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.

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.

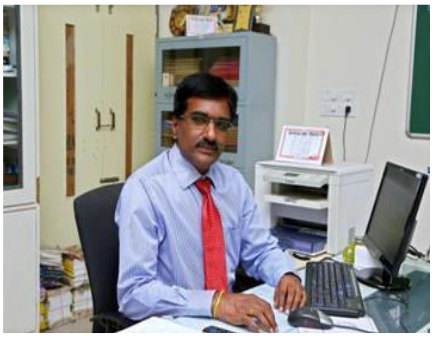
The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society. It provides students an opportunity to choose subject(s) of interest 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

CONTENTS

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 Structural Engineering discipline.

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
MTTE15F1100	CO1	3		3	3	3	3						3		3	
	CO2	3	3	3	3		2					3	3	3	3	3
	CO3	3	2		3		3						3	2	3	
	CO4	2	3	3	3	2		1					3	3	2	3
MTTE15F1200	CO1	2				3		2				3	3	2	1	3
	CO2	2			2	3		2				3	3	1	2	2
	CO3	2				2		3					3	2	1	2
	CO4	2	3	2		3		3				2	3	2	1	2
MTTE15F1300	CO1	2	3			3		2				3	3	2	1	3
	CO2	2			2	3		2				3	3	1	2	2
	CO3	2				2		3					3	2	1	2
	CO4	2	3	2		3		3				2	3	2	1	2
MTTE15F1410	CO1	3	3	3		2	2	3	3		3		3	2	2	2
	CO2	3	3	3	1	3	1	3	3		3		3	3	2	2
	CO3	3	3	3	1	3	1	3	3		3		3	3	2	2
	CO4	3	2	3	2				3		2		3			2
MTTE15F1420	CO1			3		3						3	1	2		3
	CO2	3	3	3		3				3		3	2	2		
	CO3	3		3	3	3			3	3		3	2	2	3	
	CO4	3	3		3		3			3		3				3
MTTE15F1510	CO1	3	2	2	-	2	3	-		3	2	2	3	2	1	2
	CO2	3	2	2	1	1	2	2	3		2		3	2	2	2
	CO3	3	2	2	2	2		2		3	2	2	3	3	2	2
	CO4	3	2	3	2		3	3	3		2	2	3	3	2	2
MTTE15F1520	CO1	2		3	2	3	1	1			2	3	3	3	3	2
	CO2	2	2	2	3	3				3	2		3	3	3	2
	CO3	3	2		2	3	3	2		2	3		3	3	3	1
	CO4	2	3		3	2	2		1		3		3	3	3	2
MTTE15F2100	CO1	3	3	2		3			3				3		3	
	CO2		3	3		3						3	3	3	3	3
	CO3	3	2	3	3		3						3	2		
	CO4	2	3	3	3	2	3						3	3	2	3
MTTE15F2200	CO1	2	2		2	3		2					1	2	1	2
	CO2	2	2		2	3		2				3	1	1	2	2
	CO3	2				2		3					1	2	1	2
	CO4	2	3	2		3		3				2	1	2	2	2
MTTE15F2300	CO1	3		3	3	3	3						3		3	
	CO2	3	3	3	3		2					3	3	3	3	3
	CO3	3	2		3		3						3	2	3	
	CO4	2	3	3	3	2		1					3	3	2	3

M18TE2040	CO1			3		2				2		2	3	3	3	2
	CO2	3	3	2		2	2	1		2	2	3	3	3	3	2
	CO3	2	2	3	3		2				3	3	3	3	3	1
	CO4		3		2	1		2	1		3	2	3	3	3	2
MTTE15F2420	CO1		3	3		3							2	2		
	CO2		3		3	3						3		2		
	CO3		3	3	3	3			3			3	2	2		
	CO4															
MTTE15F2510	CO1		2	3		3			3			3	2	2		
	CO2	2			3		3					3	3	3		
	CO3	2			3		3			3		3	3	3		
	CO4	2			3		3	3					2	3		
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	CO2	2	2					2	2				2	2	3	
	CO3	2	2		3			3	3				1	2	3	2
	CO4		2		3	3		2	2					2	3	2
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	CO2	2	3	3	3							3	3	3	3	1
	CO3	3	2	1	3	1	3						3	2	3	
	CO4	2	3	3	3	2		1					3	3	1	3
MTTE15F3120	CO1	2	3		1		2		1	1			3			
	CO2	3	2		2	2	2	3		2			3		1	2
	CO3	3	3	2	2		1			2	1		3	3	3	2
	CO4	3					3	3	2	2			3			
MTTE15F3210	CO1	2	2		2		2	2					3		3	
	CO2	2	2	3	3		3				3			3		2
	CO3	2		3		3		3			3		2		3	
	CO4	2	2		3		3				2		2			3
MTTE15F3220	CO1	2		2	2	2	2	2		2			2	2	2	
	CO2		2		2		2		2		2			2		2
	CO3		2		2	2		2			2			2		
	CO4	2		2		2			2		2		2		2	2
MTTE15F3410	CO1	2	2		2	2	2	2					1	2	2	
	CO2	2	2		2	2	2	2			2		2	3		
	CO3	2		3	3	2	2				2			2	2	
	CO4	2	2		2	2		2	2		2		2		2	
MTTE15F3420	CO1	3			3		3	3	3				1	2	3	
	CO2		3		3		3									
	CO3		3		3	3	3							3	3	
	CO4		3		3	3							2	3	3	3

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.

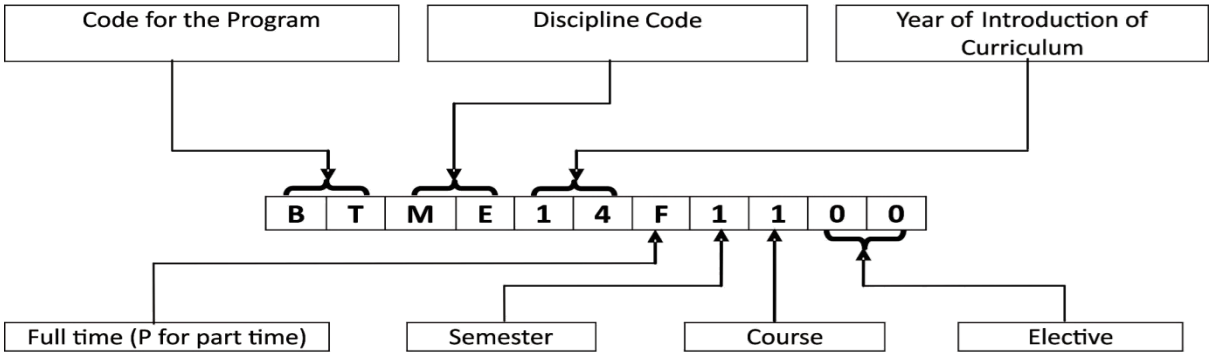
11.0. Grievance Cell

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

SCHOOL OF CIVIL ENGINEERING

M Tech in COMPUTER AIDED STRUCTURAL ENGINEERING (FULL TIME)

