirect loadings by flexibility and stiffness methods using force/displacement transformation matrices (element approach)
3. Have learnt the analysis of framed structures using standard structural analysis software
4. Be able analyze every component of a structure

UNIT-I	12HOURS

Introduction: Classification of structures, Static and Kinematic indeterminacy, Equilibrium and compatibility conditions, Energy concepts, Principles of minimum potential energy and minimum complementary energy. Concepts of stiffness and flexibility, Coordinate systems, Relation between element and structure flexibility and stiffness matrices, Principle of contra-gradience, Development of element flexibility and element stiffness matrices for bar, beam, plane frame and truss elements.

UNIT-II	12 HOURS

Flexibility method: Consideration of redundants based on static indeterminacy, Basic determinate structures, Fixed end moments and equivalent joint loads, Development of force-transformation matrices and global flexibility matrices for continuous beams, rigid plane frames and plane trusses (not more than 6x6 structure flexibility matrix).

StiffnessMethod: Consideration of coordinates based on degrees of freedom, Fixed end moments and equivalent joint loads, Development of Displacement-transformation matrices and global stiffness matrices for continuous beams, rigid plane frames and plane trusses (not more than 6x6 structure stiffness matrix).

UNIT-III	12 HOURS

Analysis using Flexibility method by transformation approach: analysis of continuous beams, beams on elastic supports, beams with rotation of supports, Analysis of non-sway and sway rigid jointed plane frames using force-transformation matrix (not more than 3x3 structure flexibility matrix).

Analysis of plane trusses by flexibility method (not more than 3x3 structure flexibility matrix) using force-transformation matrix, considerations for lack of fit and thermal stresses.

UNIT-IV	12 HOURS

Analysis using Stiffness method by transformation approach: analysis of continuous beams, beams on

elastic supports, beams with rotation of supports, Analysis of non-sway and sway rigid jointed plane frames using displacement-transformation matrix (not more than 3x3 structure stiffness matrix).
Analysis of plane trusses by stiffness method (not more than 3x3 structure stiffness matrix) using displacement-transformation matrix, considerations for lack of fit and thermal stresses.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
M18SE1010	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	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.

M18SE1020	COMPUTATIONAL STRUCTURAL DYNAMICS	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
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 learn the concepts and principles of structural mechanics
2. To frame mathematical models of SDOF and MDOF systems and analyse the corresponding free vibration response of damped and undamped systems
3. To frame mathematical models of SDOF and MDOF systems and analyze the corresponding forced vibration response of damped and undamped systems
4. To learn about principle of vibration-measuring instruments and evaluation of damping

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

1. Has learnt the concepts and principles of structural mechanics
2. Is able to frame mathematical models of SDOF and MDOF systems and analyse the corresponding free vibration response of damped and undamped systems
3. Is able to frame mathematical models of SDOF and MDOF systems and analyse the corresponding forced vibration response of damped and undamped systems
4. Has learnt about principle of vibration-measuring instruments and evaluation of damping

UNIT-I	12 HOURS

Dynamical problems in Civil Engineering, Concepts of degrees of freedom and vibration, D'Alembert's principle, principle of virtual displacement and energy principles.

Free Vibration of Single-degree-of-freedom systems: Mathematical models of SDOF system, example problems, Free vibration response of damped and undamped systems, measurement of damping, Logarithmic decrement, half power bandwidth method.

UNIT-II	12 HOURS

Free Vibration of Multi-degree freedom systems: Mathematical models of MDOF systems, free vibration of undamped MDOF systems -Shear building concept, Natural frequency, importance of fundamental frequency, finding natural frequency for different structures, relation between frequency and time period and mode shapes – orthogonality conditions,

Free vibration of damped MDOF systems. damping properties, critical damping ratio, dynamic load factor, magnification factor, Rayleigh's and Cauchey's damping methods

UNIT-III	12 HOURS

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, rotation unbalance, reciprocatingunbalance.

Numerical methods applied to SDOF, Direct integration and Duhamel integral, principle of vibration-measuring instruments – seismometer and accelerometer.

UNIT-IV	12 HOURS

Forced Vibration of MDOF Systems:Equations of Motion and Response to forced excitations, Modal analysis

– free and forced vibration with and without damping.Stiffness matrix, mass matrix (lumped and consistent); equations of motion for the discretized beam in matrixform.

Dynamics of Continuous systems: Free longitudinal vibration of bars, flexural vibration of beams with different end conditions i.e simply supported, fixed at both ends , one end fixed other end free, both ends free, forced vibrations – response of beams under moving loads, concentrated load, chain of 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	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
M18SE1020	CO1	3	2	2		1		2	2	1	1	1	3	3	1	2
	CO2	3	2	2		1		2	2	1	1	1	3	3	1	2
	CO3	3	2	2		1		2	2	1	1	1	3	3	1	2
	CO4	3	2	2		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.

M18SE1030		L	T	P	C	Hrs.

