Teaching and Examination Schemes with Syllabus

of

Master of Technology

in

(Civil) Structural Engineering

(Effective 2014-15)

(Approved in the 27th Standing Executive Committee of the Senate dated August 14, 2014)

Department of Civil Engineering

Sardar Vallabhbhai National Institute of Technology, Surat

Vision and Mission of the Institute

Vision

To be one of the leading Technical Institutes disseminating globally acceptable education, effective industrial training and relevant research output.

Mission

To be a globally accepted centre of excellence in technical education catalyzing absorption, innovation, diffusion and transfer of high technologies resulting in enhanced quality for all the stake holders.

Vision and Mission of the Department

Vision

To be a global centre of excellence for creating competent professionals in Civil Engineering

Mission

- To provide excellent education producing technically competent, globally employable civil engineers who will be leaders in the chosen field.
- To undertake research in conventional and advanced technologies fulfilling the needs and challenges of modern society.

Foreword

The SVNIT, Surat was established in the year 1961 and the Structural Engineering Section is part of the institute since 1974. The section consists of dedicated team of 12 faculty members, 11 faculties acquired their Doctorate from renowned universities in the field of Structural Engineering like IITs, NITs etc. The section has 9 well equipped laboratories. Beside high-quality teaching and instruction at UG and PG, the section is actively involved in basic and applied research and consultancy services. The section is providing quality technical and advisory support through consultancy to various private construction agencies, State Government, Central Government projects. Alumni from Structural Engineering Section are serving at various International as well as National Level Organizations and some have been successful entrepreneurs in the fields of Structural Engineering. The Structural Engineering Section presents a picture of a small but fully dedicated and developed faculty contributing to all round growth of students, Institute, Industries and Society.

Programme Educational Objectives (PEOs)

The graduates of the M.Tech. Structural Engineering Programme will:

PEO-1. Contribute constructively to analysis and design of various structural systems using modern engineering tools and materials for sustainable infrastructure development of the country

PEO-2. Deliver proficient services to solve real-time complex structural engineering problems using basic principles of engineering

PEO-3. Encourage lifetime learning to excel in teaching, research and/or consultancy by following ethical practices to lead a successful professional career in industry thereby contributing to the society

Programme Outcomes (POs)

The outcomes of the Master of Technology programme in Structural Engineering are:

PO-1. An ability to independently carry out research/investigation and development work to solve practical problems

PO-2. An ability to write and present a substantial technical report/document

PO-3. Students should be able to demonstrate a degree of mastery over the area as per the specialisation of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

Programme Specific Outcomes (PSOs)

PSO-1. Acquire advanced knowledge to analyse and design structures using current codes of practice, tools and techniques and relevant software to meet the need of the society for sustainable development.

PSO-2. Conceptualize and solve complex structural engineering problems through experimental, analytical and/or numerical study to evaluate wide range of potential solutions with reference to safety, serviceability, economy, durability and environmental considerations.

PSO-3. Contribute positively to collaborative scientific research in structural engineering applying gained knowledge for decision making as an individual/team to accomplish viable/practical solutions for structural engineering problems.

Teaching Scheme
M.Tech. in (Civil) Structural Engineering

SEMESTER - I

Sr. No.	Course	Code	Scheme	Examination Scheme				Total	Credit
				Theory		Tuto.	Pract.		
				Hour	Mark	Mark	Mark		
1	Theory of Elasticity & Plasticity	AM601	3-1-0	3	100	50	-	150	04
2	Computer Methods of Analysis	AM603	3-1-0	3	100	50	-	150	04
3	Foundation Engineering	AM633*	3-0-2	3	100	-	50	150	04
4	Advanced Design of Concrete Structures	AM607	3-1-0	3	100	50	-	150	04
5	Elective-I	**	3-1-0	3	100	50	-	150	04
			Total	**15**	**500**	**200**	**50**	**750**	**20**

* Common subject
** Student can opt any one elective subject from the subject mentioned at below.

List of Electives I

AM 609: Advanced Design of Steel Structures
AM 611: Numerical Methods for Structural Analysis
AM 613: Rehabilitation of concrete structures

Allotment of elective

The choice of the elective courses is primarily based on the interest of the students. Faculties offering the respective elective subject interact with all students and brief out the content with relevance of the subject in field or in research. On the basis of merit, students are given the freedom to select the elective of their choice. Emphasize is made to offer maximum number of electives in each semester, however, at least 6 students need to opt a certain elective to run it.

SEMESTER – II

Sr. No.	Course	Code	Scheme	Examination Scheme				Total	Credit
				Theory		Tuto.	Pract.		
				Hour	Mark	Mark	Mark		
1	Finite Element Method	AM702*	3-1-0	3	100	50	-	150	04
2	Design of Earthquake Resistant Structure	AM704*	3-1-0	3	100	50	-	150	04
3	Structural Dynamics	AM706	3-0-2	3	100	-	50	150	04
4	Experimental Stress Analysis	AM708	3-0-2	3	100	-	50	150	04
5	Elective-II	**	3-1-0	3	100	50	-	150	04
			Total	**15**	**500**	**150**	**100**	**750**	**20**

* Common subject

** Student can opt any one elective subject from the subject mentioned at below.

List of Electives II

AM 712: Design of Prestressed Concrete Structures

AM 714: Theory of Plates & Shells

AM 716: Mechanics of Composite Materials

Allotment of elective

The choice of the elective courses is primarily based on the interest of the students. Faculties offering the respective elective subject interact with all students and brief out the content with relevance of the subject in field or in research. On the basis of merit, students are given the freedom to select the elective of their choice. Emphasize is made to offer maximum number of electives in each semester, however, at least 6 students need to opt a certain elective to run it.