SCHEME OF INSTRUCTION

Sl. No.	Course Code	Title of the Course	HC/ SC	Credit Pattern			
				L	T	P	C
FIRST SEMESTER							
1	MTCA15F1100	Computational Structural Mechanics	HC	4	0	1	5
2	MTCA15F1200	Computational Structural Dynamics	HC	4	0	1	5
3	MTCA15F1300	Computer Aided Advanced Design of RC Structures	HC	4	1	0	5
4	MTCA15F1410	Computer Aided Design of Concrete Bridges	SC	4	1	0	5
	MTCA15F1420	Optimization Techniques					
5	MTCA15F1510	Computer Aided Design of Industrial Structures	SC	4	1	0	5
	MTCA15F1520	Advanced Solid Mechanics					
Total Credits							**25**
Sl. No.	Course Code	Title of the Course	HC/ SC	Credit Pattern			
				L	T	P	C
SECOND SEMESTER							
1	MTCA15F2100	Finite Element Method of Analysis	HC	4	0	1	5
2	MTCA15F2200	Computer Aided Seismic Design of Structures	HC	4	0	1	5
3	MTCA15F2300	Computer Aided Design of Plates & Shells	HC	4	1	0	5
4	MTCA15F2410	Computer Aided Design of Substructures	SC	4	1	0	5
	MTCA15F2420	Advanced Design of Prestressed Structures					
5	MTCA15F2510	Reliability Analysis of Structures	SC	4	1	0	5
	MTCA15F2520	Computer Aided Advanced Mechanics of Materials					

Total Credits							**25**
THIRD SEMESTER							
1	MTCA15F3110	Stability Analysis of Structures	SC	4	1	0	5
	MTCA15F3120	Design of Masonry Structures	SC	4	1	0	
2	MTCA15F3210	Health Monitoring, Repair and Rehabilitation of Structures	SC	4	1	0	5
	MTCA15F3220	Special Concrete					
3	MTCA15F3300	Skill Development Certification	HC	0	0	4	4
4	MTCA15F3410	Applications of Finite Element Analysis	OE	3	1	0	4
	MTCA15F3420	Applications of Optimization Techniques	OE*				
5	MTCA15F3500	Minor Project / Internship	HC	0	2	6	8
Total Credits							**26**
***Note:** 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.							
FOURTH SEMESTER							
1	MTCA15F4100	Dissertation	HC	2	2	16	20
Total Credits							**20**
Total Credits of Four Semesters							**96**

DETAILED SYLLABUS

M. Tech in Computer Aided Structural Engineering

FIRST SEMESTER

Course code	Course Title	Duration		L	T	P	C
MTCA15F1100	**COMPUTATIONAL STRUCTURAL MECHANICS**	**16 Weeks**	**HC**	**4**	**0**	**1**	**5**

Course Prerequisite: Structural Analysis I and II

Course Objectives:

- To learn the concepts and principles of structural analysis and develop element stiffness and flexibility matrices.
- To analyze framed structures subjected to direct and indirect loadings by flexibility and stiffness methods using force/displacement transformation matrices (element approach).
- To learn the analysis of framed structures using standard structural analysis software.

Course Outcomes:

At the end of the course, the student is expected 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.

Course Contents:

Unit-1

Static and Kinematic indeterminacy, Concepts of stiffness and flexibility, Energy concepts, Principles of minimum potential energy and minimum complementary energy. Development of element flexibility and element stiffness matrices for truss, beam, rigid frame and grid frame elements

Unit-2

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

Unit-3

Analysis of continuous beams, plane trusses and plane rigid frames by flexibility method (not more than 3x3 structure flexibility matrix) using force-transformation matrix. Effect of support settlement, temperature change and fabrication error.

Unit-4

Analysis of continuous beams, plane trusses and rigid plane frames by stiffness method (not more than 3x3 structure stiffness matrix) using displacement-transformation matrix. Effect of support settlement, temperature change and fabrication error.

Laboratory

- Analysis of continuous beams, plane and space trusses, plane and space rigid frames and hybrid framed structures using any standard structural analysis software such as STAAD.Pro/ETABS etc.

Reference Books:

- S.Rajasekaran, "Computational Structural Mechanics", PHI, New Dehi 2001.
- C.S.Reddy, "Basic Structural Analysis", TMH, New Delhi 2001.
- W.Weaver and J.H.Gere, "Matrix Analysis of Framed Structures", Van Nastran, 1980.
- A.K.Jain "Advanced Structural Analysis with Computer Application",Nemchand and Brothers, Roorkee, India.
- M.F.Rubinstein "Matrix Computer Methods of Structural Analysis "Prentice - Hall.1996
- Devdas Menon, "Advanced Structural Analysis", Narosa Publishers 2009

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
MTCA15F1100	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F1200	**COMPUTATIONAL STRUCTURAL DYNAMICS**	**16 weeks**	**HC**	**4**	**0**	**1**	**5**

Course Prerequisite: Engineering Mechanics, Structural Analysis II

Course Learning Objectives:

- To learn the concepts and principles of structural mechanics
- To frame mathematical models of SDOF and MDOF systems and analyse the corresponding free vibration response of damped and undamped systems
- To frame mathematical models of SDOF and MDOF systems and analyze the corresponding forced vibration response of damped and undamped systems
- To learn about principle of vibration-measuring instruments and evaluation of damping
- To learn about dynamics of continuous systems and response of structures to earthquakes

Course Outcomes:

At the end of the course, the student

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, Has learnt about dynamics of continuous systems and response of structures to earthquakes

Course Contents

Unit-1
Dynamical problems in Civil Engineering, Concepts of degrees of freedom and vibration, D'Alembert's principle, principle of virtual displacement and energy principles.
Unit-2
Free Vibration of Single-degree-of-freedom systems: Mathematical models of SDOF system, Free vibration response of damped and undamped systems,
Free Vibration of Multi-degree freedom systems: Mathematical models of MDOF systems, free vibration of undamped MDOF systems - Natural frequencies and mode shapes – orthogonality conditions, free vibration of damped MDOF systems.

