

S-25 March, 2013 AC after Circulars from Circular No.153 &amp; onwards

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**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY****CIRCULAR NO. ACAD/NP/M.E./Syllabi/189/2013**

It is hereby informed to all concerned that, on recommendations of the Faculty of Engineering and Technology, the Hon'ble Vice-Chancellor has accepted the following **"Revised Syllabi with Cumulative Grade Point Average [CGPA]"** under the Faculty of Engineering & Technology on behalf of the **Academic Council Under Section-14(7) of the Maharashtra Universities Act, 1994** as appended herewith :-

Sr. No.	Revised Syllabi
[1]	Revised Syllabus of M.E. [Computer Networking Engg.],
[2]	Revised Syllabus of M.E. [Structural Engineering],
[3]	Revised Syllabus of M.E. [Water Resources Engineering],
[4]	Revised Syllabus of M.E. [Environmental Engineering],
[5]	Revised Syllabus of M.E. [Software Engineering],
[6]	Revised Syllabus of M.E. [Computer Science],
[7]	Revised Syllabus of M.E. [Control System Engineering],
[8]	Revised Syllabus of M.E. [Heat Power],
[9]	Revised Syllabus of M.E. [Manufacturing Engineering],
[10]	Revised Syllabus of M.E. [Electronics],
[11]	Revised Syllabus of M.E. [Electronics & Telecommunication],
[12]	Revised Syllabus of M.E. [Embedded System],
[13]	Revised Syllabus of M.E. [Communication Engineering],
[14]	Revised Syllabus of M.E. [Digital Communication],
[15]	Revised Syllabus of M.E. [Biotechnology],
[16]	Revised Syllabus of M.E. [CAD/CAM],
[17]	Revised Syllabus of M.E. [Thermal],
[18]	Revised Syllabus of M.E. [Design Engineering],

This is effective from the Academic Year 2013-2014 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,  
Aurangabad-431 004.  
REF.NO. ACAD/ NP/ M.E./  
SYLLABI / 2013/14092-100  
**V.C.14[7] A-08.**  
Date:- 15-06-2013.

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*(Signature)*  
**Director,**  
**Board of College and**  
**University Development.**

S-25 March, 2013 AC after Circulars from Circular No.153 &amp; onwards

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**:: 2 ::****Copy forwarded with compliments to :-**

- 1] The Principals, affiliated concerned Colleges,  
Dr. Babasaheb Ambedkar Marathwada University.
- 2] The Director, University Network & Information Centre, UNIC, with  
**a request to upload the above all syllabi on University Website**  
**[www.bamu.net].**

**Copy to :-**

- 1] The Controller of Examinations,
- 2] The Superintendent, [ Engineering Unit ],
- 3] The Programmer [Computer Unit-1] Examinations,
- 4] The Programmer [Computer Unit-2] Examinations,
- 5] The Superintendent, [ Eligibility Unit ],
- 6] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,  
Dr. Babasaheb Ambedkar Marathwada University,
- 7] The Record Keeper,  
Dr. Babasaheb Ambedkar Marathwada University.

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S\*/160613/-

**DR. BABASAHEB AMBEDKAR  
MARATHWADA UNIVERSITY,  
AURANGABAD.**



**Revised Syllabus of**

**M.E.**

**STRUCTURAL ENGINEERING**

*[ Effective from the Academic Year 2013-14 & onwards ]*

## **Dr. Babasaheb Ambedkar Marathwada University Aurangabad.**

### **Faculty of Engineering & Technology**

#### **Rules and Regulations for M.E. & M.Tech. Courses**

##### **➤ What is a credit system**

A credit system is a systematic way of describing an educational program by attaching credits to its components. The definition of credits in higher education systems may be based on different parameters, such as student workload, learning outcomes and contact hours.

##### **➤ Advantages of the Credit System**

- Represents a much-required shift in focus from teacher-centric to learner-centric education since the work load estimated is based on the investment of time in learning, not in teaching.
- Helps to record course work and to document learner work load realistically since all activities are taken into account-not only the time learners spend in lectures or seminars but also the time they need for individual learning and the preparation of examinations etc.
- Segments learning experience into calibrated units, which can be accumulated in order to gain an academic award.
- Helps self-paced learning. Learners may undertake as many credits as they can cope with without having to repeat all the courses in a given semester if they fail in one or more courses. Alternatively, they can choose other courses and continue their studies.

##### **➤ What is Grading?**

The word Grade derived from the Latin word gradus, meaning, step. Grading, in the educational context is a method of reporting the result of a learner's performance subsequent to his evaluation. It involves a set of alphabets which are clearly defined and designated and uniformly understood by all the stake holders. A properly introduced grading system not only provides for a comparison of the learner's performance but it

also indicate the quality of performance with respect to the amount of efforts put in and the amount of knowledge acquired at the end of the courses by the learners.

## ➤ CURRICULUM:

### 1.1 Curriculum:

Every program with specialization has a prescribed course structure which in general terms is known as Curriculum. It prescribes course to be studied in each semester; the relevant information containing course structure along with detail syllabus for each course of each program is updated periodically and is uploaded on the website.

### 1.2 Semesters:

The Faculty of Engineering & Technology implements a credit based curriculum and grade based evolution system for P.G. program is of four semesters. The academic courses are delivered in the first two semesters. Dissertation work is carried out by a student in the third and fourth semester. The first semester begins in the last week of July ends by the last week of November while the second semester begins in the first week of January and ends by the second week of May. Total duration for each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

### 1.3 Course Credit:

Education is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance/progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation.

A student's performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum grade point average is required to be maintained for satisfactory progress and continuation in the program. Also a minimum number of earned credits and a minimum grade point average should be acquired in order to qualify for the degree. All programmers are defined by the total credit requirement and a pattern of credit distribution over courses of different categories.

#### 1.4 Course credits assignment

Each courses, except a few special courses, has a certain number of credits assigned to it depending upon its lecture, tutorial and laboratory contact hours in a week. This weightage is also indicative of the academic expectation that includes in-class contact and self-study outside of class hours.

**Lectures and Tutorials:** One lecture or tutorial hour per week per semester is assigned one credit.

**Practical/Laboratory:** One laboratory hour per week per semester is assigned one credit.

**Example:** Course: XYZ Engg: 4 credits (3-1-2)

The credits indicated for this course are computed as follows:

3 hours/week lectures = 3 credits

1 hours/week tutorial = 1 credit

2 hours/week practical =  $2 \times 0.5 = 1$  credit

2 hours/week seminar =  $2 \times 0.5 = 1$  credit

Dissertation seminar =  $2 \times 1 = 2$  credit

(3-1-2) 3 credit course = (3 h Lectures + 1 h Tutorial + 2 h Practical) per week  
= 6 Contact hours per week

#### 1.5 Earning Credits

At the end of every course, a letter grade is awarded in each course for which a student had registered. On obtaining a pass grade, the student accumulates the course credits as earned credits. A student's performance is measured by the number of credits that he/she has earned and by the weighted grade point average.