SEMESTER – III

Sr No	Course	Code	Scheme	Examination Scheme				Total	Credit
				Theory		Tuto.	Pract		
				Hour	Mark	Mark	Mark		
1	Seminar / Project Report	AM801	-	4	-	-	100	100	02
2	Dissertation (Prelims)	AM810	-	16	-	-	200	200	08
			Total	**20**	**-**	-	**300**	**300**	**10**

SEMESTER – IV

Sr No	Course	Code	Scheme	Examination Scheme				Total	Credit
				Theory		Tuto.	Pract		
				Hour	Mark	Mark	Mark		
1	Dissertation	AM810	-	24	-	-	300	300	12
			Total	**24**	-	-	**300**	**300**	**12**

TOTAL CREDIT OF THE COURSE = 62

Assessment of Performance

Assessment of Theory Courses

The evaluation pattern for the theory courses, *as of now*, shall be as under:

- Mid-semester examination: 30 marks
- Assignment/Quizzes: 20 marks
- Tutorials (if applicable): 25 marks
- End-semester exam: 50 marks

The mid- and end-semester examinations are of 1.5 hours and 3 hours, respectively.

Assessment of Seminar

Internal assessment of 40% weightage by guide(s) and Final assessment of 60% weightage by a panel of examiners.

Assessment of Dissertation/Projects

Internal assessment of 40% weightage by guide(s) Final assessment of 60% weightage by a panel of examiners including an examiner from outside the institute

For more details, please refer to the institute website:

https://www.svnit.ac.in/Data/Notice/AcademicRegulations2013-2014.pdf

Course-wise Detailed Syllabus

Semester I

AM 601 Theory of Elasticity and Plasticity

L	T	P	C
3	1	-	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Comprehend and apply principles of elasticity in sufficiently rigorous manner
CO2	Evaluate the response of the structure against three-dimensional stress state at a given point
CO3	Conceptualize boundary value problems and elastic-plastic analysis
CO4	Analyse the solutions of 2D and 3D elementary problems in elasticity
CO5	Implement the concept of plasticity in a plastic analysis of structural forms.

2. Syllabus

- **INTRODUCTION TO THEORY OF ELASTICITY AND PLASTICITY (12 Hours)**
  Introduction, Forces, stresses and strains (Three dimensional) plane stress and plane strain problem, Cauchy's strain displacement relations, generalized Hook`s law, Navier's equilibrium conditions, compatibility, Boundary conditions, Beltrami-Michell compatibility equations.

- **TWO DIMENSIONAL AND THREE DIMENSIONAL ELASTICITY (10 Hours)**
  Airy's stress function, Saint Venant's principle- boundary value problems in two-dimensional and three-dimensional elasticity, two-dimensional stress-strain problems in Cartesian co-ordinates. Solution of simply supported and Cantilever beams by polynomials.

- **APPLICATION OF THEORY OF ELASTICITY (10 Hours)**
  Polar Co-ordinates, Prandtl's theory of torsion-Membrane analogy, Edge Dislocation - Biharmonic Equations-Stresses in circular disc - uniqueness of solution- Betti and Maxwell's reciprocity Theorems-concentrated load action on vortex of wedge (Mitchell's Problem)-concentrated load action on the free surface of a plate (Filament's problem) - stress concentration due to circular hole in stressed plate (Kirsch's problem)

- **PLASTICITY (10 Hours)**
  Introduction to plasticity, plastic behaviour of solids, stress / strain diagram for structural solids, yield criteria and flow rules, strain hardening, plastic analysis of structures, unloading from elastic, plastic states.

(Total Lectures: 42 Hours)

3. Books Recommended

1. Filonenko M., “Theory of Elasticity” Borodich Dover Publication, New York, USA, 2000
2. Timoshenko S P and Goodier J N, “Theory of Elasticity”, MC Graw Hill Book Co., Inc., New York, USA, 2004.
3. Venkatraman B & Patel S A., “Structural Mechanics with Introduction to Elasticity and Plasticity”, MC Graw Hill Publication, New York, USA, 2006.
4. Volterra E. & Gaines J H, “Advanced Strength of Materials”, Prentice Hall Publication, New York, USA, 2000.
5. Wang C T “Applied Elasticity” McGraw Hill Publication, NY, USA, 2000.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	3
CO2	2	1	3	3	3	2
CO3	3	2	3	2	3	1
CO4	2	1	2	3	3	2
CO5	3	1	2	3	2	3

Course-wise Detailed Syllabus

Semester I

AM 603: Computer Methods of Analysis

L	T	P	C
3	1	-	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Comprehend fundamentals of computer-based analysis
CO2	Perform advanced structural analysis using stiffness method
CO3	Apply numerical methods for solving structural engineering problem
CO4	Develops computer programs for analysis and design using C++/MATLAB and Spreadsheet
CO5	Perform analysis and design of RC building structures using structural analysis software(s). Comprehend concepts of seismic design.

2. Syllabus

- **COMPUTER BASED STRUCTURAL ANALYSIS: FUNDAMENTALS (6 Hours)**
  Purpose and Types of Analysis, Kinematic and Statical determinacy, Determinacy of Plane Trusses, Pure Beams and Plane frames, Introduction to stiffness and flexibility methods of analysis

- **STIFFNESS METHOD FOR LINEAR ELASTIC ANALYSIS (12 Hours)**
  Analysis of plane and space trusses, Pure beams, Plane and space frames and grids using stiffness method

- **COMPUTER IMPLEMENTATION OF STIFFNESS METHOD (4 Hours)**
  Standard format of data generation, Global and local axes, Member and material specifications, Restraints and releases, Symmetry, Equation solution and mechanism detection, member forces and sign conventions.

- **NUMERICAL METHODS FOR ENGINEERS (10 Hours)**
  Linear simultaneous equations, Direct and Indirect methods for solving simultaneous equations, Nonlinear equations, Horner's rule to evaluate polynomials, Bisection and Newton Rapson method for finding roots of nonlinear equations, Eigen value problem in structural engineering, Solution of Eigen value problem, Computer Programmes for Numerical Methods, Structural analysis and design using C++/MATLAB.