Duration: 16weeks	ADVANCED DESIGN OF RC STRUCTURES	3	1	0	4	5
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
2. To design grid floors, continuous beams and flat slabs
3. To design chimneys, silos and bunkers
4. To learn the detailing of earthquake resistant structures and 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 design grid floors, continuous beams and flat slabs
3. Is able to design chimneys, silos and bunkers
4. Has learnt about the detailing of earthquake resistant structures and is able to design elevated water tanks

UNIT-I	12 HOURS

Yield line theory for analysis of slabs: Characteristic Features of Yield Lines, Different yield line patterns, virtual work methods and Equilibrium of analysis.
Analysis of Rectangular and circular slabs: simply supported on all four edges and all edges fixed conditions

UNIT-II	12 HOURS

Design of grid floors or Coffered floors by approximate method, Design of continuous beams with redistribution of moments , Design of flat slabs

UNIT-III	12 HOURS

Design of Chimneys
Design of Silos, Design of Square or Rectangular Bunkers

UNIT-IV	12 HOURS

Art of detailing earthquake resistant structures, Expansion and contraction joints
Design of elevated water tanks by limit state method

REFERENCE BOOKS

- Lin, TY and Burns, N H. "**Reinforced Concrete Design**".
- Kong, KF and Evans, T H. "**Design of Prestressed Concrete Structures**
- Varghese, "P.C. **Advanced Reinforced Concrete Design**", Prentice-Hall of India, New Delhi, 2005.
- Punmia, B.C.Ashok Kumar Jain and Arun Kumar Jain, **"Comprehensive RCC Design"**
- Bhavikatti, "**Advanced design of R C Structures**."

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
M18SE1030	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

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

M18SE1040	ADVANCED SOLID MECHANICS	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
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 analyze stress and strain at a point
2. To learn the equilibrium and compatibility equations and boundary conditions.
3. To solve 2D problems of elasticity by Airy's stress function approach
4. To solve elementary 3D problems

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

1. Is able to analyze stress and strain at a point
2. Has learnt the equilibrium and compatibility equations and boundary conditions.
3. Is able to solve 2D problems of elasticity by Airy's stress function approach
4. Is able to solve elementary 3D problems

UNIT-I — 12 HOURS

Introduction, Assumptions, Applications the state of stress at a point, Basic Equations of Elasticity, components of stresses at a point in Cartesian and polar co-ordinates. Equilibrium, compatibility equations and boundary conditions in 2-D and 3-D cases in Cartesian Coordinates, Principal stresses and stress Invariants, Hydrostatic and Deviatoric stress. Octahedral Stresses.

UNIT-II — 12 HOURS

Introduction, The state of strain at a point, Principal strains, Strain Invariants,Strain transformation, spherical and deviatoric strains, compatibility equations for strain, maximum shear strain, strain rosettes, Volumetric strain, Octahedral Strains.

UNIT-III — 12 HOURS

Plane stress and plane strain: Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams,St. Venant's Theory.

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
Stress – strain diagram in simple tension, perfectly elastic, Rigid – Perfectly plastic, Linear work – hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials,
Failure theories, yield conditions, stress – space representation of yield criteria through Westergaard stress space, Tresca and Von-Mises criteria of yielding.

Fracture Mechanics
Introduction, Importance, Quasi brittle materials, Review of concrete behaviour in tension and compression, Linear Elastic Fracture Mechanics – Griffith and Irwin theories

REFERENCE BOOKS

- Timoshenko & Goodier, "**Theory of Elasticity**", McGraw Hill
- Srinath L.S., **Advanced Mechanics of Solids**, 10th print, Tata McGraw Hill Publishing company, New Delhi, 1994

- Sadhu Singh, "**Theory of Elasticity**", Khanna Publishers
- Verma P.D.S, "**Theory of Elasticity**", Vikas Publishing Pvt. Ltd
- Chenn W.P and Hendry D.J, "**Plasticity for Structural Engineers**", Springer Verlag
- Valliappan C, "**Continuum Mechanics Fundamentals**", Oxford IBH Publishing Co. Ltd.
- Sadhu Singh, "**Applied Stress Analysis**", Khanna Publishers
- Govindaraju L and Sitharam G, "Applied Elasticity", Interline Publishers
- XiLu, "Theory of Elasticity", John Wiley.

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
M18SE1040	CO1	3	2	2		1			1		1	1	3	3	1	2
	CO2	3	2	2		1			1		1	1	3	3	1	2
	CO3	3	2	2		1			1		1	1	3	3	1	2
	CO4	3	2	2		1			1		1	1	3	3	1	2

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

M18SE1051	ADVANCED STRUCTURAL ANLYSIS	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5

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

Prerequisite: Strength of materials, Structural analysis

COURSE OBJECTIVES: Student will be able to learn

1. To analyze curved beams for circumferential and radial stresses
2. To analyze bending stresses in beams subjected to unsymmetrical bending and deflections of straight beams subjected to unsymmetrical bending
3. To study the shear centre in thin walled sections and tension coefficient method for the analysis of trusses
4. To understand the theoretical concept of beams on elastic foundations
5.

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

1. Is able to analyze curved beams for circumferential and radial stresses
2. Is able to analyze bending stresses in beams subjected to unsymmetrical bending and deflections of straight beams subjected to unsymmetrical bending
3. Is able to understand the concept of the shear centre in thin walled sections and tension coefficient method for the analysis of trusses
4. Is able to understand the concept of the theoretical concept of beams on elastic foundations.