The credit system enables continuous evaluation of a student's performance, and allows the students to progress at an optimum pace suited to individual ability and convenience, subject to fulfilling minimum requirement for continuation.

### 1.6 Evaluation System

1. Semester Grade Point Average (SGPA) =

$$\frac{\text{SUM (course credits in passed courses X earned grade points)}}{\text{SUM (Course credits in registered courses)}}$$

2. Cumulative Grade Point Average (CGPA) =

$$\frac{\text{SUM (course credits in passed courses X earned grade points) of all Semester}}{\text{SUM (Course credits in registered courses) of all Semester}}$$

3. At the end of M.E & M. Tech Program, student will be placed in any one of the divisions as detailed below. (According to AICTE Handbooks)

I<sup>st</sup> Division with distinction : CGPA  $\geq$  8.25 and above

I<sup>st</sup> Division : CGPA  $\geq$  6.75 and  $<$  8.25

II<sup>nd</sup> Division : CGPA  $\geq$  6.75 and  $<$  6.25

As per AICTE Handbook (2013-14), new gradation suggested as follows,

Table 1

Grade Point	Equivalent Range
6.25	55%
6.75	60%
7.25	65%
7.75	70%
8.25	75%

Conversion of CGPA to percentage marks for CGPA  $\geq$  5.0 can be obtained using equations.

$$\text{Percentage marks} = (\text{CGPA} \times 10) - 7.5$$

An example of these calculations is given below:

Typically one example for academic performance calculations of semester -I

Table 2

Course No. (1)	Course Credit (2)	Grade Awards (3)	Earned Credit (4)	Grade Points (5)	Points Secured (6)=(4) x (5)
Subject 1	4	B	4	6	24
Subject 2	4	C	4	5	20
Subject 3	4	O	4	10	40
Subject 4	4	A+	4	8	32
Subject 5	4	C	4	5	20
Seminar	2	A++	2	9	18
<b>Total</b>	<b>22</b>		<b>22</b>	<b>38</b>	<b>134</b>

$$1. \text{ Semester Grade Point Average (SGPA)} = \frac{(134)}{(22)} = 6.09$$

$$2. \text{ Cumulative Grade Point Average (CGPA)} =$$

Cumulative points earned in all passed courses = 134 (past semester) + 134 (this sem.) = 268

$$\text{Cumulative earned credits} = 22 (\text{past semesters}) + 22 (\text{this sem}) = 44$$

$$\frac{\sum (134 + 134)}{\sum (22 + 22)} = 6.09$$

System Evaluation Table

Table 3

Grade	Grade Points	Marks Obtained (%)			Description Performance
		Regular Semester	Re-Examination	Summer Semester Examination/Re-appear	
O	10	91-100	--	--	Outstanding
A++	09	86-90	91-100	91-100	Excellent
A+	08	76-85	86-90	81-90	Very Good
A	07	66-75	76-85	71-80	Good
B	06	56-65	66-75	61-70	Fair
C	05	46-55	56-65	51-60	Average
D	04	40-45	40-55	40-50	Poor
F	00	Below 40	Below 40	Below 40	Fail
EE					Incomplete
WW					Withdrawal
XX	--	--	--	--	Detained
ABSENT	--	--	--	--	Absent
PP	--	--	--	--	Passed (Audit Course)
NP	--	--	--	--	Not Passed (Audit Course)

**Grade Awards:**

- i) A ten point rating scale shall be used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-4.

**Table 4: Ten point grades and grade description**

Sr.No.	Equivalent Percentage	Grade Points	Grade	Grade Description
1	90.00 – 100	10	O	Outstanding
2	80.00 – 89.99	9	A++	Excellent
3	70.00 – 79.99	8	A+	Exceptional
4	60.00 – 69.99	7	A	Very Good
5	55.00 – 59.99	6	B+	Good
6	50.00 – 54.99	5.5	B	Fair
7	45.00 – 49.99	5	C+	Average
8	40.01 – 44.99	4.5	C	Below Average
9	40	4.00	D	Pass
10	<40	0.00	F	Fail

- ii) Non appearance in any examination/assessment shall be treated as the student have secured zero mark in that subject examination/assessment.
- iii) Minimum D grade (4.00 grade points) shall be the limit to clear/pass the course/subject. A student with F grade will be considered as 'failed' in the concerned course and he/she has to clear the course by reappearing in the next successive semester examinations. There will be no revaluation or recounting under this system.
- iv) Every student shall be awarded Grade points out of maximum 10 points in each subject (based on 10 Point Scale). Based on the Grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and cumulative Grade card with CGPA will be given on completion of the course.

### Proposed Coding System of M.E/M.Tech Subjects

Six Digit Code for a subject (PG Course)

	Digits →	1 2 3	4	5 6
Sr. No.	Branch ↓	Branch code	Year	Subject
1	Electronics	MEX	PG I year - 6	Semester -I/III
2	Communication Engineering	MEC	PG II Year - 7	1-20 Theory
3	Electronics & Telecom.	MET		21-30 Practical
4	Digital Communications	MDC		31 Dissertation-I
5	Embedded System	MES		41-49 Electives
6	Structure Engineering	MSE		Semester -II/IV
7	Environmental Engineering	MEV		51-70 Theory
8	Water Resource Engineering	MWR		71-80 Practical
9	Computer Engineering	MCE		81 Dissertation-II
10	Computer Network	MCN		91-99 Electives
11	Software Engineering	MSW		
12	Mechanical Engineering	MME		
13	Thermal Engineering	MTE		
14	CAD/CAM	MCC		
15	Manufacturing	MMF		
16	Heat Power	MHP		
17	Machine Design	MMD		
18	M.Tech Mechanical	MTM		
19	CSE & IT	MCI		
20	Manufacturing Processing Engineering	MMP		

Note: - Kindly, Allot Same Code for same Electives/ subjects for different branches to avoid repetitions of Question papers/settings/assessments.

**DEGREE OF MASTER OF ENGINEERING**  
(Course with effective from academic year: 2013-2014)

<b>I</b>	1	The examination for the Degree of Master of Engineering will be held in four semesters; M.E. Semester-I, M.E. Semester-II, M.E. Semester-III, and M.E. Semester-IV in case of full time course.
<b>II</b>	1	<b>Rules &amp; Eligibility</b> Rule for admission to P.G. Degree course in Engineering and Technology as per rules and regulation of AICTE/DTE & Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
<b>III</b>	1	<b>Evaluation method</b> Each theory course will be of 100 marks and be divided in to internal examination of 20 marks and semester examination of 80 marks (20+80=100 marks). Each practical course will be of 50 marks
	2	There shall be two class tests within a semester. First based on 40% syllabus taught and second based on 60% syllabus taught. The setting of question paper and assessment will be done by the concerned teacher who has taught the syllabus. Average marks obtained out of two examinations will be considered for the preparation of final sectional marks/ grade.
	3	The Question papers in theory subjects shall be set by the Examiners appointed for the purpose by the University on the recommendations of the Board of studies of the concerned PG Course.
	4	The assessment of the term work for any subject will be done by recognized post-graduate teacher.
	5	To pass the examination a candidate must obtain a minimum CGPA of 6.25 (CGPA to the scale of 10).
	6	Candidate who secures $CGPA \geq 6.25$ and $CGPA < 6.75$ declared to have passed examination in second class.
	7	Candidate who secures $CGPA \geq 6.75$ and $CGPA < 8.25$ declared to have passed examination in first class.
	8	Candidate who secures $CGPA \geq 8.25$ declared to have passed examination in first class with distinction.