- **COMPUTER ASSISTED STRUCTURAL ANALYSIS AND MODELLIN (10 Hours)**
  Modeling of structural elements like truss, beam, frame and grid using Structural design software, Developing structural models using graphical user interphase (GUI), Understanding preprocessing and post processing phases for solving analysis problem, Solution errors and Model correctness, Analysis of building frames for gravity and lateral loading.

(Total Lectures: 42 Hours)

3. Books Recommended

1. Balfour, J A D "Computer Analysis of Structural Frameworks", 2nd edition, Blackwell Scientific Publication, Oxford, UK, 1992.
2. Johnson, David "Linear Analysis of Skeletal Structures", Thomas Telford, London, UK, 2004.
3. Paz, M and Leigh, W "Integrated matrix Analysis of structures: Theory and Computation", Kluwer Academic Publishers, Boston, USA, 2001.
4. Hoit, Mark "Computer Assisted Structural Analysis and Modelling", Prentice Hall, Inc., NJ, USA, 1995.
5. Chapra S C and Canale R P "Numerical Methods for Engineers", 5th edition, Special Indian Edition, Tata MC Graw Hill, New Delhi, 2007.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	0	2	2	1	3
CO2	3	1	3	3	1	3
CO3	2	1	3	2	1	3
CO4	3	2	3	3	2	3
CO5	3	3	3	3	3	3

Course-wise Detailed Syllabus

Semester I

AM 633: Foundation Engineering

L	T	P	C
3	-	1	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Interpret laboratory and field-testing results for foundation design.
CO2	Comprehend soil investigation reports and suggest the suitable type of foundation.
CO3	Design shallow and deep foundation, various machine foundations.
CO4	Evaluate bearing capacity and settlement of shallow and deep foundations using various approaches
CO5	Apply the acquired knowledge for the design of special foundation.

2. Syllabus

- **SOIL PROPERTIES AND EXPLORATION** **(8 Hours)**
  Soil properties and its applications, Laboratory testing, Soil exploration techniques – comparisons, Sounding tests, Geophysical methods, Sampling, Interpretation of Laboratory & field Testing.

- **INTRODUCTION SHALLOW FOUNDATION** **(8 Hours)**
  Soil Investigation Reports study, Bearing capacity of soil, Settlement of Foundations

- **MACHINE FOUNDATION** **(8 Hours)**
  Machine foundation – Types of machine foundation, General criteria, Theory of vibration, Single degree freedom system, Soil dynamic parameters, Block type machine foundation (Checking of resonance and permissible amplitude), vibration isolation techniques

- **PILE FOUNDATION** **(8 Hours)**
  Pile foundation – Types of piles, Factors affecting choice of types of piles, Load carrying capacity of piles, Pile group, Group efficiency, Lateral resistance of piles, settlement of piles, Negative skin friction

- **SPECIAL FOUNDATIONS** **(10 Hours)**
  Classification of Foundation, Special foundations, Raft foundation, types of rafts, Beams on elastic foundation, footing subjected to moments, Footing subjected to tension, Geotextiles, various methods of foundation design, Technological consideration in Geotechnical Engineering.

(Total Lectures: 42 Hours)

3. Books Recommended

1. Bowles J E “Foundation Analysis & Design” McGraw Hill Inc. New York, 1988.
2. Nayak N V “Foundation Design Manual” Dhanpatrai & Sons, New Delhi 1985.
3. Das B M “Principles of Foundation Engineering” PWS Publishing Co., Boston, 1990.
4. Barnes G E “Soil Mechanics” Principles and Practice “MacMillan, 2000.
5. Terzaghi, Peck .and Mesri “Soil Mechanics in Engineering Practice “1996

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	3	3	1	3
CO2	3	3	3	3	3	3
CO3	3	2	3	3	2	3
CO4	3	2	2	3	3	2
CO5	3	1	3	3	3	3

Course-wise Detailed Syllabus

Semester I

AM 607 Advanced Design of Concrete Structures

L	T	P	C
3	1	-	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Interpret and apply the provisions of relevant IS-code for design of various advanced RCC structures
CO2	Extend knowledge and proficiency in preparing reinforced concrete structural design with detailed report and drawings
CO3	Design appropriate type of combined shallow foundations for various conditions
CO4	Analysis and design of deep foundations like pile and pile cap
CO5	Enhance the knowledge for the design concepts of flat slab

2. Syllabus

- **DESIGN OF RCC FLAT SLAB** **(08 Hours)**
  Merits and Demerits of flat slabs as compared to other floor systems. Drop and capital in flat slab. Direct design method and equivalent frame method. IS provisions related to flat slab. Effect of opening in design of flat slab.

- **DESIGN OF COMBINED FOOTINGS** **(14 Hours)**
  Slab/pad footings, Slab-beam footings, footings on boundary of plot, footings with length/width restrictions, Strip footing and Strap footing design, design of raft foundation. IS provisions related to all design.

- **DESIGN OF DEEP FOUNDATIONS:** **(10 Hours)**
  Pile foundation, Soil design and structural design of pile. Load carrying capacity of pile in sandy soil, clayey soil. Pile resting on rock. Design of group of piles. Design of pile cap.

- **DESIGN OF RETAINING WALLS** **(06 Hours)**
  Different components of cantilever and counterfort retaining wall with and without surcharge. Check for overturning and check for sliding. Provision of key wall.