UNIT-I	12 HOURS

Curved Beams: Introduction, Circumferential stress in a curved beam, Radial stresses in curved beams, Correction for circumferential stresses in curved beams having I, T, or similar cross sections, Deflections of curved beams, Statically indeterminate curved beams, Closed ring subjected to concentrated load.

UNIT-II	12 HOURS

Non symmetrical Bending of Straight Beams: Definition of shear centre in bending, Symmetrical and nonsymmetrical bending, Bending stresses in beams subjected to unsymmetrical bending, Deflections of straight beams subjected to unsymmetrical bending, Sensitivity of deep I sections.

UNIT-III	12 HOURS

Shear Centre for Thin-Wall Beam Cross Sections: Approximation employed for shear in thin wall beam cross sections, Shear flow in thin-wall beam cross sections, Shear centre for a channel, I and angle sections. Method of Tension Co-Efficient: General principles, Analysis of three-dimensional trusses and frames

UNIT-IV	12 HOURS

Beams on Elastic Foundations: General theory, Infinite beam subjected to concentrated load, Boundary conditions, Infinite beam subjected to a distributed load segment, Semi-infinite beam subjected to loads at its end, Semi-infinite beam with concentrated load near its end, Short beams.

REFERENCE BOOKS

1. Boresi, A.P. and Sidebottom, O.M. (1985), Advanced Mechanics of Materials, Fourth Edition, John Wiley and Sons, New York.
2. Junnarkar, S.B. and Shah, H.J. (1996), Mechanics of Structures, Vol. III, Charotar Publications, Char House, Anand
1. Reference Books:
1. Gere, G.M. and Timoshenko, S.P. (2000), Advanced Mechanics of Materials, Second Edition, CBS Publishers, New Delhi.
2. Ugural, A.C. and Fenster, S.K. (1981), Advanced Strength of Material and Applied Elasticity, Arnold Publishers.

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
M18SE1051	CO1	3	2	2		2			1	1		1	3	3	1	2
	CO2	3	2	2		2			1	1		1	3	3	1	2
	CO3	3	2	2		2			1	1		1	3	3	1	2
	CO4	3	2	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.

M18SE1052	DESIGN OF BRIDGES	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
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 historical developments, site selection for bridges
2. To learn about the design of box culvert and design of T beam slab
3. To learn about the different IRC loading cases and to design the slab culvert
4. To design T- beam bridge slab

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
2. Has learnt about the classification, components and forces acting on bridges
3. Has learnt about the different IRC loading cases and to design the slab culvert
4. Is able to design T- beam bridge slab

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

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

UNIT-II	12HOURS

Box Culvert: Working outthe 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 SlabUsing 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 IRCClass AA Tracked, Wheeled Class A Loading A Loads, Structural Design of Beam, with Reinforcement Detail.

T Beam Bridge Main Girder Design: Analysis of Main Girder for Dead Load & Live Load Using IRCClass 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 vehicleonly, 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 andstructural 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 supportedportion 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 – 1966 "**Standard Specifications And Code Of Practice For Road Bridges"-** Section II Loads and Stresses, The Indian Road Congress New Delhi
5. IRC 21 – 1966 "**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 – 2000 "**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	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
M18SE1052	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

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

M18SE1061	SPECIAL CONCRETES	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)					

Prerequisite: Concrete Technology

COURSE OBJECTIVES: Student will be able to learn

- To learn the different types of cement replacement materials and Light weight concrete
- To learn about High Density concrete and Ferro-cement
- To learn about fibre reinforced concrete and its properties
- To learn about High performance concrete and other types of concrete

COURSE OUTCOME:

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

- Has learnt the different types of cement replacement materials and Light weight concrete
- Has learnt about High Density concrete and Ferro-cement
- Has learnt about fibre reinforced concrete and its properties
- Has learnt about High performance concrete and other types of concrete.

UNIT-I **12HOURS**

Introduction to concrete as a construction material, significance of properties of concrete, Components of modern concrete and developments in the process and constituent materials: Role ofconstituents, Development in cements and cement replacement materials, pozzolona, fly ash, silica fume, rice husk ash, Aggregates classification and properties, artificial and recycled aggregates, chemical and mineral admixtures.

Mix proportioning of Concrete: Principles and methods of mix design, variables in proportioning, exposure conditions, and procedure of mix design as per relevant codal provisions and numerical examples of mix design of conventional concretes, Self-Compacting concrete and Geopolymer concrete

Microstructure of concrete, interfacial transition zone and its significance, application of nano materials, durability of concrete.

UNIT-II **12HOURS**

Light Weight concrete: Introduction, classification, properties, strength and durability, mix proportioningand problems.

High density concrete: Radiation shielding ability of concrete, materials for high density concrete, mixproportioning, properties in fresh and hardened state, placement methods.

Ferrocement: Ferrocement materials, mechanical properties, cracking of ferrocement, strength andbehaviour in tension, compression and flexure, Design of ferrocement in tension, ferrocement constructions, durability, and applications.

UNIT-III **12HOURS**

Fibre reinforced concrete: Fibre materials – types and properties, mix proportioning, distribution and orientation, interfacial bond,properties in fresh state.