IV	1	In case candidate fails to get D grade in one or more heads of passing examination, he will be allowed at his option, to reappear for only those heads of passing in which he has failed or got less than D grade at subsequent examinations.
	2	The grades obtained by the candidate in any head of passing at the examination will be carried forward unless the candidates reappear for the head of passing in accordance with ref. IV (1)
	3	In case the candidate passes in all heads of passing under M.E. Semester-I, M.E. Semester-II examination and obtained a minimum CGPA of 6.25 in M.E. Semester-I, M.E. Semester-II taken together as required under ref. II(2) above, he will not be allowed to reappear for any head of passing under M.E. Semester-I, M.E. Semester-II in accordance with ref. IV(1)
	4	A candidate will not be allowed to appear for M.E. Semester-III examination unless he passes in all heads of passing under M.E. Semester-I, M.E. Semester-II examination and obtains a minimum CGPA of 6.25 in M.E. Semester-I, M.E. Semester-II taken together under reference II(2).
	5	Whenever a candidate reappears for M.E. Semester-III and M.E. Semester-IV examinations he will have to resubmit the dissertation with suitable modification and must also reappear for oral examination on it.
	6	A candidate registered for M.E. Examination must clear his examination within five years from the date of registration.
V	<b>Attendance Requirement</b>	
	1	Each semester of the course shall be treated as a separate unit for calculation of the attendance
	2	A candidate shall be considered to have satisfied the attendance requirement if he/she has attended not less 75% of the class in each subject of all the semesters (Theory, Laboratory, Semester Practical training and Dissertation work) actually conducted up to the end of the semester.
	3	A Candidate, who does not satisfy the attendance required, mentioned as above, shall not be eligible to appear for the Examination of that semester and shall be required to repeat that semester along with regular students later.
4	The Principal of the concerned College shall display regularly, the list of such candidates who fall short of attendance, on the Notice Boards.	

	5	The list of the candidates falling short of attendance shall be sent to the University at least one week prior to the commencement of theory/practical examination, whichever is earlier.
VI		The following are the syllabi in the various subjects of the examination for the Degree of Master of Engineering.

**FACULTY OF ENGINEERING AND TECHNOLOGY**  
**Proposed Revised Structure of M.E. (Structural. Engg)**

SEMESTER - I		CONTACT HRS.PER /WEEK				EXAMINATION SCHEME						
SUB Code.	SUBJECT	TH	T	P	TOTAL	TH.	CT	TW.	P	TOTAL	Th. Exam (HRS)	CREDITS
MSE601	Theory of Elasticity & Plasticity	3	1	-	4	80	20	-	-	100	3	4
MSE602	Advanced Structural Mechanics- I	3	1	-	4	80	20	-	-	100	3	4
MSE603	Advanced Concrete Technology	3	1	-	4	80	20	-	-	100	3	4
MSE604	Numerical Methods	3	1	-	4	80	20	-	-	100	3	4
MSE641 To MSE643	Elective – I	3	1	-	4	80	20	-	-	100	3	4
MSE621	Labrotary-1	-	-	4	4	-	-	-	50	50	-	1
MSE622	Labrotary -2	-	-	2	2	-	-	50	-	50	-	2
MSE623	Seminar -1	-	-	2	2	-	-	-	50	50	-	1
	<b>Total</b>	<b>15</b>	<b>5</b>	<b>8</b>	<b>28</b>	<b>400</b>	<b>100</b>	<b>50</b>	<b>100</b>	<b>650</b>		<b>24</b>

SEMESTER - II		CONTACT HRS.PER /WEEK				EXAMINATION SCHEME						
SUB Code.	SUBJECT	TH	T	P	TOTAL	TH.	CT	TW.	P	TOTAL	Th. Exam (HRS)	CREDITS
MSE 651	Advanced Structural Mechanics- II	3	1	-	4	80	20	-	-	100	3	4
MSE 652	Finite Element Method	3	1	-	4	80	20	-	-	100	3	4
MSE 653	Structural Dynamics & Earthquake Engineering	3	1	-	4	80	20	-	-	100	3	4
MSE 654	Theory of Plates & Shells	3	1	-	4	80	20	-	-	100	3	4
MSE 691 To MSE 693	Elective – II	3	1	-	4	80	20	-	-	100	3	4
MSE 671	Labrotary-III	-	-	2	2	-	-	-	50	50	-	1
MWE672	Labrotary -IV	-	-	4	4	-	-	50	-	50	-	2
MWE673	Seminar -II	-	-	2	2	-	-	-	50	50	-	1
	<b>Total</b>	<b>15</b>	<b>5</b>	<b>8</b>	<b>28</b>	<b>400</b>	<b>100</b>	<b>50</b>	<b>100</b>	<b>650</b>		<b>24</b>

**FACULTY OF ENGINEERING AND TECHNOLOGY**  
**Proposed Revised Structure of M.E. Second Year (ENVIORNMENTALENGG)**

SEMESTER - III		CONTACT HRS.PER /WEEK				EXAMINATION SCHEME						
SUB Code.	SUBJECT	L	T	CH	TOTAL	TH	C	TW.	P	TOTAL	Th. Exam (HRS)	CREDITS
MSE721	Dissertation-I	-	-	12	12	-	-	50	50	100	-	12
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>12</b>	<b>12</b>	<b>0</b>	<b>0</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>-</b>	<b>12</b>

SEMESTER - IV		CONTACT HRS.PER /WEEK				EXAMINATION SCHEME						
SUB Code.	SUBJECT	L	T	CH	TOTAL	TH	C	TW.	P	TOTAL	Th. Exam (HRS)	CREDITS
MSE771	Dissertation-II	-	-	20	20	-	-	100	200	300	-	20
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>20</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>200</b>	<b>300</b>	<b>-</b>	<b>20</b>
<b>Total of Semester I to IV</b>										<b>1700</b>		<b>80</b>

**Elective -I is to be chosen from the following:**

- a) Bridge Engineering
- b) Design of Composite Construction
- c) Advanced Design of Concrete Structures

**Elective -II is to be chosen from the following:**

- a) Structural Stability
- b) Analysis of Composite Structures
- c) Inelastic Analysis of Plates.

## **MSE 601: Theory of Elasticity and Plasticity**

### **Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

### **Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

### **Unit 1. Elasticity:**

Stress at a point, stress tensor, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, stress invariants. The state of strain at a point, strain displacement relations, strain compatibility condition and stress compatibility conditions. Generalized Hook's law.

(06 Hrs.)

### **Unit 2. Elasticity:**

Plane stress, Plane strain and axisymmetric problems, Problems in 2D Cartesian coordinate system, Airy's stress function, bending of beams. Principal stresses and strains, Plane stress and Plane strain problems. Differential equations of equilibrium and compatibility equations.