- **ANALYSIS AND DESIGN ASPECTS FOR WIND LOAD** **(04 Hours)**
  Analysis and design aspects of tall structures for wind load

(Total Lectures: 42 Hours)

3. Books Recommended

1. Shah H J, “Reinforced Concrete (Vol – II), Charotar Publishing House, 2020.
2. K. Raju, “Advanced Reinforced Concrete design”, CBS Publishers and distributors Pvt. Ltd., 2017.
3. Sinha S N, “Reinforced Concrete Design”, Tata Mc-Graw Hill Publication, 2014.
4. Varghese P. C., “Design of Reinforced Concrete Foundations”, Prentice-Hall of India Pvt. Ltd., 2009
5. Sharma H K & Agrawal G L, “Earthquake Resistant Building Construction” ABD Publishers, 2001.
6. Varghese P. C., “advanced reinforced concrete design”, Prentice-Hall of India Pvt. Ltd., 2011.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	3
CO2	3	3	3	2	2	1
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	2	3	2

Course-wise Detailed Syllabus

Semester I

AM 609 Advanced Design of Steel Structures

L	T	P	C
3	1	-	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Characterize the concept of space structure, history, material uses.
CO2	Audit the structures configuration of single, multi-layer grids, domes, cables, suspended roof structures.
CO3	Diagnose the different connector system for space structures.
CO4	Examine the rigorous analysis of space structure with Approximate Method of Analysis.
CO5	Create the Innovative space structure like Grid, Domes, Tensegrity and Pneumatic structures.

2. Syllabus

- Introduction, types, history, materials, characteristics. **(6 Hours)**
- Single & Multi-layer Grids – Single layer, double layer grids, space grids, two-way, three-way grids, triple layer grids, grid walls, support, camber case studies, innovative grids. **(6 Hours)**
- Braced Domes – types, characteristics, braced, lamella, Schwedler, ribbed, plate, networked, double layer domes, erection, wind loads, innovative domes. **(6 Hours)**
- Connectors – classification, characteristics, ball joint, socket joint, slot joint, shell joint, Modular systems, Comparison of joints, practical and innovative joints. **(6 Hours)**
- Cable Suspended Roof Structures – types, shapes, examples, double layer systems, Analysis, construction and design, innovative case studies. **(6 Hours)**
- Rigorous Analysis of skeletal space structures – frames & trusses – analytical methods, matrix analysis, solution, stiffness matrix, software package, latest methods. **(6 Hours)**
- Approximate Method of Analysis – double layer grids, domes, shells, buckling of shells, steel frame, folded plate roofs, cable suspended roof structures. **(6 Hours)**

(Total Lectures: 42 Hours)

3. Books Recommended

1. Subramanian, N., "Principles of space structures" 2nd Edition, Wheeler Publishing, New Delhi, 1999.
2. Ramaswamy, G.S., Eekhout, M. and Suresh G. R., "Analysis, Design & Construction of Steel Space Frames," Thomas Telford, London, 2002.
3. Chandra R., Gehlot. V. "Design of Steel Structures" Vol-2, Scientific Publishers, Jodhpur, 2007
4. Steel Designer's Manual: Prepared for the British steel produces' conference in conjunction with the British Iron and Steel Federation, Cross by Lockwood & Son Ltd, 26 Old Brompton Road, London SW 7, Second Edition, 1960, PP 447
5. Dayaratnam P "Design of Steel Structures" S. Chand of Co., Delhi 2003 edition.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	1
CO2	1	1	1	1	2	1
CO3	1	1	2	2	2	1
CO4	2	1	2	2	3	2
CO5	3	3	3	3	3	3

Course-wise Detailed Syllabus

Semester I

AM 611 Numerical methods of structural analysis

L	T	P	C
3	-	-	3

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Solve non-linear algebraic as well as simultaneous equations.
CO2	Obtain numerical solution of ordinary and partial differential equations.
CO3	Apply integration method/s for structural analysis.
CO4	Evaluate solution of eigen value problems and Fourier series for structural analysis.
CO5	Apply iterative and transformation methods in structural engineering.

2. Syllabus

- **SOLUTION OF NON-LINEAR ALGEBRAIC AND TRANSCENDENTAL EQUATIONS (6 Hours)**
  Solution by graphical method, bisection method, Newton Raphson iterative method, Regula-Falsi method.

- **ERRORS (4 Hours)**
  Error analysis, types of errors, accuracy & precision, stability in numerical analysis

- **SOLUTION OF SIMULTANEOUS EQUATION (6 Hours)**
  Gauss elimination with Partial Pivoting, Gauss Jordan elimination method, LU Decomposition using clout's, Jacobi iterative – Gauss-Seidel iteration.

- **ELEMENTS OF MATRIX ALGEBRA (6 Hours)**
  Solution of systems of linear equations, Eigen value problems. Applications to Structural Dynamic problems, stress problems, buckling of columns

- **NUMERICAL DIFFERENTIATION & INTEGRATION (10 Hours)**
  Solution of Ordinary and Partial Differential Equations, Euler's equation and other methods. Laplace equation - Properties of harmonic functions - Fourier transform methods for Laplace equation. Numerical Integration.

- **FINITE DIFFERENCE METHOD (6 Hours)**
  Finite difference technique, its applications to structural engineering problems.

- **COMPUTER ALGORITHMS (4 Hours)**
  Numerical solutions for different structural problems.

(Total Lectures: 42 Hours)

3. Books Recommended

1. Amos Gilat and Vish Subramaniam, “Numerical methods for engineers and scientists” 3rd edition, Wiley, 2014.
2. Richard L. burden, J. Douglas Faires “Numerical analysis”, 9th edition, Brook/Cole, 2011.
3. Ramin S. Esfandiari,” Numerical methods for engineers and scientists using MATLAB”, CRC Press, 2017.
4. James W. Hiestand, Jones and bartlett, “Numerical methods with VBA programming”, Jones and bartlett, 2009.
5. Kamlendra Kumar and Rakesh Kumar “Computer based numerical and statical techniques”, CBS Publishers, 2018.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	1	3	3	1	3
CO2	2	0	2	3	2	3
CO3	3	1	3	3	2	3
CO4	3	1	3	3	2	3
CO5	2	0	2	2	3	2

Course-wise Detailed Syllabus

Semester I

AM 613 Rehabilitation of Concrete Structures (Elective-I)