Strength and behaviour in tension, compression and flexure of steel fibre reinforced concrete, mechanical properties, crack arrest and toughening mechanism, applications.

UNIT-IV **12HOURS**

High Performance concrete: constituents, mix proportioning, properties in fresh and hardened states,applications and limitations.

Ready Mixed Concrete – manufacture, transporting, placing and precautions, Self-Compacting Concrete, Self-Curing Concrete, Reactive powder concrete, Roller compacted concrete, Bacterial Concrete, Porous concrete.

REFERENCE BOOKS

1. Neville A.M, "Properties of Concrete" Pearson Education Asis, 2000
2. P. Kumar Mehta, Paul J.N.Monterio, CONCRETE, "Microstructure, Properties and Materials"-Tata McGraw Hill
3. A.R.Santhakumar, (2007) "Concrete Technology"-Oxford University Press, New Delhi, 2007.
4. Short A and Kinniburgh.W, "Light Weight Concrete"- Asia Publishing House, 1963
5. Aitcin P.C. "High performance concrete"-E and FN, Spon London 1998
6. Rixom.R. and Mailvaganam.N., "Chemical admixtures in concrete"- E and FN, Spon London 1999

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
M18SE1061	CO1	2	1		2	1	2	1	2		1	1	2	1	1	2
	CO2	2	1		2	1	2	1	2		1	1	2	1	1	2
	CO3	2			2	1	2	1	2		1	1	2	1	1	2
	CO4	2			2	1	2	1	2		1	1	2	1	1	2

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

M18SE1062	DESIGN OF TALL STRUCTURES	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5

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 know about different types of loads, materials and design philosophy.
3. Various structural systems with their behaviour are introduced.
4. To impart knowledge about static, dynamic and stability analysis of various systems.

COURSE OUTCOME:

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

1. Develop various systems of tall buildings.
2. Understand different types of loads, materials for the design of tall structures.
3. Understand the behaviour of structural members.
4. Design stable structures.

UNIT-I	12HOURS

INTRODUCTION

Design Philosophy - History - Classification of buildings according to NBC – Wind load – Seismic load – Quasi static approach- combination of loading

UNIT-II	12HOURS

LOADS AND MATERIALS

Wind loading:static and dynamic approach, Analytical and wind tunnel experimentation method. Earthquake loading: Equivalent lateral force, modal analysis, combinations of loading, working stress design, Limit state design, Plastic design.

Materials – high performance concrete, fiber reinforced concrete, lightweight concrete, design mixes

UNIT-III	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 - outrigger braced systems - Mega systems.

UNIT-IV	12HOURS

ANALYSIS AND DESIGN

Analysis and Design principles of various horizontal load transfer systems - approximate methods - Modelling for accurate analysis - 3D analysis - Member forces - displacements. Analysis for various secondary effects - Creep, shrinkage and temperature. Stability Analysis - Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity loading, P - effect and various methods of analysis - influence of foundation instability, out of plumb effects - Elastic Deformations. Dynamic Analysis - Principles of design of tall braced frames for earthquake and blast resistant design.

REFERENCE BOOKS

1. Schuller.W.G., "High Rise Building Structures", John Wiley & sons, 1977
2. Lynn.S. Beedle, "Advances in Tall Buildings", CBS Publishers and Distributors, New Delhi, 1996
3. LinT.Y. and Burry D.Stotes, " Structural Concepts and Systems for Architects and Engineers ", John Wiley, 1994.

4. 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.
5. Lecture Notes on "Tall Buildings" - Short Term Course organized by Civil Engineering Department, SRM Engg college, Kattankulathur. June 2002
6. Smith .B.S. and Coull .A., "Tall Building Structure", 'Analysis and Design', John Wiley & Sons, Inc., 1991
7. Taranath .B.S., "Structural Analysis and Design of Tall Buildings", Mc Graw Hill Co. 1988

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
M18SE1062	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

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

M18SE1070	STRUCTURAL ENGINEERING LABORATORY (CONCRETE LABORATORY)	L	T	P	C	Hrs.
Duration: 16weeks		0	0	4	4	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, which governs the quality of the materials
3. To impart knowledge of mix design of concrete
4. to gain experimental knowledge of testing specimens in loading frame

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

1. Implement good quality construction techniques
2. Identify the quality of the materials used for construction
3. Identify the proportion of the mix design
4. Perform testing on loading frame

EXPERIMENTS TO BE CARRIED OUT

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

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 Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
M18SE1070	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

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

SECOND SEMESTER

M18SE2010	FINITE ELEMENT ANALYSIS	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)					

Prerequisite: Structural Analysis – II, Theory of Elasticity

COURSE OBJECTIVES: Student will be able to learn

- To learn about the basic concepts and principles of structural mechanics, FDM, RRM and GM.
- To learn about the basic analysis procedure, advantages and disadvantages of FEM.
- To learn about various types of finite elements used
- To derive the element stiffness matrices and load vectors for bar, beam, truss, plane frame, plane stress/strain elements.

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

1. Has learnt about the basic concepts and principles of structural mechanics, FDM, RRM and GM.
2. Has learnt about the basic analysis procedure, advantages and disadvantages of FEM.
3. Has learnt about various types of finite elements used
4. Is able to derive the element stiffness matrices and load vectors for bar, beam, truss, plane frame, plane stress/strain elements.