Unit-3
Forced Vibration of SDOF Systems: Response damped and undamped systems to harmonic loading, support motion, evaluation of damping, vibration isolation, transmissibility, response to periodic forces. Numerical methods applied to SDOF, Direct integration and Duhamel integral, principle of vibration-measuring instruments – seismometer and accelerometer.
Forced Vibration of MDOF Systems: Equations of Motion and Response to forced excitations, Modal analysis – free and forced vibration with Damping and without damping.

Unit-4

Dynamics of Continuous systems: Free longitudinal vibration of bars, flexural vibration of beams with different end conditions, forced vibrations – response of beams under Live loads, wave propagation in solids

Response of structures to earthquakes: Characterization of earthquake ground motion.

Laboratory

- Natural frequencies and mode shapes using Horizontal Shake Table
- Dynamic analysis of structures using standard software

Reference Books:

- Mario Paz, "**Structural dynamics – Theory and Computation**", CBS Publishers 2004
- R.W. Clough & J. Penzien, "**Dynamics of Structures**", McGraw Hill 1975
- Anil K. Chopra, "**Dynamics of Structures**", Prentice Hall of India 2005
- Timoshenko, S., "**Vibration Problems in Engineering**", VanNostrand Co., 2008
- Mukyopadhyaya, "**Vibration and Structural Dynamics**", Oxford &IBH 2002
- William Thompson, "**Theory of Vibration with Applications**"
- William Seto, "**Mechanical Vibrations**", McGraw Hill Pub., (Schaum Series) 1964

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
MTCA15F1200	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F1300	**COMPUTER AIDED ADVANCED DESIGN OF RC STRUCTURES**	**16 Weeks**	**HC**	**4**	**1**	**0**	**5**

Course Prerequisite: Design of RCC Structural Elements

Course Learning Objectives:

- To design RC slabs
- To design grid floors, continuous beams and flat slabs
- To design chimneys, silos and bunkers
- To learn the detailing of earthquake resistant structures and to design elevated water tanks

Course Outcomes:

At the end of the course, the student

1. Is able to design RC slabs
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

Course Contents:

Unit-1

Design of RC slabs using Yield line theory and strip theory.

Unit-2

Design of grid floors, Design of continuous beams with redistribution of moments and flat slabs.

Unit-3

Design of Chimneys, Design of Silos and Bunkers.

Unit-4

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	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
MTCA 15F1300	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

Course code	Course Title	Duration		L	T	P	C
MTCA15F1410	COMPUTER AIDED DESIGN OF CONCRETE BRIDGES	16 Weeks	SC	4	1	0	5

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

Course Learning Objectives:

- To learn about the historical developments, site selection for bridges
- To learn about the classification, components and forces acting on bridges
- To learn about the different IRC loading cases and to design the slab culvert
- To design T- beam bridge slab type
- To analyze and design T- beam bridge cross girder and main girder
- To learn about components of PSC bridges and tensioning methods
- To analyze and design slab, main girder and end block of PSC bridges
- To learn and design the components of balanced cantilever bridge

Course Outcomes:

At the end of the course, the student

1. Has learnt about the historical developments, site selection for bridges, Has learnt about the classification, components and forces acting on bridges
2. Has learnt about the different IRC loading cases and to design the slab culvert, Is able to design T- beam bridge slab type
3. Is able to analyze and design T- beam bridge cross girder and main girder, Has learnt about components of PSC bridges and tensioning methods
4. Is able to analyze and design slab, main girder and end block of PSC bridges, Has learnt and is able to design the components of balanced cantilever bridge

Course Contents

Unit-1

Introduction: Historical Developments, Site Selection for Bridges, Classification of Bridges Forces on Bridges.
Bridge substructures: Abutments, piers and wing walls

Unit-2

Box Culvert: Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, working out the worst combination of loading, moment distribution, calculation of BM & SF, structural design of slab culvert, with reinforcement details.
T Beam Bridge Slab Design: Proportioning of Components Analysis of interior Slab & Cantilever Slab Using IRC Class AA Tracked, Wheeled Class A Loading, Structural Design of Slab, with Reinforcement Detail.
Unit-3

T Beam Bridge Cross Girder Design: Analysis of Cross Girder for Dead Load & Live Load Using IRC Class 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 IRC Class AA Tracked, Wheeled Class A Loading Using COURBON'S Method, Analysis of Main Girder Using HENDRY-JAEGER and MORICE-LITTLE Method for IRC Class AA Tracked vehicle only, BM & SF for different loads, Structural Design of Main Girder With Reinforcement Details

Unit-4

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

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

Reference Books:

- **"Essentials of Bridge Engineering**"- D Johnson Victor, Oxford & IBH Publishing Co New Delhi
- **"Design of Bridges"-** N Krishna Raju, Oxford & IBH Publishing Co New Delhi **2005**
- **"Principles and Practice of Bridge Engineering"-** S P Bindra Dhanpat Rai & Sons New Delhi **1996**
- IRC 6 – 1966 "**Standard Specifications And Code Of Practice For Road Bridges"-** Section II Loads and Stresses, The Indian Road Congress New Delhi
- 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
- IS 456 – 2000 "**Indian Standard Plain and Reinforced Concrete Code of Practice"-** (Fourth Revision) BIS New Delhi
- IS 1343 – "**Indian Standard Prestressed Concrete Code of Practice"-** BIS New Delhi
- Raina V.K., "**Concrete Bridge Practice**"- Tata McGraw Hill 1988
- Bakht B & Jaeggar, "**Bridge Analysis Simplified**"- McGraw Hill 1985
- Ponnuswamy . S, "**Bridge Engineering**"- Tata McGraw Hill. 2008

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
MTCA15F1410	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F1420	**OPTIMIZATION TECHNIQUES**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Course Prerequisite: Advanced Engineering Mathematics

Course Learning Objectives:

- To learn engineering applications and formulation of optimization problems
- To learn various optimization techniques
- To learn the geometry and standard form of linear programming problems
- To learn various methods of non-linear programming to compute structural engineering problems.
- To learn geometric and dynamic programming
- To formulate and obtain the solution of structural optimization problems by different techniques.

Course Outcomes:

At the end of the course, the student

1. Has learnt engineering applications and formulation of optimization problems, Has learnt various optimization techniques
2. Has learnt the geometry and standard form of linear programming problems
3. Has learnt various methods of non-linear programming to compute structural engineering problems. Has learnt geometric and dynamic programming
4. Is able to formulate and obtain the solution of structural optimization problems by different techniques.

Course Contents:

Unit-1

Introduction: Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems.

Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques.

Unit-2

Linear Programming: Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simpler methods, duality in linear programming.

Unit-3

Non-linear programming: Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods. Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems.