(04 Hrs.)

### **Unit 3. Elasticity:**

Relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations, Stress-strain relationship, Strain-displacement relationship for plane stress and plane strain conditions

(06 Hrs.)

### **Unit 4. Elasticity:**

Torsion, Assumptions and Torsion equation for general prismatic solid bars, Warping of Non-circular sections and St. Venant's theory

(04 Hrs.)

### **Unit 5. Plasticity:**

Basic concepts, yield criteria, Criterion of yielding, von Mises initial yield condition, the Tresca initial yield condition, strain hardening rules of plastic flow different stress-strain relation, flow and deformation theories

(06 Hrs.)

**Unit 6. Plasticity:**

Plane stress and plane strain problems, torsion, bending of bars, theoretical problems. Examples of tube under pressure (04 Hrs.)

**Reference Books:**

1. "Applied Elasticity", Wang, McGraw hill book Co.
2. "Theory of Elasticity", Timoshenko and Goodier, McGraw hill book Co.
3. "Theory of Plasticity", J. Chakrabarti, McGraw hill book Co.
4. "Strength of Materials Vol – I & II", Timoshenko S., CBS Publishers
5. "Mechanics of Deformable Solids", Shames I. H., Prentice Hall India
6. "Advanced Mechanics of Solids", Srinath L. S., Tata McGraw
7. Plasticity for Mechanical Engineers, Johnson w. and mellor
8. Introduction to Mechanics of solid Venkatraman and patel
9. Plasticity, Fundamentals and General Results, Martin, J.BMIT Press, London.
10. Theory of Plasticity, Chakraborty, J, McGraw Hill, New York.
11. Theory of Plasticity, Timoshenko, McGraw Hill

**MSE 602: Advanced Structural Mechanics – I****Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

**Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit 1:** Beams on Elastic Foundations, Semi-infinite and Finite Beams (05 Hours)**Unit 2:** Generalised Grid Structures, Analysis of right angle, skew and curved Bridges  
(07 Hours)**Unit 3:** Principle of Multiple and Substitute Frame Method (04 Hours)**Unit 4:** Analysis of Beams Curved in Plan (06Hours)**Unit 5:** Secondary Stresses in Frames and Trusses (04 Hours)**Unit 6:** Minimum Weight Design of Plane Frames (04 Hours)**Reference Books:**

1. Theory of Structures ----- Ramamurtham
2. Optimization theory and applications ..... S.S. Rao.
3. Numerical methods for engineering problems .....N.Krishna Raju &Muthu.
4. Theory of Structures----- Vazarani and Rathavani
5. Structural Analysis ----- A. Ghali and A. M. Neville  
(A Unified classical Matrix approach)

**MSE 603: Advanced Concrete Technology:****Teaching Scheme**

Lectures: 3 Hours/Week

Term Work: 25

Tutorial: 1 Hours/Weeks

**Examination Scheme**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit 1**

Types of Cementitious materials, Types and properties of Chemical Admixtures, compatibility with cement, Natural and Artificial sand (04 Hrs.)

**Unit 2**

Fresh Concrete: Rheology, Workability, Cohesiveness, Segregation, Temperature, Air Content, Hardened Concrete: Factors affecting properties of concrete, Strength, Elasticity, Shrinkage, Creep and Durability of concrete, Testing of Concrete: Destructive and nondestructive tests (06 Hrs.)

**Unit 3**

Methods of Concrete mix proportioning: IS 10262, ACI method, British method and their relative merits and demerits. Quality control of concrete, Statistical aspects. (06 Hrs.)

**Unit 4**

High Performance Concrete: Materials, properties, Mix proportioning, Ready Mix Concrete, (04 Hrs.)

**Unit 5**

Self Compacting Concrete: Materials, properties, Mix proportioning (04 Hrs.)

**Unit 6**

Concrete Composite: Various types of Fibers used in concrete, Law of Mixtures, Halpin-Tsai Equations for evaluation of elastic constants, Behavior of Fiber Reinforced Concrete (FRC) in Tension, Compression, Flexure, shear, Fatigue and Impact, Durability aspects of FRC. (06 Hrs.)

**Reference Books:**

1. Properties of concrete.....A.M.Neville
2. Concrete Technology .....D.F.Orchard
3. Chemistry of Cement and concrete.....F.M.Lee.
4. Concrete technology.....M.S.Shetty.
5. Concrete Technology ..... A.R.Santhakumar, Oxford University Press,2007.
6. Fiber Reinforced Cement Composites..... Balaguru P.N. and Shah S.P.

**MSE 604: Numerical Methods****Teaching Scheme**

Lectures: 3 Hours/Week

Term Work: 25

Tutorial: 1 Hours/Weeks

**Examination Scheme**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit 1:** Number representation and errors, Number in different bases, Non integer & Fraction, mantissa, exponent, normalized scientific notations, Errors in representing numbers, Inverse error analysis, Loss of Significance, Introduction to MATLAB. (04Hours)

**Unit 2:** Systems of Linear Algebraic Equations, Introduction, ill Conditioning, Methods of Solution (Gauss Elimination Method, LU Decomposition Method, Doolittle Decomposition Method, Gauss-Jordon Elimination Method, Gauss Seidel Method), Symmetric & Banded Coefficient Matrices, Pivoting, Diagonal Dominance, Gauss Elimination with scaled row Pivoting, Roots of Algebraic & Transcendental Equations, Fixed point iteration method, Iterative Search Method, Bisection Method, Geometrical Approach to Root Finding, Convergence towards Roots of Equation, Secant Method, False Secant/ Regula-Falsi Method, Ridder's Method, Newton Raphson Method, System of Non-Linear equations (Newton Raphson Method), Application of various methods using MATLAB. (06 Hours)

**Unit 3:** Interpolation and Curve Fitting, Discrete Data, Lagrange's Interpolating Polynomial, Newton's Polynomial Method, Limitations of Interpolation with Polynomials, Spline Interpolation, Curve Fitting, Least Square Fit, Fitting with straight Line, Polynomial Fit, Weighted Linear Regression, Fitting Exponential Function, Application of various methods using MATLAB. (06 Hours)

**Unit 4:** Numerical Differentiation and Integration, Taylor's Series, Finite Difference Method, Error in Finite Difference Approximation, Richardson Extrapolation, Derivatives by Interpolation, Cubic Spline Interpolant, Numerical Integration or Quadrature, Newton Cotes Formula, Trapezoidal & Composite Trapezoidal Rule, Simpson Rule, Recursive Trapezoidal Rule, Romberg Integration, Gaussian Integration, Orthogonal Polynomial, Abscissas and Weights for Gaussian Quadrature, Gauss Legendre Quadrature, Gauss Laguerre & Gauss Hermite Method, Gauss-Chebyshev Quadrature, Gauss Quadrature with Logarithmic Singularity,

Application of various methods using MATLAB. (06 Hours)

**Unit 5:** Initial Value Problem, Taylor series approach, Euler's Method, Runge-Kutta Method, Second Order Runge-Kutta Method, Forth order Runge-Kutta Method, Stability of Euler's Method, Stiffness, Adaptive Runge-Kutta Method, Bulirsch Stoer Method, Numerical Methods in Structural Dynamics, Implicit and Explicit Method, Central Difference Method, Newmark-Beta Method, Wilson-Theta Method, Application of various methods using MATLAB.