UNIT-I — 12HOURS

Introduction, Historical background, Principles of virtual displacement and minimum potential energy, Approximate methods of analysis - concepts of Finite Difference Method, Rayleigh-Ritz method and Galerkin method, Principles involved in FEM, Basic analysis procedure of FEM for structural problems, Advantages and disadvantages of FEM, , Static and kinematic variables for various structural problems.

Finite elements for 1-D, 2-D and 3-D problems, Coordinate systems – member, structure and natural coordinates, Displacement functions for various structural problems – polynomial form of displacement function, Derivation of Shape functions for standard elements – Bar elements, Beam elements, Truss elements, Triangular elements, Rectangular elements, Quadrilateral elements –Higher order Elements, Choice of displacement function - C^0 , C^1 and C^2 Continuity functions, Lagrangian, Hermitian Polynomials, Serendipity and Lagrangian family of elements, Convergence requirements,Geometric invariance, Pascal's triangle, Patch test, Static condensation.

UNIT-II — 12HOURS

General expression for stiffness, Derivation of strain-displacement matrices and element stiffness matrices for Bar, Beam, Truss and Frame elements (planar), Linear static analysis of one-dimensional problems using Linear and Quadratic bar elements, Treatment of boundary conditions – Elimination approach and Penalty approach. Linear static analysis of indeterminate beams, continuous beams and beams on elastic supports using beam elements. Linear static analysis of pin jointed plane trusses, Considerations for lack of fit and thermal stresses.

Two dimensional problems, Derivation of properties for Constant Strain Triangle element (CST element), transformation of coordinate information using Jacobian, Application to plane stress, plane strain, axisymmetric problems using CST and quadrilateral elements.

UNIT-III — 12HOURS

Concept of Iso-parametric elements, sub and super parametric elements, Advantages of Iso-parametric elements, Convergence requirements for Iso-parametric elements, Concept of mapping in Iso-parametric

elements, Iso-parametric formulation of 4-noded quadrilateral element, Numerical Integration by Gauss quadrature rule –one-point rule, two-point rule, n-point rule, including numerical examples.

Dynamic considerations in FEM, Concept of consistent and lumped load vectors, Consistent and Lumped mass matrices in local and global coordinate systems – for bar, beam, frame and truss elements, Evaluation of Eigenvalues and Eigenvectors, Free vibration analysis, techniques of non-liner analysis.

UNIT-IV	**12HOURS**

Modeling considerations and Use of software – Mesh generation and refinement, Element selection, Material properties, Loads and reactions, Connections in structures, Boundary conditions, Symmetry and anti-symmetry, Stress concentrations, Sub-structuring, Methods of model generation, Common mistakes in modelling, analysis and design capabilities.

Organization of Computer Program for FEM – flowcharts, Classification and structure of finite element analysis software programs, Desired features of Pre and Post Processors, Commonly used commercial software packages, Use of Software to analyse Bar, Beam, Frame and Plane Stress/Strain problems.

REFERENCE BOOKS

- Finite element analysis Theory and Programming, C S Krishnamurthy, McGraw Hill
- Fundamental of finite Element Analysis, David V Hutton, McGraw Hill
- Introduction to Finite Element Method, Desai & Abel, CBS Publishers
- Bhatti, M.A., Fundamental Finite Element Analysis and Applications: with Mathematica and Matlab Computations, Wiley, 2005.
- Reddy, J. N., An Introduction to the Finite Element Method, 3rd Edition, McGraw-Hill Science/Engineering/Math,2005.
- Logan D. L., A First Course in the Finite Element Method, Thomson- Engineering, 3rd edition, 2001.
- The Finite Element Methods and its basics 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	PO10	PO11	PSO 1	PSO 2	PSO 3	PSO 4
M18SE2010	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	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.

M18SE2020	ADVANCED DESIGN OF FOUNDATIONS	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5

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 design of pile foundations
3. To learn methods and design of well foundations
4. To learn soil structure interaction

COURSE OUTCOME:

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

1. has learnt method of estimating bearing capacity and design of shallow foundations
2. has learnt design of pile foundations
3. has learnt methods and design of well foundations
4. has learnt soil structure interaction

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

Soil-Foundation Interaction : Idealized soil, foundation and interface behavior. Elastic models of soil behavior; Elastic-plastic and time dependent behavior 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	PSO1	PSO2	PSO3	PSO4
M18SE 2020	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

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

M18SE2030	ADVANCED DESIGN OF STEEL STRUCTURES	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
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 familiarize with industrial structures such as gantry girder, crane girder
2. To understand the design concept of cooling towers, bunkers and silos
3. To familiarize with transmission towers
4. To familiarize the design of chimneys

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

1. Design independently gantry girders, crane girders which are compulsorily used in manufacturing industries
2. Able to know the concept of analysis and design of power plants, containment structures such as cooling towers, bunkers and silos
3. Able to analyze and design transmission towers
4. Able to analyze and design chimneys