Unit-4

Geometric programming: Geometric programming, conversion of NLP as a sequence of LP/ geometric programming.
Dynamic programming: Dynamic programming conversion of NLP as a sequence of LP/ Dynamic programming.
Structural Optimization: Formulation and solution of structural optimization problems by different techniques.

Reference Books:

1. Spunt, "**Optimum Structural Design**"- Prentice Hall 1971
2. S.S. Rao, "**Optimization – Theory and Practice**"- Wiley Eastern Ltd. 1999
3. Uri Krisch, "**Optimum Structural Design**"- McGraw Hill 1981
4. Richard Bronson, "**Operation Research**"- Schaum's Outline Series 1981
5. Bhavikatti S.S.- "**Structural optimization using sequential linear programming"-** Vikas publishing house. 1963

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
MTCA15 F1420	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F1510	COMPUTER AIDED DESIGN OF INDUSTRIAL STRUCTURES	16 Weeks	SC	4	1	0	5

Course Prerequisite: Design of Steel Structures

Course Learning Objectives:

- To analyze and design the components of industrial buildings.

- To analyze and design transmission line towers for lateral load
- To analyze and design of tall chimneys
- To analyze and design open web structures

Course Outcomes:

On successful completion of the course, the student

1. Is able to analyze and design the components of industrial buildings
2. Is able to analyze and design transmission line towers for lateral load
3. Is able to analyze and design of tall chimneys
4. Is able to analyze and design open web structures

Course Contents:

Unit-1

Analysis of industrial building for Gravity and Lateral Load (Wind/Seismic). Analysis and design of framing components namely, girders, trusses, gable frames, gantry column (stepped column / column with bracket), purlins, girts, bracings including all connections.

Unit-2

Analysis of transmission line towers for lateral load and design of towers including all connections.

Unit-3

Steel Chimneys. Analysis and design of tall chimneys including foundation.

Unit-4

Design of open web structures.

Reference Books:

- Ramchandra and Virendra Gehlot " Design of Steel Structures " Vol 1 and Vol.2, Scientific Publishers, Jodhpur. 1994
- IS-800-2007, IS-875
- B.C. Punmia, A.K. Jain "Design of Steel Structures", Laxmi Publications, New Delhi**.** 2005

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
MTCA15F1510	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F1520	**ADVANCED SOLID MECHANICS**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Course Prerequisite: SOM

Course Learning Objectives:

- To analyze stress and strain at a point
- To learn the equilibrium and compatibility equations and boundary conditions.
- To solve 2D problems of elasticity by Airy's stress function approach
- To solve elementary 3D problems
- To analyze circular and non-circular shafts by TOE approach
- To learn about the basic concepts of theory of plasticity and yield criteria

Course Outcomes:

On successful completion of the course, the student

1. Is able to analyze stress and strain at a point, Has learnt the equilibrium and compatibility equations and boundary conditions.
2. Is able to solve 2D problems of elasticity by Airy's stress function approach
3. Is able to solve elementary 3D problems, Is able to analyze circular and non-circular shafts by TOE approach
4. Has learnt about the basic concepts of theory of plasticity and yield criteria

Course Contents:

Theory of Elasticity

Unit-1

Stress and strain at a point, components of stress and strain at a point in Cartesian and polar co-ordinates. Equilibrium, compatibility equations and boundary conditions in 2-D and 3-D cases(Cartesian and Polar Coordinates).

Unit-2

Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatoric stress,

spherical and deviatoric strains, maximum shear strain, strain rosettes.

Unit-3

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

Theory of Plasticity.

Unit-4

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 Westergard stress space, Tresca and Von-Mises criteria of yielding.

Reference Books:

- Timoshenko & Goodier, "**Theory of Elasticity**", McGraw Hill 2010
- Srinath L.S., **Advanced Mechanics of Solids**, 10th print, Tata McGraw Hill Publishing company, New Delhi, 1994
- Sadhu Singh, "**Theory of Elasticity**", Khanna Publishers 1978
- Verma P.D.S, "**Theory of Elasticity**", Vikas Publishing Pvt. Ltd 1997
- Chenn W.P and Hendry D.J, "**Plasticity for Structural Engineers**", Springer Verlag 1988
- Valliappan C, "**Continuum Mechanics Fundamentals**", Oxford IBH Publishing Co. Ltd.
- Sadhu Singh, "**Applied Stress Analysis**", Khanna Publishers 1978
- Govindaraju L and Sitharam G, "Applied Elasticity", Interline Publishers 2003
- XiLu, "Theory of Elasticity", John Wiley. 2002

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
MTCA15 F1520	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.

SECOND SEMESTER

Course code	Course Title	Duration		L	T	P	C
MTCA15F2100	**Finite Element Analysis**	**16 Weeks**	**HC**	**4**	**0**	**1**	**5**

Course Prerequisite: Structural Analysis – II, Theory of Elasticity

Course Learning Objectives:

- 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.
- To analyze beams, trusses and plane stress/strain problems using FEM
- To learn about the isoparametric concept and formulation of isoparametric elements including numerical integration
- To carry out free vibration analysis of simple beams
- To learn about modeling aspects, errors in FEM.
- To learn about organization of FEM program and some commercially available softwares.

Course Outcomes:

On successful completion of the course, the student -

1. Has learnt about the basic concepts and principles of structural mechanics, FDM, RRM and GM, Has learnt about the basic analysis procedure, advantages and disadvantages of FEM.
2. Has learnt about various types of finite elements used, Is able to derive the element stiffness matrices and load vectors for bar, beam, truss, plane frame, plane stress/strain elements, Is able to analyze beams, trusses and plane stress/strain problems using FEM
3. Has learnt about the isoparametric concept and formulation of isoparametric elements including numerical integration, Is able to carry out free vibration analysis of simple beams
4. Has learnt about modeling aspects, errors in FEM, Has learnt about organization of FEM program and some commercially available softwares.

Course Contents:

Unit-1

Introduction, Historical background, Principles of virtual displacement and minimum potential energy, Concepts of Finite Difference Method, Rayleigh-Ritz method and Galerkin method, Advantages and disadvantages of FEM, Basic analysis procedure of FEM for structural problems.

Finite elements for 1-D, 2-D and 3-D problems, Natural coordinates, Displacement and Shape functions for standard elements – Bar elements, Beam elements, Truss elements, Triangular elements, Rectangular elements, Quadrilateral elements –Higher order Elements. C^0 , C^1 and C^2 Continuity functions, Lagrangian, Hermitian Polynomials, Serendipity and Lagrangian family of elements, Pascal's triangle, Convergence requirements, Patch test, Static condensation.

Unit-2

Derivation of 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 continuous beams using beam elements. Linear static analysis of pin jointed plane trusses.