L	T	P	C
3	1	-	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Interpret and apply the provisions of relevant IS-code for design of various advanced RCC structures
CO2	Extend knowledge and proficiency in preparing reinforced concrete structural design with detailed report and drawings
CO3	Design appropriate type of combined shallow foundations for various conditions.
CO4	Analysis and design of deep foundations like pile and pile cap
CO5	Enhance the knowledge for the design concepts of flat slab

2. Syllabus

- **INTRODUCTION** **(4 Hours)**
  The repair process, plain concrete: a review: introduction to concrete, materials for making concrete, fresh concrete, structure of concrete, hardened concrete, physical and chemical characteristics of cement composites

- **MAINTENANCE & REPAIR OF STRUCTURES** **(4 Hours)**
  Need for maintenance and repairs Inspection of Structures for repairs and maintenance methods. for repairs, material and methodology for repairs, Cost of repair & maintenance, Repair to foundation columns, piles, floor, roof and walls

- **DETERIORATION MECHANISM** **(6 Hours)**
  Chemical and physical causes (corrosion), basic corrosion processes of steel in concert, Corrosion cell, Phases, Pourbaix-Diagram, types of corrosion, factor affecting the rate of corrosion, role of chlorides, corrosion protection techniques a) cathodic protection b) chemical inhibitors, c) re-passivation (patch repairs) d) protection by alkalization f) electrochemical chloride removal; Freeze-thaw durability of concrete, freeze-thaw mechanism, air entrainment, damages due to freeze-thaw, influencing factors, protection methods against freeze-thaw. Volume changes, alkali-aggregate reaction in concrete alkali- silica reaction-mechanism, alkali reaction with amorphous silica, alkali reaction with silicates caused by reactions in polyphase siliceous aggregates (shale, granite, sandstone), alkali carbonate reaction, mechanism of ASR, effects of alkali aggregate reaction, typical cracking due to alkali- aggregate reaction, swelling of the concrete due to alkali-aggregate reaction, factors affecting alkali-aggregate reaction. Sulphate attack in concrete sulphate attack of on concrete, sulphate attack mechanism, damages due to sulphate attack, influencing factors, protection methods against sulphate attack. Exposure condition of RC structures, durability, exposure condition, freezing exposure, coastal exposure, acid and thermal exposure, soil exposure

- **INSPECTION AND EVALUATION OF CONCRETE (4 Hours)**
  Introduction, preliminary consideration, condition survey, in situ compressive strength, locating delamination and cracks, locating embedded steel, monitoring movements and stresses, corrosion evaluation, destructive methods, core-sampling, laboratory tests, load testing

- **DAMAGE EVALUATION, DEFECT AND CRACKING OF CONCRETE (5 Hours)**
  Philosophy & definition, causes of failure, failure in ancient time & recent times. Deficiency in design drag, material production, construction and use maintenance etc. Failure related problems; Manmade and natural failure or damage. Diagnosis of failure; change in appearance on an exposure, chemical deterioration, Mechanical deterioration. Cracking in buildings. Failure of flat roofs, balconies, trenches, dams, piles abutments piers, silos, chimney, cooling towers, reinforced cement concrete (RCC) frames, Failure information & Analysis.

- **CONCRETE REPAIR AND REHABILITATION OF DISTRESS STRUCTURES (7 Hours)**
  Defect in concrete structures, performance requirements, repair process, repair materials, materials selection, repair methods and placement, inspection and testing distressed structures, techniques for rehabilitation of concrete structures, retrofitting of structures. Format of investigation. shear, torsion compression failure, erection difficulty, failure in tanks silos, space frame, precast assemblies prestressed concrete structure, formwork failure, case studies.

- **INTRODUCTION OF FRP STRENGTHENING CONCRETE STRUCTURES (6 Hours)**
  Introduction, FRP materials, evaluation of existing structures, flexural strengthening shear strengthening, column strengthening, installation of FRP strengthening systems quality control and quality assurance, additional applications, field applications.

- **STRUCTURE ASSESSMENT & LEGAL ASPECTS (3 Hours)**
  Art of structure assessment, method of testing, IS code for testing, safety assessment, legal aspects in connection to failure a repair.

- **PREVENTIVE MEASURES FOR DURABILITY OF STRUCTURES (3 Hours)**
  Proper selection and specification for material, the use of modern techniques for construction, Proper design, better workmanship.

(Total Lectures: 42 hours)

3. Books Recommended

1. Ted Kay "Assessment and Renovation of Concrete Structures" ed., John Wiley & Sons,
2. Inc. New York., 1992.
3. Rakshit K. S. "Construction Maintenance & Repair of Highway Bridges", 1994.
4. Champion S., “Failure & Repair of Concrete Structures” Wiley Publishers, 1961.
5. Grass F K, Clarke J L & Armer GST., “Structural Assessment”, Butter Worth Publisher, 1987.
6. Raiker R N, “Learning from failures”. Deficiencies in Design, Construction and Service, R & D Centre, Structwel Designers & Consultants, 1987

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	2	3	3	3	2
CO2	2	2	3	3	3	2
CO3	2	2	3	2	3	3
CO4	3	2	3	3	2	3
CO5	3	3	3	3	3	2

Course-wise Detailed Syllabus

Semester II

AM 702 Finite Element Methods

L	T	P	C
3	1	-	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Illustrate the basic concepts of finite element (FE) analysis
CO2	Identify and select the suitable element and mesh configuration to obtain converged solution
CO3	Develop the element characteristic equation and generation of global equation
CO4	Create 1D, 2D and 3D FE models of practical problems
CO5	Apply the FE analysis on an actual problem to determine induced displacements, forces, stresses and strains

2. Syllabus

- Concept & Solution procedure for finite element displacement approach. **(06 Hours)**
- Principles of discretization. **(06 Hours)**
- Lagrangian & Hermitian interpolation functions. **(06 Hours)**
- Shape function & numerical integration technique. **(06 Hours)**
- Element properties for one dimensional (bar & beam) element & two dimensional (rectangular, triangular & isoparametric elements using natural & area coordinate system. **(06 Hours)**
- Introduction to plate elements – shell elements – dynamics and vibration – buckling – Galerkin method. **(06 Hours)**
- Pre and post processors, Solution Techniques & Software Packages. **(06 Hours)**