(04 Hours)

**Unit 6:** Boundary Value Problem, Shooting Method, Two Point Boundary Value Problem, Eigenvalues and Eigenvectors, Symmetric Matrix Eigenvalue Problem, Inverse Power & Power Methods, Eigenvalue Problem in Structural Dynamics, Inverse vector iteration method, Application of various methods using MATLAB. (04Hours)

**Reference Books:**

1. Numerical Analysis, L. Ridgway Scott.
2. Elementary Numerical Analysis: An Algorithmic Approach, S. D. Conte, Carl de Boor.
3. An introduction to Programing and Numerical methods in MATLAB, S. R. Otto, J. P. Deneir.
4. Numerical Methods in Engineering with MATLAB, Jaan Kiusalaas.
5. Numerical Recipes in C, William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery.

**MSE 641: (Elective-1) Bridge Engineering****Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

**Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit - 1**

Classification and components of bridges, historical perspective, layout and planning, investigations for bridges, choice of type of the bridges, conceptual bridge design, bridge aesthetics. bridge appurtenances. Loading standards for highway and railway bridges (IRC, IRS)  
(05 Hours)

**Unit - 2**

Slab culvert bridges, slab-and-beam bridges, load distribution in slabs and beams, bow-string girder bridges, behaviour of skew bridge decks. Behaviour, analysis and design of RC and PSC box-girder bridge decks.  
(05 Hours)

**Unit - 3**

Behaviour, analysis and design of steel bridge decks: girder bridges, truss bridges; arch bridges, composite construction  
(05 Hours)

**Unit - 4**

Design of bearings, substructure and foundations – piers and abutments of different types, shallow and deep foundations – design and constructional aspects  
(05 Hours)

**Unit - 5**

Modern methods of construction of concrete, steel and composite bridges, their impact on analysis and design  
(05 Hours)

**Unit - 6**

Introduction to analysis and design of long span bridges: suspension and cable stayed bridges.

(05 Hours)

**Recommended Books:**

1. Design of Bridges; Raju N. K., Oxford & IDH
2. Bridge Engineering; Ponnuswamy S., Tata McGraw Hill.
3. Concrete Bridge Practice; Raina V.K., Tata McGraw Hill.
4. Essentials of Bridge Engineering; Victor D. J., Oxford & IDH
5. Design of Bridge Structures: T.R Jagdeesh & M.A Jayaram, Prentice Hall India Private Ltd. New Delhi.

**MSE 642: (Elective-I) Design of Composite Construction****Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

**Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit 1:**

Introduction of Composite Constructions. Benefits of Composite Construction, Introduction to IS, BS and Euro codal provisions. Composite beams, elastic behaviour of composite beams, No and Full Interaction cases, Shear Connectors, Ultimate load behaviour, Serviceability limits, Effective breadth of flange, Interaction between shear and moment, Basic design consideration and design of composite beams. (05 Hrs)

**Unit 2:**

Composite floors, Structural elements, Profiled sheet decking, Bending resistance, Serviceability criteria, Analysis for internal forces and moments (05 Hrs.)

**Unit 3:**

Composite Columns, Materials, Concrete filled circular tubular sections, Non-dimensional slenderness, local buckling of steel sections, Effective elastic flexible stiffness, resistance of members to axial compressions, Composite Column design, Fire Resistance. (05 Hrs.)

**Unit 4:**

Composite trusses, Design of truss, Configuration, Application range, Analysis and Design aspects and connection details. (05 Hrs.)

**Unit 5:**

Design of Multi-storeyed commercial and residential composite building, Design basis, load calculations, Design of composite slabs with profile decks, composite beam design, design for compression members, vertical cross bracings, design of foundation. (05 Hrs.)

**Unit 6:**

Design of Composite Construction in Bridges – IRC specifications and code of practice for loads and composite construction. Composite Deck Slab Design – Design of one way deck slab for Class AA and Class A loading, Design of Cantilever Portion of deck Slab. Design of longitudinal girders. (05 Hrs.)

**Recommended Books:**

1. Johnson R. P. – Composite Structures of Steel and Concrete, Vol I, Beams, Columns and Frames in Buildings, Oxford Blackwell Scientific Publications.
2. INSDAG teaching resources for structural steel design Vol – 2, Institute for Steel Development and Growth Publishers, Calcutta
3. INSDAG Handbook on Composite Construction – Multi-Storey Buildings, Institute for Steel Development and Growth Publishers, Calcutta
4. INSDAG Design of Composite Truss for Building, Institute for Steel Development and Growth Publishers, Calcutta
5. INSDAG Handbook on Composite Construction – Bridges and Flyovers, Institute for Steel Development and Growth Publishers, Calcutta
6. INSDAG Design Guide for Composite Highway Bridges (Steel Bridges), Institute for Steel Development and Growth Publishers, Calcutta
7. D. Johnson Victor - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
8. N. Krishna Raju - Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
9. IS:11384, 1985 Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi.
10. IRC Codes – IRC: 5, IRC: 6, IRC: 18, IRC: 27, IRC: 45, IRC: 78, IRC: 83

**MSE 643: (Elective-1)\_Advanced Design of Concrete Structures****Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

**Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit 1:**

Yield Line Theory for analysis of Slabs: Equilibrium and virtual work methods of analysis, Rectangular slabs and triangular slabs with various edge conditions – yield line patterns, Circular slabs, Design for limit state of strength and serviceability, Orthotropically reinforced slabs.

(04 Hrs.)

**Unit 2:**

Limit state design of bunkers, silos, spherical and conical domes, liquid retaining structures, chimneys, cooling towers.

(06 Hrs.)

**Unit 3:**

Elevated Service Reservoirs: Rectangular, Circular. Design of staging for wind and earthquake forces, container with flat top and domed bottom. Membrane analysis, Effect of Joint reactions due to continuity.

(06 Hrs.)

**Unit 4:**

Design of Pretension and Posttension Flexural members: Design of partially Prestressed concrete members. Prestressed Concrete Slabs: Introduction, Design of one way, two way and flat slabs.

(04 Hrs.)

**Unit 5:**

Statically Indeterminate Structures: Analysis and Design of continuous beams and Frame.

Choice of cable profile-linear transformation-concordancy: Composite Beams: Composite sections of Prestressed concrete beam and cast in-situ RC slab - Analysis of stress, Differential

shrinkage, Deflections, Flexural and Shear strength of composite sections, Design of composite sections. (06 Hrs.)

**Unit 6:**

Prestressed Concrete Pipes and Tanks: Circular prestressing, types of Prestressed concrete pipes. Prestressed Concrete tanks: General features, Analysis and design of circular tanks. (04 Hrs.)