Two dimensional problems, Derivation of element stiffness matrices and equivalent nodal force vectors for CST element.

Unit-3

Concept of Iso-parametric elements, sub and super parametric elements, Convergence requirements for Iso-parametric elements, Iso-parametric formulation of 4-noded quadrilateral element, Numerical Integration – Gauss quadrature.

Dynamic analysis, Consistent and Lumped mass matrices in local and global coordinate systems, Evaluation of Eigen values and Eigenvectors, Free vibration analysis.

Unit-4

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, Common mistakes in modeling.

Organization of Computer Program for FEM – flowcharts, 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.

Laboratory

- Analysis of plane stress/strain and axisymmetric problems using a standard FEM package such as SAP2000/ANSYS etc.
- Analysis of plate and shell problems using a standard FEM package such as SAP2000/ANSYS etc.

Laboratory

- Analysis of plane stress/strain and axisymmetric problems using a standard FEM package such as SAP2000/ANSYS etc.
- Analysis of plate and shell problems using a standard FEM package such as SAP2000/ANSYS etc.

Reference Books:

- Finite element analysis Theory and Programming, C S Krishnamurthy, McGraw Hill 1990
- Fundamental of finite Element Analysis, David V Hutton, McGraw Hill 2004

- Introduction to Finite Element Method, Desai & Abel, CBS Publishers 1974
- 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 2000

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
MTCA15 F2100	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F2200	**COMPUTER AIDED SEISMIC DESIGN OF STRUCTURES**	**16 Weeks**	**HC**	**4**	**0**	**1**	**5**

Course Prerequisite: Structural dynamics

Course Learning Objectives:

- To learn about engineering seismology, characteristics and quantification of earthquakes
- To learn about study of response of buildings and structures during past earthquakes.
- To learn about the Response Spectrum, types and plotting
- To learn about the codal provisions of IS-1893 and analyze multi-storeyed buildings
- To learn about structural configuration for earthquake resistant design and capacity design procedures.
- To compute the effect of infill masonry walls on frames
- To learn about ductility and energy absorption in buildings and behaviour of masonry buildings during earthquakes

Course Outcomes:

At the end of the course, the student

1. Has learnt about engineering seismology, characteristics and quantification of earthquakes, Has learnt about study of response of buildings and structures during past earthquakes.
2. Has learnt about the Response Spectrum, types and plotting, Has learnt the codal provisions of IS-1893 and is able to analyze multi-storeyed buildings
3. Has learnt about structural configuration for earthquake resistant design and capacity design procedures.
4. Is able to compute the effect of infill masonry walls on frames, Has learnt about ductility and energy absorption in buildings and behaviour of masonry buildings during earthquakes

Course Contents:

Unit-1

Introduction to engineering seismology, seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales, seismic instruments. Seismic response of buildings, structures and sites, study of response of buildings and structures during past earthquakes.

Unit-2

The response spectrum – elastic and elasto-plastic spectra, tripartite plot, use of response spectrum in earthquake resistant design. dynamics of multi-storeyed buildings – natural frequencies and mode shapes, analysis Tall-storeyed buildings, obtaining seismic forces using is-1893.

Unit-3

Structural Configuration for earthquake resistant design, frames, shear walls and dual systems, Effect of infill masonry walls on frames, problems of the soft first-storey, Bearing Capacity design procedures.

Unit-4

Ductility and energy absorption in buildings, Reinforced concrete for earthquake resistance, confinement of concrete for ductility, ductility of columns and beams – codal provisions Behaviour of masonry buildings during earthquakes, Collapse patterns, strength of masonry in shear and flexure, concepts for earthquake resistant masonry buildings – codal provisions

Laboratory

- Analysis and Design of Multi-Storeyed Reinforced Concrete Buildings (with and without shear walls and infill walls), for dead, live, wind/earthquake loadings using standard software such as ETABS etc.
- Analysis and Design of Elevated Water Tanks for dead, live, wind/earthquake loadings using standard FEM software.

Reference Books:

- Minoru Wakabayashi, "**Design of Earthquake Resistant Buildings**", McGraw Hill Pub. 1986
- G G Penelis and A J Kappos, "**Earthquake Resistant Concrete Structures**", Chapman and Hall, 1999
- T Paulay and M J N Priestley, "**Seismic Design of Reinforced Concrete and Masonry Buildings**", John Wiley and Sons, 1992
- P Agarwal and M Shrikande, "**Earthquake Resistant Design of Structures**", Prentice Hall (India) Ltd, New Delhi, 2006.
- S.K.Duggal, (2007), "**Earthquake Resistant Design of Structures**", Oxford University Press, New Delhi 2007.
- Steven L Kramer, "**Geotechnical Earthquake Engineering**", Pearson Education pub. 1996
- Anil K Chopra, "**Dynamics of Structures – Theory and Application to Earthquake Engineering**"-2nd ed., Pearson Education pub. 2005
- IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993
- Clough and Penzien, "**Dynamics of Structures**"- McGraw Hill 1993
- Mukyopadhyaya, "**Vibration and Structural Dynamics**", Oxford &IBH 2013
- James Ambrose and Dimitry Vergun, "**Design for Earthquakes**"-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
MTCA15F2200	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F2300	Computer Aided Design of Plates & Shells	16 Weeks	HC	4	1	0	5

Course Prerequisite: Advanced Engineering Mathematics, SOM

Course Learning Objectives:

- To learn plate theory and small deflection of laterally loaded thin rectangular plates
- To learn the energy methods and to design the folded plates
- To learn about classification of shells and Membrane theory
- To learn symmetric bending of shells of revolution
- To design and detail simple shells

Course Outcomes:

At the end of the course, the student

1. Has learnt plate theory, Has learnt the Energy methods and is able to design the folded plates
2. Has learnt about classification of shells and Membrane theory
3. Has learnt symmetric bending of shells of revolution
4. Is able to design and detail simple shells

Course Contents:

Unit-1

Introduction to plate theory, Small deflection of laterally loaded thin rectangular plates for pure bending. Navier's and Levy's solution for various lateral loading and boundary conditions (No derivation), Numerical examples.

Unit-2

Energy methods for rectangular and circular plates with clamped edges subjected to symmetric loadings, design and detailing of folded plates with numerical examples.

Unit-3

Introduction to curved surfaces, and classification of shells. Membrane theory of spherical shells, cylindrical shells, hyperbolic paraboloids, elliptic paraboloid and conoids. Axially symmetric bending theory, of shells of revolution. Closed cylindrical shells, and water tanks, spherical shells and Geckler's approximation.

Unit-4

Bending theory of doubly curved shallow shells. design and detailing of simple shell problems – spherical domes, water tanks, barrel vaults and hyperbolic paraboloid roofs.