(Total Lectures: 42 Hours)

3. Books Recommended

1. Cook R. D., Malkus, D. S., Plesha, E. & Witt, R. J. "Concepts and Application of Finite Element Analysis" by John Wiley & Sons Inc., Singapore, 2003. Singapore.
2. Logan, D. L., "A first course in the Finite Element Method", 3rd Edition, Thomson Asia Pvt Ltd, Bangalore, 2004.
3. Reddy, J. N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw Hill Pub. Ltd, New Delhi, 2005.
4. Chandrupatla, T. R. & Belegundu, A. D., "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice – Hall of India Pvt Ltd, New Delhi, 2002.
5. Rao, S. S., "The Finite Element Method in Engineering" 4th Edition, Butterworth – Heinemann, Oxford, UK, 2005.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	1	1	0	1	1
CO2	2	1	2	2	2	2
CO3	2	1	2	1	2	1
CO4	3	2	3	2	3	3
CO5	3	2	3	3	3	3

Course-wise Detailed Syllabus

Semester II

AM 704 Design of Earthquake Resistant Structures

L	T	P	C
3	1	-	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Describe the principles of engineering seismology.
CO2	Calculate the lateral load distribution on RCC Building.
CO3	Categorize the irregularities in buildings as per the clauses given in Codal Provisions.
CO4	Analyze and Design earthquake resistant reinforced concrete buildings as per the Codal provision.
CO5	Deduce the concept of base-isolation and dampers in building.

2. Syllabus

- **SEISMIC HAZARD ASSESSMENT** **(10 Hours)**
  Seismic Hazard Assessment: Engineering Seismology, Definitions, Introduction to Seismic hazard, Earthquake phenomenon, Seismotectonic and seismic zoning of India-Earthquake monitoring and seismic instrumentation, Characteristics of strong Earthquake motion, Estimation of earthquake parameter, Micro zonation

- **LATERAL LOAD ON BUILDINGS** **(12 Hours)**
  Lateral load on Buildings: Rigid diaphragm effect, Centre of mass and centre of stiffness, Torsional coupled and uncoupled systems, Distribution of lateral force for One storey and Multiple stories building.

- **STRUCTURAL CONFIGURATION OF BUILDINGS** **(10 Hours)**
  Structural Configuration for earthquake resistant design, Concept of plan irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS-1893. The effect of infill masonry walls on frames. Modelling concepts of infill masonry walls. Behaviour of masonry building during earthquake, failure patterns.

- **CONCEPT OF EARTHQUAKE RESISTANCE DESIGN** **(10 Hours)**
  Concept of earthquake resistance design: Review of latest Indian seismic code IS 1893:2000 (part-1) and IS 4326 Provisions for buildings, Earthquake design philosophy, Analysis by seismic coefficient and response spectrum methods, IS 13920 Provisions for ductile detailing of RC building – beams, columns and joints. Earthquake analysis of elevated water tank, Model provisions for ground supported and elevated water tanks, impulsive and convective mass of water, Calculation of time period, Base shear, Base moments, Hydrodynamic pressure and sloshing wave height.

(Total Lectures: 42 Hours)

3. Books Recommended

1. Agrawal Pankaj & Shrikhande Manish, "Earthquake Resistant Design of Structures" 1st Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2004.
2. Farzand Naeim & Van Nostrand Reinmhold, "The Seismic Design", Handbook, New York, 1989
3. Pauley & Priestly, "Seismic design of reinforced concrete and masonry buildings", John Wiley & Sons, 1992.
4. Park R and Paulay Y., "Reinforced Concrete Structures", John Wiley & Sons, 1975.
5. Ghose S. K., "Earthquake Resistance Design of Concrete Structures", SDCPL – R&D Center, New Mumbai 73.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	1
CO2	2	1	1	1	2	1
CO3	1	1	2	2	2	1
CO4	2	2	2	2	3	2
CO5	3	3	3	3	3	3

Course-wise Detailed Syllabus

Semester II

AM 706 Structural Dynamics

L	T	P	C
3	-	1	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Conceptualization of the structural vibration and its characterization. Development of Simplest modelling approach for complex structure
CO2	Ability to define structural damping & appropriate springs considering different end conditions
CO3	Anticipation of suitable analysis approach for a special structure & its implementation
CO4	Conceptualize vibrating body for free and forced vibration
CO5	Understand behaviour of Special structures and their adaptivity considering different forced vibration

2. Syllabus

- **INTRODUCTION TO DYNAMICS (08 HOURS)**
  Cause and effect of vibration, various types of pulses of vibration, single degree of freedom with and without damping, Free and forced vibration. Types of damping, viscous damping, critically damped system. Response of harmonic excitation, Dynamic equilibrium equation and solution, damping factor, Logarithmic decrement, Dynamic magnification factor, Eigen value, Problems on response of one degree of freedom system in harmonic loading.

- **INTRODUCTION TO MULTI DEGREE FREEDOM SYSTEM (08 HOURS)**
  Idealization of actual problem, continuous mass v/s Lumped mass, natural frequencies and mode shapes. Introduction to modal analysis, free vibration analysis and it's important in seismic analysis. Approximate time period of different structures.

- **DYNAMICS OF BEAMS (08 HOURS)**
  Resonance, dynamically sensitive structure – flexural vibration of uniform beams; Bernoulli – Euler Theorem, natural frequencies and mode shapes for five different end conditions of beams. Importance of first mode, and higher mode for various field problems. Dhumel integral, Blast load, Fourier analysis.