**Recommended Books:**

1. T.Y. Lin & Ned H. Burns – Design of Prestressed Concrete Structures, John Wiley Publication
2. N. Krishna Raju – Prestressed Concrete, Tata Mc Graw Hill Publication Co
3. Limit State Design of Prestressed Concrete, Guyon Y.
4. Edward Nawy – Prestressed Concrete – A Fundamental Approach, Prentice Hall International
5. B.C. Punmia, Ashok K. Jain, Arun K. Jain – Reinforced Concrete Structures Vol. II, Laxmi publications, New Delhi
6. N.C. Sinha, S.K. Roy – Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, New Delhi
7. P.C. Varghese – Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi
8. IS: 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
9. IS: 1343: Indian Standard code of practice for Prestressed concrete, Bureau of Indian Standards, New Delhi.
10. IS: 1893: Indian Standard code of practice for criteria for Earthquake resistant design of structures, Bureau of Indian Standards, New Delhi.
11. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi.

**MSE621: LABROTARY-I****Teaching Scheme:**

Practical: 02 Hours / Week

**Exam Scheme:**

Practical Exam: 50 Marks

Credit: - 1

**Lab – I (Advanced Concrete Technology)**

The experiments to be performed are as given below:

1. To obtain compressive strength, split tensile strength using I S method of mix design.
2. To obtain compressive strength, split tensile strength using British method of Mix design.
3. To obtain compressive strength, split tensile strength using ACI method of Mix design

**MSE622: LABROTARY-II****Teaching Scheme:**

Practical: 02 Hours / Week

**Exam Scheme:**

Term Work: 50Marks

Credit: -2

**Lab – II (Numerical methods)**

(Term work- 25 marks, Practical / Oral – 25 marks).

The experiments will be assignments with manual solution and solutions using MATLAB programming on the following topics:

1. Simple programs for matrix algebra, Plotting 2-D and 3-D graphs, Applications of DO loop, WHILE loop, Conditional Operators, Programming through MATLAB built-in functions etc.
2. Gauss Elimination Method. (Solving Linear Simultaneous Equation)
3. Gauss Elimination Method with Pivoting.
4. Gauss Seidel Method.
5. LU Decomposition Method.
6. Bisection Method.
7. Incremental Root Search method.
8. Newton Raphson Method.
9. Polynomial Interpolation and Cubic Spline Method.
10. Linear & Exponential Curve Fitting.
11. Curve Fitting (Weighted Non-Linear Regression)
12. Finite Difference Method.
13. Newton Cotes Formula.
14. Richardson Extrapolation.
15. Romberg Integration.
16. Runge Kutta (Second & Forth Order Method)
17. Solving ODE & PDE through MATLAB Solver.
18. Shooting Method (Two Point Boundary value Problem: Application in Static & Dynamic Structural Analysis Problems)
19. Program for Non Linear ODE
20. Solving Eigen-Value Problem using MATLAB.

**MSE623: SEMINAR –I****Teaching Scheme:**

Practical: 02 Hours / Week

**Exam Scheme:**

Term work: 50 marks

Credit: - 1

Each candidate is required to give one seminar on any chosen topic connected with the field of specialization. The topic shall be chosen in Consultation with the concerned Faculty and Head of the Department. Preparation and presentation of a seminar is intended to investigate an In depth review of literature; to prepare a critical review and to develop Confidence for making a good presentation. A report has to be submitted in the prescribed format and the seminar shall be evaluated by the respective department committee.

Seminar shall be a term work submitted in the form of technical report of research, analysis and design on any current topic in the concerned or allied field. It is expected that the students should refer the journals, and proceedings of National and International seminar / conference. Student should follow standard practice of seminar report writing (International journals). The candidate will deliver a talk on the topic and the assessment will be made on the basis of term work and the talk thereon by internal examiner appointed by the Principal of the Institution. Seminar topics from text and reference books will not be accepted.

**MSE 651: Advanced Structural Mechanics - II****Teaching Scheme**

Lectures: 3 Hours/Week

Term Work: 25

Tutorial: 1 Hours/Weeks

**Examination Scheme**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit 1:** Introduction and Review of various methods in finding slopes and deflections at a point in statically determinate and indeterminate structures. (04 Hours)

**Unit 2:** Direct Flexibility Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames. (05 Hours)

**Unit 3:** Generalised Flexibility Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames. (06 Hours)

**Unit 4:** Direct Stiffness Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames. (06 Hours)

**Unit 5:** Generalised Stiffness Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames. (05Hours)

**Unit 6:** Material & Geometric Non-Linearity, Stiffness method with Material & Geometric Non-Linearity. (04 Hours)

**Recommended Books:**

1. Matrix Analysis of Framed Structures, Weaver W., Gere G. M.
2. Structural Analysis, Hibbler R. C.
3. Basic Structural Analysis, Reddy C. S.
4. Structural Analysis – A Matrix Approach, G. S. Pandit , S. P. Gupta.

### **MSE 652:Finite Element Method**

#### **Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

#### **Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit 1:** Introduction, Overview of various methods to solve Integral & Differential Equations (Point Collocation Method, Method of Least Square, Weighted Residual Method, Galerkin's Method), Variational Calculus (Hamilton's variational Principle, Minimum Potential Energy Principle, Euler Lagrange Equation), Partial FEM (Kantorovich Method/ Finite Strip Method/ Semi-Analytical Method), Local & Global Finite Element Methods (Rayleigh-Ritz Method), Basics of Finite Element Methods (Stepwise Procedure).  
(04 Lectures)

**Unit 2:** Application of FEM to solve various 1-D (One Dimensional Finite Elements, Shape Functions for 1-D Elements, Properties of Shape Functions, Lagrange Interpolating Polynomials),  $C^0$  Continuum, 1-D FE Analysis (Discretization, Selection of Shape Function, Defining Gradients of Primary Unknowns & Constitutive Equations, Derivation of Element Equations, Assembly & Application of Boundary Conditions, Computation of Primary and Secondary Unknowns), Direct Approach for Assembly, Boundary Conditions (Geometric, Natural), Concept of Sub-Structuring (Static Condensation), Stiffness Matrix for the Basic Bar & Beam Element, Representation of Distributed Loading, The Assembly Process within the PMPE Approach, Element Stresses), FE Analysis of 1-D Non-Prismatic Members, Solution of Differential Equation using FEM, Solution of BIVP using Galerkin's MWR (1-D Transient Analysis).  
(8 Lectures)

**Unit 3:**  $C^1$  Continuum, Formulation of 1-D Beam Element, Classical Beam Theory, Element Equation Formulation (Galerkin's Approach, Rayleigh-Ritz Approach), Derivation of Scalar

Functional from Differential Equation and vice versa, Application to Fixed and Continuous Beams. (04 Lectures)

**Unit 4:** Conditions of Symmetry & Anti Symmetry (Applications), 2-D FE Analysis, Review of Theory of Elasticity, CST Element (3-Node Triangular Element), Pascal's Triangle and Pyramid, Area Co-ordinate, Stepwise Formulation, Equivalent Load vector, Computer Implementation of FEM, Plane Stress Problems using CST Elements, 2-D Stress Analysis using 4-noded Rectangular Element, Stepwise Formulation, Effect of Aspect ratio, Explicit & Iso-parametric Formulation, Iso-parametric Elements for Plane Problems (Quadrilateral Element, Bilinear Element, Para-linear Element, Bi-Quadrilateral Element, Serendipity Elements, Lagrange Element), Numerical Integration, (1-D Domain, 2-D Domain, n-point Gauss Rule), Formulation of Transition Element. (06 Lectures)