Reference Books:

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

- Ramaswamy G.S. – "**Design and Constructions of Concrete Shell Roofs**" – CBS Publishers and Distributors – New Delhi – 1986.
- Ugural, A. C. "**Stresses in Plates and Shells"**, 2nd edition, McGraw-Hill, 1999.
- R. Szilard, "**Theory and analysis of plates - classical and numerical methods"**, Prentice Hall,1994
- Chatterjee.B.K. – "**Theory and Design of Concrete Shell**", – Chapman & Hall, Newyork-third edition, 1988

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
MTCA15F2300	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F2410	**Computer Aided Design of Substructures**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Course Prerequisite: Geo-Technical Engineering, Basics of R.C.C.

Course Learning Objectives:

- To learn about various types of in-situ testing and properties of soil, Types of foundation.
- To learn about computation of loads, Different methods of analysis and design of substructures
- To learn about effect of complexities of soil in the design of substructures
- To learn about the design concepts of various types of shallow and deep foundations

Course Outcomes:

At the end of the course, the student

1. Has learnt properties of soil, behaviour of soil under various loading.
2. Is able to characterize soil parameters for substructure design.
3. Has learnt various methods of analysis and design of different types of substructures.
4. Is able to analyze and design and suggest the different types of substructures

Course Contents:

Unit-1

Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems. General requirement of foundations, Selection of foundations, Computations of Loads, Design concepts.

Unit-2

Concept of soil shear strength parameters, Settlement analysis of footings, Shallow foundations in clay, Shallow foundation in sand & C-Φ soils, Footings on layered soils and sloping ground, Design for Eccentric or Moment Loads.

Unit-3

Types of rafts, bearing capacity & settlements of raft foundation, Rigid methods, Flexible methods, soil-structure interaction, different methods of modeling the soil. Combined footings (rectangular & trapezoidal), strap footings & wall footings.
Raft –super structure interaction effects & general concepts of structural design, Basement slabs.

Unit-4

Deep Foundations: Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, Laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles.

Types of caissons, Analysis of well foundations, Design principles, Well construction and sinking. Foundations for tower structures: Introduction, Forces on tower foundations, Selection of foundation type, Stability and design considerations, Ring foundations – general concepts.

Reference Books:

- Swami Saran – "**Analysis & Design of Substructures**"- Oxford & IBH Pub. Co. Pvt. Ltd., 1998.
- Nainan P Kurian – "**Design of Foundation Systems**"- Narosa Publishing House, 1992.
- R.B. Peck, W.E. Hanson & T.H. Thornburn – "**Foundation Engineering"-** Wiley Eastern Ltd.,Second Edition, 1984.
- J.E. Bowles – "**Foundation Analysis and Design**"- McGraw-Hill Int. Editions, Fifth Ed., 1996.
- W.C. Teng – "**Foundation Design"-** Prentice Hall of India Pvt. Ltd., 1983.
- Bureau of Indian Standards:IS-1498, IS-1892, IS-1904, IS-6403, IS-8009, IS-2950, IS-11089, IS-11233, IS-2911 and all other relevant codes.

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
MTCA15 F2410	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F2420	**Advanced Design of Prestressed Structures**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Course Prerequisite: Design of Prestressed Concrete Structures

Course Learning Objectives:

- 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

Course Outcomes:

On completion of the course, the students will be able to:

1. develop skills in the analysis and design of pre-stressed concrete beams, columns and slabs
2. design anchorage zones and composite pre-stressed concrete members.
3. Understand the concepts and techniques of precast construction and Select or design precast elements
4. Develop Prestressed concrete poles manufacturing techniques,

Course Contents:

Unit-1

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

Unit-2

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-3

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-4

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
MTCA15 F2420	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F2510	**Reliability Analysis of Structures**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Course Prerequisite: Basic Concepts of Probability and Statistics

Course Learning Objectives:

- 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
- To learn about decision making processes
- To learn about the applications of theory

Course Outcomes:

At the end of the course, the student is expected to have:

1. learnt basic concepts of probability and statistics, learnt basic concepts of random phenomena
2. learnt formulation of Mathematical Modeling using uncertainties
3. learnt about simulation and particularly as a modeling tool
4. learnt about decision making processes, learnt about the applications of theory

Course Contents:

Unit 1

Preliminary Data Analysis: Graphical representation- Histogram, frequency polygon, Measures of central tendency- 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, Coefficient of correlation.

Unit 2

Probability Concepts: Random events-Sample space and events, Venn diagram and event space, Measures of 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 3

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

Reliability Analysis: Measures of reliability-factor of safety, safety margin, reliability index, performance function 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 4

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. "**Structural Reliability Analysis and design"-** Jaico publishing house, Mumbai, India. 1999
- Ang, A. H. S., and Tang, W. H. "**Probability concepts in engineering planning and design"**-1984Volume –I, John Wiley and sons, Inc, New York.
- Ang, A. H. S., and Tang, W. H. "**Probability concepts in engineering planning and design"**-Volume –II, John Wiley and sons, Inc, New York. 1984
- Milton, E. Harr "**Reliability based design in civil engineering"-** Mc Graw Hill book Co. 1987
- Nathabdndu, T., Kottegoda, and Renzo Rosso Statistics, "**Probability and reliability for Civil and Environmental Engineers"**- Mc Graw Hill international edition, Singapore. **1998**
- Achintya Haldar, and Sankaran Mahadevan "**Probability, Reliability and Statistical methods in Engineering design"-** John Wiley and Sons. Inc. **2000**
- Thoft-christensen, P., and Baker, M., J., "**Structural reliability theory and its applications**"-Springer-Verlag, Berlin, NewYork. 1982
- Thoft-christensen, P., and Murotsu, Y. "**Application of structural systems reliability theory"**-Springer-Verlag, Berlin, NewYork. **1986**

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
MTCA15 F2510	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F2520	**Computer Aided Advanced Mechanics of Materials**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Course Prerequisite: Strength of Materials

Course Learning Objectives:

- To determine the stresses and deflection in curved beams of different sections including statically indeterminate curved beams.
- To determine the shear flow and shear centre of different beam sections.
- To determine the bending stresses and deflections of straight beams subjected to unsymmetrical bending
- To analyze beams on elastic foundations
- To analyze beams, frames and grids subjected to out-of-plane loading

Course Outcomes:

On successful completion of the course, the student

1. Is able to determine the stresses and deflection in curved beams of different sections including statically indeterminate curved beams.
2. Is able to determine the shear flow and shear centre of different beam sections.
3. Is able to determine the bending stresses and deflections of straight beams subjected to unsymmetrical bending
4. Is able to analyze beams on elastic foundations, Is able to analyze beams, frames and grids subjected to out-of-plane loading

Course Contents:
Unit-1

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 a concentrated load.