UNIT-I	**12HOURS**
PLANNING AND FUNCTIONAL REQUIREMENTS Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration, Guidelines of Factories Act.	
UNIT-II	**12HOURS**
INDUSTRIAL BUILDINGS: Steel Gantry Girder, Crane Girders – Design of Corbels and Nibs	
UNIT-III	**12HOURS**
POWER PLANT STRUCTURES: Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos - Pipe supporting structures	
UNIT-IV	**12HOURS**
TRANSMISSION LINE STRUCTURES AND CHIMNEYS: Analysis and design of transmission line towers - Sag and Tension calculations, testing of towers – Design of self supporting chimney, Design of Chimney bases.	
REFERENCE BOOKS	

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
M18SE2030	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

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

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings: A Design Manual, Birkhauser Publishers, 2004.
2. Manohar S.N, Tall Chimneys - Design and Construction, Tata McGraw Hill, 1985
3. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill, 1992
4. Srinivasulu P and Vaidyanathan.C, Handbook of Machine Foundations, Tata McGraw Hill

M18SE2040		L	T	P	C	Hrs.
Duration: 16weeks	**STRUCTURAL HEALTH MONITORING**	3	1	0	4	5
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

- To learn the causes for deterioration of concrete and Non Destructive Tests
- To learn about effect of corrosion and prevention of concrete
- To learn detailed procedure of evaluating damaged structures
- To learn about maintenance of concrete structures

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

1. Has learnt the causes for deterioration of concrete and Non Destructive Tests
2. Has learnt about effect of corrosion and prevention of concrete
3. Has learnt detailed procedure of evaluating damaged structures
4. Has learnt about maintenance of concrete structures

UNIT-I **12HOURS**

General: Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis,preliminary investigations, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods.

Quality assurance for concrete construction as built concrete properties strength, permeability, thermalproperties and cracking.

Influence on Serviceability and Durability: Effects due to climate, temperature, chemicals, wear anderosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking,

Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

UNIT-II **12HOURS**

Maintenance and Repair Strategies: Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance, Preventive measures on various aspects. Inspection,

Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

UNIT-III **12HOURS**

Materials for Repair: Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete.

Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning.

UNIT-IV **12HOURS**

Introduction to Structural Health Monitoring (SHM) : Definition & motivation for SHM, SHM - a way for smart materials and structures, SHM and bio mimetic - analog between the nervous system of a man and a structure with SHM, SHM as a part of system management, Passive and Active SHM, NDE, SHM and NDECS, basic components of SHM, materials for sensor design.

Application of SHM in Civil Engineering: Introduction to capacitive methods, capacitive probe for cover concrete, SHM of a bridge, applications for external post- tensioned cables, monitoring historical buildings.

REFERENCES

1. Sidney, M. Johnson "Deterioration, Maintenance and Repair of Structures".
2. Denison Campbell, Allen & Harold Roper, "**Concrete Structures – Materials, Maintenance andRepair"-** Longman Scientific and Technical
3. R.T.Allen and S.C. Edwards, "**Repair of Concrete Structures**"-Blakie and Sons
4. Raiker R.N., "Learning for failure from Deficiencies in Design, Construction and Service"- R&D Center (SDCPL)
5. B.Vidiveli, "Rehabilitation of Concrete Structures", Standard Publishers.
6. B.L.Gupta and Amit Gupta, "Maintenance and Repair of Civil Structures", Standard Publishers.
7. Gahlot and Sharma, "Building Repair and Maintenance Management", CBS Publishers.
8. Daniel Balag eas, Claus-PeterFritzen and Alfredo Guemes Structural Health Monitoring, Published by ISTE Ltd., U.K., 2006.

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
M18SE2040	CO1	2	1		2	1	2	1	2		1	1	2	1	1	2
	CO2	2	1		2	1	2	1	2		1	1	2	1	1	2
	CO3	2			2	1	2	1	2		1	1	2	1	1	2
	CO4	2			2	1	2	1	2		1	1	2	1	1	2

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

M18SE2051	DESIGN OF EARTHQUAKE RESISTANT STRUCTURES	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
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 familiarize with causes of earthquake and its history
2. To understand the principles of seismic design
3. To learn response spectrum method and time acceleration method
4. To learn Earthquake resistant design of masonry buildings

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

1. To gain complete knowledge of history of seismicity
2. Use codal provisions for the analysis and design of structures to resist seismic forces
3. Is able to understand response spectrum method and time acceleration method
4. Is able to design earthquake resistant masonry buildings

UNIT-I	**12HOURS**

Elements of Earthquake Origin

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 1893-2002 - 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 Design

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.Codal provision for detailing for earthquake resistance- IS 13920-1993 – shear wall design and detailing

UNIT-IV	**12HOURS**

Earthquake resistant design of masonry buildings

Elastic properties of structural masonry, lateral load analysis, Design of two storeyed masonry buildings.