**Unit 5:** 3-D Stress Analysis using FEM, Iso-parametric Formulation, 3-D Brick Element, Application to 3-D Analysis, FEA of Axi-symmetric Solids subjected to Axi-symmetric and Asymmetric Loads (Application of Partial FEM). (04 Lectures)

**Unit 6:** Computer Implementation of FEM, Application of FEM to Time Dependent Problems, Partial FEM, h-version of FEM, p-version of FEM, Adaptive Meshing, Exposure to Hybrid FEM (Mixed/ Hybrid Formulation, Unidirectional Composites), Introduction to ANSYS, Static & Dynamic Analysis of 1-D, 2-D and 3-D structures using ANSYS. (04 Lectures)

**Recommended Books:**

1. The Finite Element Method in Engineering Science...O. C. Ziekiewicz & Cheung
2. Concept and application of Finite Element Analysis...M. Mukhopdhyay
3. Finite Element Method, Y. M. Desai, T. I. Eldho & A. H. Shah
4. Finite Element Procedures, K. J. Bathe

**MSE 653: Structural Dynamics & Earhtquake Engineering****Teaching Scheme**

Theory: 03 Hrs / Week

Tutorial: 01 Hr. / Week

**Examination Scheme:**

Theory: 80 Marks

Class Test: 20 Marks

**UNIT I**

Systems with single degree of freedom natural frequency, period. Damping. (4 hrs.)

**UNIT II**

Forced oscillations – trigonometrical forcing functions – other forcing functions like Unit impulse, rectangular function. Response of the structure, dynamic implication factor. Critical damping under and over damping. (6 hrs.)

**UNIT III**

Multi Degree freedom system formulation of problem, Structural property Matrices, Modal analysis

– Stodola and Hozer method. Application to multistory frames with rigid girders. (6 hrs.)

**UNIT IV**

Distributed mass system- Application to beam problems. Rayleigh-Ritz solutions. Natural frequencies

of frames. (4 hrs.)

**UNIT V**

Elementary concepts of earthquakes, Nature of loading due to earthquake, Response of structures,

Deterministic and stochastic approach. (5 hrs.)

**UNIT VI**

Earthquake resistant structures- IS code provisions and applications to building frame, dams, retaining

walls. (5 hrs.)

**Recommended Books:**

- |   |    |                       |
|---|----|-----------------------|
| 1. Dynamics of structures                 | :- | Clough & Penzien.     |
| 2. Fundamentals of earthquake engineering | :- | Newman & Rosenblueth. |
| 3. Dynamics of structures                 | :- | Mukhopadhyay          |
| 4. Fundamentals of earthquake engineering | :- | A.K. Chopra.          |

## **MSE 654: Theory of Plates and Shells**

### **Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

### **Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

### **Unit-1:**

Introduction: Thin and thick plates, small and large deflections. Small deflection theory of thin plates, Assumptions, Moment Curvature relations. Stress resultants. Governing differential equation in Cartesian co-ordinates, various boundary conditions. (05 Hrs.)

### **Unit-2:**

Analysis of Rectangular Plates: Navier solution for plates with all edges simply supported. Sinusoidal load, Distributed loads and point loads. Levy's Method: Distributed load and line load. Plates under distributed edge moments. Introduction to shear deformation theories. (05 Hrs.)

### **Unit-3:**

Circular Plates: Analysis of circular plates under axi-symmetric loading. Moment - Curvature relations. Governing differential equation in polar co-ordinates. Simply supported and fixed edges. Distributed load, ring load, a plate with a central hole. (06 Hrs.)

### **Unit-4:**

Introduction: Classification of shells on geometry, thin shell theory, equations to shell surfaces, stress resultants, stress- displacement relations, compatibility and equilibrium equations. Shells of Revolution: Membrane theory, equilibrium equations, strain displacement relations, boundary conditions, cylindrical, conical and spherical shells. (05 Hrs.)

### **Unit-5:**

Circular cylindrical shells: Membrane theory: Equilibrium equations, strain displacement relations, boundary conditions. Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell, various boundary conditions. (05 Hrs)

### **Unit-6:**

Bending analysis of cylindrical shells by beam theory, Finstewalder, Schorer , Flugge`s and D. K. J. theory. (04 Hrs.)

**Recommended Books:**

1. S.Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Graw Hill.
2. Ansel C. Ugural, Stresses in Plates and Shells, Mc Graw Hill
3. G. S Ramaswamy, Design and Construction of Concrete Shell Roofs, CBS Publications
4. Chandrashekhara K., Analysis of Concrete Shells, New Age International Edition
5. Chandrashekhara K., Analysis of Plates, New Age International Edition
6. Theory of Analysis of plates ----- R. S. Zilard

**MSE 691: (Elective-II) Structural Stability:****Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

**Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit 1:**

Fundamental concepts, elastic structural stability, structural instability, analytical methods for the stability analysis, equilibrium, imperfections and energy methods. (05 Hrs.)

**Unit 2:**

Elastic buckling of columns, assumptions, critical load for various boundary conditions, columns with geometric imperfection, large deflection theory of columns, Southwell plot, Orthogonality of buckling modes, eccentrically loaded columns, numerical techniques – Finite difference and Finite element approach. (05 Hrs.)

**Unit 3:**

Elastic buckling of beam-column, differential equations of beam-column, beam-column with concentrated point load, several point loads, continuous lateral load, single couple, uniformly distributed load, end couples. (05 Hrs.)

**Unit 4:**

Elastic buckling of frames, triangular, partial, multistory portal and box frames with symmetric & anti symmetric buckling, stiffness method approach, approximate method, buckling of open sections, torsional buckling. (05 Hrs.)

**Unit 5:**

Elastic buckling of thin plates, equilibrium approach, rectangular plate with axial load in one and two directions, various boundary conditions, Energy methods – Rayleigh Ritz and Galerkin, large deformation theory of plates and effective width concept, post buckling behavior of plates. (05 Hrs.)

**Unit 6:**

Dynamic stability of structures, objectives, Hamilton and Lagrange's equation for discrete and continuous systems, pulsating load on a column. (05 Hrs.)