Shear Center for Thin-Wall Beam Cross Sections: Definition of shear center in bending Approximations employed for shear in thin-wall beam cross sections, Shear flow in thin- walled beam cross sections, Shear center for singly symmetric and unsymmetrical sections.

Unit-2

Nonsymmetrical Bending of Straight Beams:, Symmetrical and nonsymmetrical bending, Bending stresses in beams subjected to nonsymmetrical bending, Deflections of straight beams subjected to nonsymmetrical bending.

Unit-3

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 with different end conditions subjected to concentrated load and moment at its end - Short beams.

Unit-4

Structures subjected to out of plane loading: Analysis of simple bents, frames, grids and beams circular in plan – Cantilever beams, semicircular continuous beams with three equally spaced supports, circular beams with different number of equally spaced supports.

Reference Books:

- Arthur P. Boresi and Omar M. Sidebottom: "Advanced Mechanics of Materials", Fourth Edition, John Wiley & Sons, 1985
- S. P. Thimoshenko: "Strength of Materials", Part I and II.2002
- Ugural.A.C. and Fenster.S.K "Advanced Strength of material and Applied Elasticity", Arnold Publishers, 1981
- Junnarkar.S.B., "Mechanics of Structures", Volume - III, Charotar Publications, Anand, India 2015

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
MTCA15F2520	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.

THIRD SEMESTER

Course code	Course Title	Duration		L	T	P	C
MTCA15F3110	**Stability Analysis of Structures**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Course Prerequisite: SOM, SA-I and SA-II

Course Learning Objectives:

- 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
- To perform lateral buckling analysis of beams with different end conditions and loading
- To perform buckling analysis of plates subjected to in-plane compressive loading with different boundary conditions

Course Outcomes:

At the end of the course, the student

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

Course Contents:

Unit-1

Beam – column – Differential equation. Beam column subjected to (i) lateral concentrated load, (ii) several concentrated 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. Elastica. Energy method – Approximate calculation of critical loads for a cantilever. Exact critical load for hinged – hinged column using energy approach.

Unit-2

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-3

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 discretised column with different boundary condition – calculation of critical loads for a discretised (two elements) column (both ends built in). Buckling of pin jointed frames (maximum of two active dof) – symmetrical single bay portal frame.

Unit-4

Lateral buckling of beams – differential equation – pure bending – cantilever beam with tip load – simply supported 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 compressed rectangular 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. 1985
- Robert D Cook et.al, "**Concepts and Applications of Finite Element Analysis**"-3rd Edition, John Wiley and Sons, New York. 2001
- S.Rajashekar, "**Computations and Structural Mechanics**"-Prentice – Hall, India.
- Ray W Clough and J Penzien, "**Dynamics of Structures**" – 2nd Edition, McGraw Hill, New Delhi 2015
- H.Zeiglar, "**Principles of Structural Stability**"-Blaisdall Pu 2013

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
MTCA15F3110	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F3120	Design of Masonry Structures	16 Weeks	SC	4	1	0	5

Course Prerequisite: Advanced Building Materials and Concrete Technology

Course Learning Objectives:

- To learn the history of masonry structures
- To learn the characteristics, classification and properties of masonry materials
- To learn the strength and elastic behaviour of masonry under compression
- To learn the failure theories of masonry under compression.
- To learn the flexural and shear bond between masonry unit and mortar and to determine flexural and shear strength
- To understand the concepts of permissible stresses as per BIS codal provisions
- To design load bearing masonry buildings for various loading conditions and parameters
- To learn the concepts and design procedure for earthquake resistant masonry
- To learn the components of masonry structures and construction procedure

Course Outcomes:

At the end of the course, the student

1. Has learnt the history of masonry structures, Has learnt the failure theories of masonry under compression.
2. Has learnt the characteristics, classification and properties of masonry materials, Has learnt the strength and elastic behaviour of masonry under compression
3. Has learnt the flexural and shear bond between masonry unit and mortar and to determine flexural and shear strength, Has understood the concepts of permissible stresses as per BIS codal provisions
4. Is able to design load bearing masonry buildings for various loading conditions and parameters , Has learnt the concepts and design procedure for earthquake resistant masonry, Has learnt the components of masonry structures and construction procedure

Course Contents:

Unit 1

Introduction, Masonry units, materials and types: History of masonry, Characteristics of Brick, stone, clay block, concrete block, stabilized mud block masonry units – strength, modulus of elasticity and water absorption. Masonry materials – Classification and properties of mortars, selection of mortars.

Strength of Masonry in Compression: Behaviour of Masonry under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context.

Unit 2

Failure theories of masonry under compression. Effects of slenderness and eccentricity, effect of rate of absorption, effect of curing, effect of ageing, workmanship on compressive strength.

Flexural and shear bond, flexural strength and shear strength: Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of

bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating flexural and shear strength.

Unit 3

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

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

Unit 4

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

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

Reference books:

- Hendry A.W., **"Structural masonry**"- Macmillan Education Ltd., 2nd edition 1998
- Sinha B.P & Davis S.R., "**Design of Masonry structures**"- E & FN Spon 1997
- Dayaratnam P, "**Brick and Reinforced Brick Structures**"- Oxford & IBH 1987
- Curtin, "**Design of Reinforced and Prestressed Masonry**"- Thomas Telford 1988
- Sven Sahlin, "**Structural Masonry**"-Prentice Hall 1967
- Jagadish K S, Venkatarama Reddy B V and Nanjunda Rao K S, "**Alternative Building Materials and Technologies**"-New Age International, New Delhi & Bangalore **2014**
- IS 1905, BIS, New Delhi.
- SP20(S&T),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	PO10	PO11	PSO 1	PSO 2	PSO 3	PSO 4
MTCA15F3120	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

Course code	Course Title	Duration		L	T	P	C
MTCA15F3210	**Health Monitoring, Repair and Rehabilitation of Structures**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Course Prerequisite: Concrete Technology, Alternative Building materials.

Course Learning Objectives:

- 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
- To learn about special materials and techniques for repair
- To learn about structural health monitoring of structures

Course Outcomes:

At the end of the course, the student

1. Has learnt the causes for deterioration of concrete and Non Destructive Tests
2. Has learnt about effect of corrosion and prevention of concrete, Has learnt detailed procedure of evaluating damaged structures
3. Has learnt about maintenance of concrete structures
4. Has learnt about special materials and techniques for repair, Has learnt about structural health monitoring of structures

Course Contents:

Unit-1

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, thermal properties and cracking.