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
M18SE2051	CO1	2	1	1			1		1				2	1		2
	CO2	2	2	2		1	1		1		1		2	1	2	2
	CO3	2	2	2		1	1		1		1		2	1	2	2
	CO4	2	2	2		1	1		1		1		2	1	2	2

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

M18SE2052	STABILITY ANALYSIS OF STRUCTURES	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5

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

Prerequisite: SOM, SA-I and SA-II

COURSE OBJECTIVES: Student will be able to learn

- To analyze beam columns subjected to different loadings and end conditions
- To determine buckling load and mode of frames and continuous beams
- To determine buckling load and mode of columns with different end conditions and loadings by different methods
- To perform buckling analysis of columns, pin-jointed frames and portal frames by FEM

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

1. Is able to analyze beam columns subjected to different loadings and end conditions
2. Is able to determine buckling load and mode offrames and continuous beams
3. Is able to determine buckling load and mode of columns with different end conditions and loadings by different methods
4. Is able to perform buckling analysis of columns, pin-jointed frames and portal frames by FEM

UNIT-I **12HOURS**

Beam – column –Differential equation. Beam column subjected to (i) lateral concentrated load, (ii) severalconcentrated loads, (iii) continuous lateral load. Application of trigonometric series, Euler's formulation using fourth order differential equation for pined – pined, fixed – fixed, fixed – free and fixed – pinned column.

Buckling of frames and continuous beams. Elastic Energy method –Approximate calculation ofcritical loads for a cantilever. Exact critical load for hinged – hinged column using energy approach.

UNIT-II **12HOURS**

Buckling of bar on elastic foundation. Buckling of cantilever column under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section.
Effect of shear force on critical load. Column subjected to non – conservative follower and pulsating forces.

UNIT-III **12HOURS**

Stability analysis by finite element approach–deviation of shape function for a two nodded Bernoulli–Euler beam element (lateral and translation of) – element stiffness and element geometric stiffness matrices – assembled stiffness and geometric stiffness matrices for a discretized column with different boundary condition – calculation of critical loads for a discretized (two elements) column (both ends built in). Buckling of pin jointed frames (maximum of two active degree of freedom) – symmetrical single bay portal frame.

UNIT-IV **12HOURS**

Lateral buckling of beams–differential equation–pure bending–cantilever beam with tip load–simplysupported beam of I section subjected to central concentrated load. Expression for strain energy in plate bending with in plate forces (linear and non – linear). Buckling of simply supported rectangular plate–uniaxial load and biaxial load. Buckling of uniformly compressedrectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having various edge condition along the other two sides.

REFERENCE BOOKS

- Stephen P.Timoshenko, James M Gere, "Theory of Elastic Stability"-2nd Edition, McGraw – Hill, New Delhi.

- Robert D Cook et.al, "Concepts and Applications of Finite Element Analysis"-3rd Edition, John Wiley and Sons, New York.
- S.Rajashekar, "Computations and Structural Mechanics"-Prentice – Hall, India.
- Ray W Clough and J Penzien, "Dynamics of Structures" – 2nd Edition, McGraw Hill, New Delhi
- H.Zeiglar, "Principles of Structural Stability"-Blaisdall Pu

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
M18SE2052	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	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.

M18SE2061	RELIABILITY ANALYSIS AND DESIGN OF STRUCTURES	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
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 learn basic concepts of probability and statistics
- To learn basic concepts of random phenomena
- To learn formulation of Mathematical Modeling using uncertainties
- To learn about simulation and particularly as a modeling tool

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

1. learnt basic concepts of probability and statistics
2. learnt basic concepts of random phenomena
3. learnt formulation of Mathematical Modelling using uncertainties
4. learnt about simulation and particularly as a modelling tool

UNIT-I **12HOURS**

Preliminary Data Analysis: Graphical representation- Histogram, frequency polygon, Measures of centraltendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry.

Curve fitting and Correlation: Fitting a straight line, curve of the form $y = ab^x$ and parabola, Coefficientof correlation.

UNIT-II **12HOURS**

Probability Concepts: Random events-Sample space and events, Venn diagram and event space, Measuresof probability-interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem.

Random variables: Probability mass function, probability density function, Mathematical expectation,Chebyshev's theorem.

UNIT-III **12HOURS**

Probability distributions: Discrete distributions- Binomial and poison distributions, Continuousdistributions- Normal, Log normal distributions.

Reliability Analysis: Measures of reliability-factor of safety, safety margin, reliability index, performancefunction and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method)

UNIT-IV **12HOURS**

System reliability: Influence of correlation coefficient, redundant and non-redundant systems-series,parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability

Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy,Generation of random numbers- random numbers with standard uniform distribution, continuous random variables, discrete random variables

REFERENCE BOOKS

- Ranganathan, R. (1999). "Structural Reliability Analysis and design"- Jaico publishing house, Mumbai, India.

- Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planning and design"- Volume –I, John Wiley and sons, Inc, New York.
- Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planning and design"- Volume –II, John Wiley and sons, Inc, New York.
- Milton, E. Harr (1987). "Reliability based design in civil engineering"- Mc Graw Hill book Co.
- Nathabdndu, T., Kottegoda, and Renzo Rosso (1998). Statistics, "Probability and reliability for Civiland Environmental Engineers"- Mc Graw Hill international edition, Singapore.
- Achintya Haldar, and Sankaran Mahadevan (2000). "Probability, Reliability and Statistical methodsin Engineering design"- John Wiley and Sons. Inc.
- Thoft-christensen, P., and Baker, M., J., (1982), "Structural reliability theory and its applications"- Springer-Verlag, Berlin, NewYork.
- Thoft-christensen, P., and Murotsu, Y. (1986). "Application of structural systems reliabilitytheory"- Springer-Verlag, Berlin, NewYork.