**Recommended Books:**

1. George Gerard, Introduction to Structural Stability Theory, Mc Graw Hill, New York
2. Iyenger N.G.R., Elastic Stability of Structural elements, Mc Millan, India
3. Ashwini Kumar, Stability of Structures, Allied Publishers, New Delhi
4. Buckling of bars, plates and shells Don O. Brush & B. O. Almorth.
5. Theory of elastic stability S.P. Timoshenko & J. M. Gere.
6. Principles of structural stability A. Chajes.
7. Structural stability of plates & shells N.G.R. Jyenger.
8. An Introduction to the elastic
9. Stability of structures G.J. Simitses
10. Stability of structures: Elastic, Inelastic ,
11. Fracture and damage Therioes P. Bazant & L. cedolin.
12. Introduction to Structural Stability Theory George Gerard

**MSE 692: (Elective – II) Analysis of Composite Structures:****Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

**Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

<b>Unit 1:</b> Constituent materials for composites – fibre and matrix	(04 Hrs)
<b>Unit 2:</b> Structural applications of composites, fabrication processes	(04 Hrs)
<b>Unit 3:</b> Mechanical behavior of composites	(04 Hrs)
<b>Unit 4:</b> Stress – strain relations for orthotropic materials	(04 Hrs)
<b>Unit 5:</b> Lamina stress – strain relations, Strength of lamina, failure criteria, Shear deformation theories for laminates	(08 Hrs)
<b>Unit 6:</b> Stress, vibration and buckling analysis of laminate bars, beams, arches, plates and shells	(06 Hrs)

**Recommended Books:**

1. Jones R. M., "Mechanics of Composite Materials", McGraw Hill, Tokyo
2. Christensen R. M., "Mechanics of Composite Materials", John Wiley & Sons, New York.
3. Agarwal B. D. and Broutman L. J., "Analysis and Performance of Fibre composites", John Wiley & Sons, New York.
4. Calote L. R., "The analysis of Laminated Composite Structures", Van Nostrand Reinhold Co., New York
5. Holmes M. and Just D. J., "GRP in structural Engineering", Applied Science Publishers, London.
6. Gibson R. F., "Principles of Composite Material Mechanics"
7. Reddy J. N., "Analysis of Composite Laminated Plates", McGraw Hill. - 448
8. Chandrashekhara K., Analysis of Plates, New Age International Edition

**MSE 693: (Elective-II) Inelastic Analysis of plates:****Teaching Scheme:**

Lectures: 3 Hours/Week

Tutorial: 1 Hours

**Examination Scheme:**

Theory Paper: 80 Marks

Test: 20 Marks

Credit: - 4

**Unit 1** Limit analysis of plates, lower bound and upper bound solutions. (05Hrs)**Unit 2** Ultimate strength of reinforced concrete slabs. (05Hrs)**Unit 3** Yield line analysis by the work method and equilibrium method, Isotropic and orthotropic reinforcement. (05Hrs)**Unit 4** Strip method for analysis of R.C. slabs. (05Hrs)**Unit 5** Estimation of deflections in R.C slabs (05Hrs)**Unit 6** . Load test and acceptance criteria. (05Hrs)**Recommended Books:**

1. Plastic and elastic design of slabs and plates ----- R.H. Wood
2. Yield line analysis of slabs ----- L. L. Jones
3. IS 456-2000: Code of practice for plain and R. C. BIS, New Delhi

**MEV671: LABROTARY- III****Teaching Scheme:**

Practical: 02 Hours / Week

**Exam Scheme:**

Practical Exam: 50 marks

Credit: - 1

**Lab – III (Advanced Structural Mechanics- II)**

Minimum Six problems shall be solved based on the theory syllabus of Advanced Structural Mechanics- II.

**MEV672: LABROTARY- IV****Teaching Scheme:**

Practical: 02 Hours/ Week

**Exam Scheme:**

Term work: 50 marks

Credit: - 2

**Lab – IV (Structural Dynamics & Earthquake Engineering)**

The experiments to be performed are listed below. (Minimum 7)

- | <b>Sr. No.</b> | <b>Name of the Experiment</b>  |
|----------------|--|
| 1.             | Dynamics of a three-storied building frame subjected to harmonic base motion                     |
| 2.             | Dynamics of a one-storied building frame with planar asymmetry subjected to harmonic base motion |
| 3.             | Dynamics of a three-storied building frame subjected to periodic (non harmonic) base motion      |
| 4.             | Vibration isolation of a secondary system.   |
| 5.             | Dynamics of a vibration absorber.  |
| 6.             | Dynamics of a four-storied building frame with and without an open ground floor.                 |
| 7.             | Dynamics of one-span and two span beams.   |
| 8.             | Earthquake induced waves in rectangular water tanks.   |
| 9.             | Dynamics of free-standing rigid bodies under base motions  |
| 10.            | Seismic wave amplification, liquefaction and soil-structure interactions.                        |

**MSE673: SEMINAR- II****Teaching Scheme :**

Practical: 02 Hours / Week

**Exam Scheme :**

Term work: 50 marks

Credit: - 1

Topic of the seminar II shall be decided in such a way that it will enhance the knowledge of the student in a particular topic which is not covered in the syllabus. It is expected that the students should refer the journals, and proceedings of National and International seminar/conferences. Student should follow International Practice of seminar report writing (International Journals). The candidate will deliver a talk on the topic and the assessment will be made on the basis of term work and the talk thereon by internal examiner appointed by the Principal of the Institution. Seminar topics from text and reference books will not be accepted.

## SEMISTER – III

### MSE731: DISSERTATION PART-I

**Teaching Scheme:**

Practical: 12 Hours / Week

**Exam Scheme :**

Term work : 50 marks

Practical : 50 marks

Credit :- 12

It will be taken up by the student at the end of the second semester and the duration would be six months. This is aimed at training the students to analyze independently any problem posed to them. The work may be analytical, experimental, design or combination of these. The dissertation report is expected to exhibit clarity of thought and expression, critical appreciation of the existing literature and analytical and/or experimental or design skill. The evaluation of dissertation will be based on continuous internal assessment comprising three seminars, one internal Viva-voce and an external Viva-voce examination.

The dissertation shall consist of a report on any research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of experimentation/ numerical work, design and or development work that the candidate has executed.

- In part I dissertation it is expected that the student should decide a topic of dissertation which is useful in field or practical life. It is expected that the students should refer the journals, and proceedings of National and International seminar/conferences. Emphasis should be given to the introduction of topic, literature review, objective of the study along with some preliminary work/experimentation carried out on dissertation topic.
- Student should submit part I dissertation report (soft bound) in three copies covering the content discussed above and highlighting the features of the works to be carried out part II of the dissertation. Student should follow standard practice of dissertation writing.
- The candidate will deliver a talk on the topic and the assessment will be made on the basis of term work and the talk thereon by internal examiner appointed by the Principal of the Institution.

**SEMISTER - IV****MSE 781: DISSERTATION PART - II****Teaching Scheme:**

Practical: 20 Hours / Week

**Exam Scheme:**

Term work: 100 Marks

Practical: 200 Marks

Credit: 20

The part II of dissertation will be in continuation of part I after completion of work satisfactorily the examinee shall submit the dissertation in soft bound two copies to the head of department. The examinee shall present the pre synopsis of the dissertation work before two internal examiners out of which one will be guide. The suggestion given by these two examiners should be incorporated before submitting the final four copies of the head of the institution. The term work marks should be submitted to the university by the internal guide, examinee should take into account the opinion of other two examiners who were present at time of pre synopsis.

Viva-voce examination shall consist of defense presented by the examinee on his/her work in the presence of other teachers and students and two examiners appointed by the university, one of whom will be the guide and second will be external examiner