Influence on Serviceability and Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

Unit-2

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-3

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

Fiber 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-4

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.

Reference Books:

- Sidney, M. Johnson "Deterioration, Maintenance and Repair of Structures". 1965
- Denison Campbell, Allen & Harold Roper, "**Concrete Structures** – **Materials, Maintenance and Repair"-** Longman Scientific and Technical **1991**
- R.T.Allen and S.C. Edwards, "**Repair of Concrete Structures**"-Blakie and Sons 1997
- Raiker R.N., "Learning for failure from Deficiencies in Design, Construction and Service"- R&D Center (SDCPL)
- B.Vidiveli, "Rehabilitation of Concrete Structures", Standard Publishers.2009
- B.L.Gupta and Amit Gupta, "Maintenance and Repair of Civil Structures", Standard Publishers.
- Gahlot and Sharma, "Building Repair and Maintenance Management", CBS Publishers. 2015
- Daniel Balag eas, Claus-PeterFritzen and Alfredo Guemes Structural Health Monitoring, Published by ISTE Ltd., U.K., 2006.

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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
MTCA15F 3210	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F3220	Special Concrete	16 Weeks	SC	4	1	0	5

Course Prerequisite: Concrete Technology

Course Learning Objectives:

- 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 fiber reinforced concrete and its properties
- To learn about High performance concrete and other types of concrete

Course Outcomes:

At the end of the course, the student

1. Has learnt the different types of cement replacement materials and Light weight concrete
2. Has learnt about High Density concrete and ferro-cement
3. Has learnt about fiber reinforced concrete and its properties
4. Has learnt about High performance concrete and other types of concrete.

Course Contents:

Unit-1

Components of modern concrete and developments in the process and constituent materials : Role of constituents, Development in cements and cement replacement materials, pozzolona, fly ash, silica fume, rice husk ash, recycled aggregates, chemical admixtures.

Mix proportioning of Concrete: Principles and methods.

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

Unit-2

High density concrete: Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods.
Ferro cement: Ferrocement materials, mechanical properties, cracking of ferrocement, strength and behaviour in tension, compression and flexure, Design of ferrocement in tension, ferrocement constructions, durability, and applications.
Unit-3

Fibre reinforced concrete: Fibre materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state, strength and behavior in tension, compression and flexure of steel fibre reinforced concrete, mechanical properties, crack arrest and toughening mechanism, applications.

Unit-4
High Performance concrete: constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. Ready Mixed Concrete, Self Compacting Concrete, Self Curing Concrete,

Reactive powder concrete, Bacterial Concrete.

Reference Books:

- Neville A.M, "**Properties of Concrete"** Pearson Education Asis, 2000
- P. Kumar Mehta, Paul J.N.Monterio, CONCRETE, "**Microstructure, Properties and Materials"**-Tata McGraw Hill 2007
- A.R.Santhakumar, (2007) "**Concrete Technology**"-Oxford University Press, New Delhi, 2007.
- Short A and Kinniburgh.W, "**Light Weight Concrete"**- Asia Publishing House, 1963
- Aitcin P.C**. "High performance concrete"**-E and FN, Spon London 1998
- 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	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
MTCA15F3220	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.

Course code	Course Title	Duration		L	T	P	C
MTCA15F3300	**Skill Development Certification**	**16 Weeks**	**HC**	**0**	**0**	**4**	**4**

The following OPEN ELECTIVE Courses are offered by the School of Civil Engineering. These 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.

Course Code	Course Title		L	T	P	C	
MTCA15F3410	**Applications of Finite Element Analysis**	**OE**	**3**	**1**	**0**	**4**	Division of Structural Engineering
MTCA15F3420	**Applications of Optimization Techniques**	**OE**	**3**	**1**	**0**	**4**	

Course code	Course Title	Duration		L	T	P	C
MTCA15F3500	**Minor Project / Internship**	**16 Weeks**	**HC**	**0**	**2**	**6**	**8**

FOURTH SEMESTER

Course code	Course Title	Duration		L	T	P	C
MTCA15F4100	**Dissertation**	**16 Weeks**	**HC**	**2**	**2**	**16**	**20**

TRAINING AND PLACEMENT

Having a degree or P.G. Degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

- Willingness to learn
- Self motivation
- Team work
- Communication skills and application of these skills to real scenarios
- Requirement of gathering, design and analysis, development and testing skills
- Analytical and Technical skills
- Computer skills
- Internet searching skills
- Information consolidation and presentation skills
- Role play
- Group discussion, and so on

The REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling, Training and Placement (CCTP) Centre headed by well experienced dynamic Trainer, Counselor and Placement Officer supported by an efficient team does handle all aspects of Internships and Placement for the students of REVA University. The prime objective of the CCTP Centre is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CCTP Centre organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CCTP Centre forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Engineering is efficient leaders of repute, who can deal the real time problems with a flavour of innovation. This kept in focus, the Training and Placement cell has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his/her interest and march forward to make better career.

Skill development is one of the very important activities of the University and Industry relationship.
A skill development centre is established to organize skill and certification programs. The students shall compulsorily complete at-least two skill/certification based programs before the completion of the degree.

The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs.

The various skill/certification programs identified are as follows.

- Big-data and Cloud Computing, Internet of Things (IOT), ORACLE, MYSQL, Advanced Java and Internals of LINUX/UNIX
- Red-hat certified programs on LINUX,
- Management related programs like SAP,ERP and Business Analytics
- Open Source software/hardware, Software Testing
- Advanced networking based CISCO / Microsoft technology.
- Web designing, System administration
- IBM certified programs.

The University has signed MOU's with Multi-National Companies, research institutions, Government agencies like NSDC (National Skill Development Corporation) and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

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FIRST SEMESTER CALENDAR

DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university.
2. Be regular and punctual to classes.
3. Study regularly and submit assignments on time.
4. Be respectful to your Teaches/friends and hostel staff/management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Center on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop and other valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DON'TS

1. Ragging inside / outside the campus.
2. Possession of Fire arms and daggers etc.
3. Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
4. Use of Crackers, explosives and ammunition etc.
5. Smoking and keeping any kind of such items.
6. Misusing college & hostel premises/facilities for activities other than studies.
7. Playing loud music in the room which may disturb studies of colleagues / neighbors.
8. Making noise and raising slogans.
9. Keeping electrical appliances, other than authorized ones.
10. Involvement in politics, ethnic, sectarian and other undesirable activities.
11. Proxy in any manner.
12. Use of mobiles in the academic areas.

Note: 1. Rules are revised / reviewed as and when required.
2. Healthy suggestions are welcome for betterment of Institution