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
M18SE2061	CO1	3	1	1		2	1	2	1				2	2		1
	CO2	3	2	2		2	1	2	1				2	2	2	1
	CO3	3	2	2		2	1	2	1				2	2	2	1
	CO4	3	2	2		2	1	2	1				2	2	2	1

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

M18SE2062	ADVANCED DESIGN OF PRESTRESSED CONCRETE	L	T	P	C	Hrs.
Duration: 16weeks		3	1	0	4	5
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

- To impart the knowledge about behaviour, analysis and design of pre-stressed concrete members
- To develop an understanding of the design of continuous beams and simple portal frames.
- To study the design of anchorage zones, composite beams, analysis and design of continuous beam
- To study the shear and Torsion resistance of prestressed members

COURSE OUTCOME:

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

- develop skills in the analysis and design of pre-stressed concrete beams, columns and slabs
- design anchorage zones and composite pre-stressed concrete members.
- Understand the concepts and techniques of precast construction and Select or design precast elements
- Is able to understand the shear and Torsion resistance of prestressed members

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, Columns, short columns, long columns, biaxially loaded columns, 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.

Slab and grid floors: Types of floor slabs, Design of one way, two way and flat slabs. Distribution of pre-stressing tendons, Analysis and design of grid floors.

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

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

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
M18SE2062	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

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

M18SE2070	STRUCTURAL ENGINEERING LABORATORY-II	L	T	P	C	Hrs.
Duration: 16weeks		0	0	4	4	3

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. To impart STAAD PRO and ETABS software knowledge
2. To make them aware different tools in these two software
3. To analyze and design through STAAD PRO
4. To analyze and design through ETABS

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

1. Gained sufficient knowledge of the software
2. Is able to analyze and design the structural components
3. Is able to design through STAAD PRO
4. Is able to design through 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 - 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
M18SE2070	CO1	2	3	3	2	3	1		1	1		1	3	3	3	2
	CO2	2	3	3	2	3	1		1	1		1	3	3	3	2
	CO3	2	3	3	2	3	1		1	1		1	3	3	3	2
	CO4	2	3	3	2	3	1		1	1		1	3	3	3	2

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

M18SE3010	ROADS AND BUILDING STRUCTURES	L	T	P	C	Hrs.
Duration:16weeks		3	1	0	4	5
Internal Assessment: 50 Marks	Semester End Examination: 50 Marks (Minimum 20 Marks)					

COURSE OBJECTIVE: Student will be able to learn

1. About traffic characteristics and control over the vehicles.
2. The importance of highway geometric design and drainage systems.
3. Understand the building planning and Bye-Laws.
4. Different aspects of building construction.

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

1: Describe about traffic characteristics and control over the vehicles.
2: Provide conceptual details of highway geometric design and drainage systems
3: Describe building planning and Bye-Laws.
4: Provide different aspects of building construction.

UNIT-I	12HOURS

Traffic Characteristics: Objectives and scope of traffic engineering. Components of road traffic: the vehicle, driver and road. Road user characteristics: human and vehicular characteristics.

Traffic Regulation and Control: Driver, vehicle, traffic flow and general regulations and control. Traffic Control Devices: traffic signs, markings, islands and signals.

UNIT-II	12HOURS

Elements of Highway Geometric Design: Design controls and criteria.Cross Section Elements: Pavement surface characteristics, width considerations for various components of cross section elements, right of way.

Highway Drainage: Objects and requirements of highway drainage. Surface drainage systems – analysis and design. Sub-surface drainage systems types and design.

UNIT-III	12HOURS

Building Planning: Introduction, Types of Buildings Based on Occupancy, Types of Residential Buildings, Basic Concepts of Building Elements, Methods of Construction, Cost-effective Building Techniques in Construction, Construction Management Techniques, Site Selection for Residential Buildings, Influence of Climate on Building Planning, Orientation of Building , Principles of Building Planning , Building bye-Laws , Planning of Residential Buildings, Building Services .

UNIT-IV	12HOURS

Building Construction: Foundations, Shallow and Deep Foundations, Stone Masonry, Brick Masonry,Partitions,Lintels, Stairs, Doors, Windows And Ventilators,Floors And Flooring , Roofs, Pointing And Plastering , Painting, Varnishing And Distempering, Etc. Acoustics, Fire Protection in Buildings.

REFERENCE

1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., 'Highway Engineering', Nem Chand and Bros, Roorkee - 2014.
2. Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publishers, Delhi – 2007.
3. Relevant IRC Publications.
4. "Building Drawing", Shah M.H and Kale C.M, Tata McGraw Hill Publishing co. Ltd., New Delhi.
5. "Building Construction", Gurucharan Singh, Standard Publishers &distributors, New Delhi.
6. National Building Code, BIS, New Delhi.

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
M18SE3010	CO1	3	2		2	2	1		1			1	3	1	3	2
	CO2	3	2		2	2	1		1			1	3	1	3	2
	CO3	3	2		2	2	1		1			1	3	1	3	2
	CO4	3	2		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.