- **CONCEPTS OF MODAL ANALYSIS (06 HOURS)**
  Approximate formula for quick determination of natural frequencies and mode shape for beam, plate - square shape, circular shape with different end conditions at edges. IS code permissible limits for vibration.

- **WIND INDUCED VIBRATION (04 HOURS)**
  Tall chimney Problem, damping, Von-Karman street formation, Strouhal number applications, vortex shedding frequency, Galloping of cable, Negative damping of cables. Numerical for Vortex shedding frequency.

- **SEISMIC LOAD FORMULATION (08 HOURS)**
  Concept of response spectrum, Concept of plaza type, Soft storey, Building on sloping ground, Building plus Tower. Time period for elevated water tank and Bridge pier. Pipe supporting structure & Oil tank. Introduction to different software for dynamic analysis like SAP: 2000, MIDAS, ANSYS, ETABS, Fundamentals of Time history analysis & synthetic time history.

(Total Lectures: 42 hours)

3. Books Recommended

1. Anderson J S and Bratos - Anderson, "Solving problems in vibrations ", Longman scientific and technical, Harlow, 1987.
2. Booth Edmund, "Concrete Structure in Earthquake Regions: Design and Analysis", Longman scientific and technical, Harlow, 1994.
3. Chopra A. K, "Dynamics of structures; Theory Application to earthquake engineering", Prentice Hall of India Pvt. ltd., New Delhi, 2007.
4. Clough R W & Penzien J., "Dynamics of Structures", MC Graw Hill, Inc., New York, 1993.
5. Paz Mario, "Structural Dynamics ", 2nd edition Tata McGraw Hill inc., 2004.
6. L. Meirovitch, "Elements of Vibration analysis", 2nd edition, Tata Mc Graw-Hill, Singapore, 1986.
7. Martin Williams, "Structural Dynamics", CRC Press, 2016.
8. Ashok K. Jain, "Dynamics of Structure with MATLAB Applications", Pearson, 2017.
9. Pankaj Agrawal & Manish Shrikhande, "Earthquake resistant design of structure", PH1 Learning Pvt Ltd, 2006.
10. Anil K. Chopra, "Dynamics of structure" Global edition, 5th edition, 2017.
11. S. K. Duggal, "Earthquake Resistant design of structure", Oxford higher education, 2007.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	2
CO2	3	3	2	2	2	1
CO3	2	1	3	3	2	2
CO4	3	2	1	3	3	2
CO5	3	3	3	3	3	3

Course-wise Detailed Syllabus

Semester II

AM 708 Experimental Stress Analysis

L	T	P	C
3	-	1	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Demonstrate state of the art measurement techniques of strain gauges and system of transducers to acquire force – deformation information.
CO2	Acquire the knowledge of photoelasticity fringe order to measure the principal stresses for 2D objects.
CO3	Apply the brittle coating methods in analysis of cracking behaviour.
CO4	Conduct the structural audit for applying appropriate various non-destructive tests.
CO5	Implement appropriate elastic failure theories in analysis and design of structures.

2. Syllabus

- Introduction to stresses and strains, plane stress and plane strain problem, Cauchy's strain displacement relations, generalized Hook`s law dimensional analysis and theory and practice of direct and indirect model techniques. **(02 Hours)**

- Mechanical and electrical gauges, optical gauge, pneumatic and acoustical gauges, transverse sensitivity of strain gauges, temperature compensation of gauges, bonded and unbonded gauges, strain gauge rosettes. **(08 Hours)**

- Load application and its measurement using gauges and use of deflection gauge for various structural systems/elements. **(04 Hours)**

- Brittle coating techniques and its applications to know the crack patterns qualitatively of structures for various to loadings. Moire and grid techniques for patterns of cracks. **(06 Hours)**

- Introduction to holography and interferometry, two and three dimensional photo-elasticity, photo elastic coatings, analogies, ideal properties of photo-elastic materials. Diffused light and lens polariscope, plane and circular polariscope. **(06 Hours)**

- Introduction to non-destructive testing techniques like Rebound hammer method, Ultra pulse velocity test, core test etc. and its field applications. Interpretations of test results. **(06 Hours)**

- Introduction to LVDT, X-rays technique, vibration measurement and application of shake table to get required desired data of various technical parameters. **(04 Hours)**

- Theories of elastic failures like. Maximum principal stress theory, maximum principal strain theory, maximum shear stress theory, maximum strain energy theory and maximum shear strain energy theory etc., and its application in structural engineering. **(06 Hours)**

(Total Lectures: 42 hours)

3. List of Practicals

1. To determine the stress-strain behaviour of mild steel using mechanical gauge (Huggenberger) and electrical stain gauge. **(CO1)**
2. To determine the modulus of elasticity and modulus of rupture of wooden beam, concrete using mechanical gauges. **(CO1)**
3. To determine principal stresses using the polariscope. **(CO2)**
4. Demonstration and applicability of brittle coating method. **(CO3)**
5. Preparation of report of retrofitting fitting technique for RCC structures based on visual inspection by conducting site visit. **(CO4)**
6. Determine the residual compressive strength of concrete structure using non-destructive and core test. **(CO4)**
7. Demonstration of graphical representation for different theories of failure for 2-D stress system. **(CO5)**

4. Books Recommended

1. James W. Dally, William F. Riley, Experimental stress analysis, McGraw-Hill International Editions, New Delhi, Third edition, 2001.
2. L.S Srinath, M.R Raghavan, Lingaiah, G. Gargesha, B. Pant, Ramachandra, Experimental stress analysis, Pearson publication 2013.
3. U.C Jindal, Experimental stress Analysis, Pearson publication 2013.
4. Dove R C and Adams P H., "Experimental Stress Analysis and Motion Measurements", C E Merrill books, 1964.
5. Perry and Lisner "Strain Gauge Prime", Elsevier Publication, 1992.

5. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	2	3	1	2	3
CO2	1	1	2	2	3	2
CO3	2	1	3	3	3	3
CO4	3	2	3	3	3	3
CO5	2	1	3	3	3	3

Course-wise Detailed Syllabus

Semester II

AM 712 Design of Prestressed Concrete Structures

L	T	P	C
3	1	-	4

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Demonstrate the basic knowledge of theory and practice of prestressing of structural elements.
CO2	Apply different techniques of prestressing such as pretensioning, post tensioning, and other means of prestressing.
CO3	Analyse the limit state design criteria for prestressed concrete members and quantify the prestress losses as well as deflections.
CO4	Design pretension and post tensioned Flexural member and statically indeterminate prestressed structures.
CO5	Develop various types of concrete structures either by linear or circumferential prestressing

2. Syllabus

- **INTRODUCTION TO PRESTRESSED CONCRETE AND MATERIALS (7 Hours)**
  Introduction – concept of Prestressing – Advantages of Prestressing – Materials for prestressed concrete

- **ANALYSIS OF PRESTRESS AND LOSSES OF PRESTRESS (5 Hours)**
  Different Prestressing System – Analysis of prestress and bending stresses various losses of prestress – Deflection of prestressed concrete member

- **FLEXURAL STRENGTH OF PRESTRESSED CONCRETE MEMBERS (6 Hours)**
  Flexural strength of prestressed concrete members- Transfer of prestress in pretensioned members

- **ANCHORAGE ZONE STRESSES (6 Hours)**
  Anchorage zone stresses in post tensioned members- Limit state design criteria for Prestressed concrete members

- **DESIGN OF INDETERMINATE PRESTRESSED STRUCTURES (6 Hours)**
  Design of prestressed concrete sections – Design of pretension and post tensioned Flexural member statically indeterminate Prestressed Structures

- **PRESTRESSED CONCRETE PIPES AND TANKS (7 Hours)**
  Prestressed concrete pipes and tanks- Prestressed concrete slabs and grid floors

- **DESIGN OF PRESTRESSED CONCRETE STRUCTURES (5 Hours)**
  Prestressed concrete poles, pipes, sleepers, pressure vessels and pavements – Prestressed concrete Bridges.

(Total Lectures: 42 hours)

3. Books Recommended

1. Krishna Raju N., "Prestressed concrete" Tata Mc Graw Hil, new Delhi, 2006.
2. Dayaratnam P., "Prestressed concrete Structures" Oxford & IBH Publication, New Delhi, 2005.
3. Lin L.Y., "Design of prestressed concrete Structural", Asia Public House, New Delhi, 2000.
4. Leonhardt. F, "Prestressed concrete – Design & construction", Welhelm Ernst and sohn – Munich, Germany,2000.
5. Guyon. Y, "Prestressed concrete", Asia Publication, Vol I and II, Pune, 2003.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3
CO2	1	2	2	2	3	2
CO3	3	3	3	3	3	3
CO4	2	3	3	3	3	3
CO5	3	3	3	3	3	3

Course-wise Detailed Syllabus

Semester II

L	T	P	C
3	1	-	4

AM 714 Theory of Plates and Shells

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Explain the concepts of bending and membrane theory
CO2	Develop analytical methods of solution for thin plates and shells
CO3	Predict the behaviour of plates and shells under applied loading
CO4	Identify solution to complex problems using numerical techniques and tools
CO5	Demonstrate the knowledge and skills obtained to challenges in practice

2. Syllabus

- **PLATES** **(21 Hours)**
  Introduction, classification, plate equation for rectangular and circular (thin) plates, Navier's solution, Levy's solution, plates with various boundary conditions, geometrics and loading, Application to bridge decks and water tanks design. Energy method, numerical methods: finite difference, fine element method.

- **SHELLS** **(21 Hours)**
  Introduction, classification, pre-requirements, membrane theory of cylindrical shells, Bending theory of cylindrical shells, design of cylindrical shells, beam theory of cylindrical shells, north light cylindrical shells, folded plate – introduction, types, and analysis with design. Introduction to shells of double curvature, membrane theory. Development in shell design.

(Total Lectures: 42 hours)

3. Books Recommended

1. Ramaswamy G S., "Design Construction, Concrete Shell Roofs", CBS Publishers, 2005.
2. Szilard R, "Theory & Analysis of Plates" Prentice Hall, New York, 1974.
3. Timoshenko & Krieger W., "Theory of Plates and shells", Mc Graw Hill Kiga New York, International Edition, 1980.
4. Shames & Dym, "Energy & Finite Element Methods in Structural Mechanics", New Age International Publications, New York, 1991.
5. Billington, D. "Thin Shell Concrete Structures", Mc-Graw Hill Book Co., New York, 2000.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3
CO2	3	2	2	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	2	3
CO5	3	3	3	3	2	3

Course-wise Detailed Syllabus

Semester II

AM 716 Mechanics of Composite Materials

L	T	P	C
3	-	-	3

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Understand the phenomenon of composite material. Analyze the characteristics of different composite materials.
CO2	Describe the characteristics of different composites.
CO3	Analyze problem on Macro mechanical & micromechanical behavior of a lamina, lamina constitutive equations.
CO4	Understanding of typical commercial material properties, rules of mixtures.
CO5	Evaluate the lamina properties from laminate tests

2. Syllabus

- Introduction to Composite Materials Constituents, Applications Definition –Need – General Characteristics, Applications. **(4 Hours)**
- Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. **(6 Hours)**
- Micromechanical and Micromechanical behavior of a lamina, Lamina Constitutive Equations. **(4 Hours)**
- Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix, Typical Commercial material properties, Rule of Mixtures. **(4 Hours)**
- Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. **(2 Hours)**
- Micromechanical behavior of a laminate, Definition of stress and Moment Resultants, Strain Displacement relations. **(2 Hours)**
- Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations –Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. **(4 Hours)**
- Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates. Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. **(6 Hours)**

- Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies Modification of Hooke's Law due to thermal properties - Modification of Laminate Constitutive Equations. **(6 Hours)**

- Orthotropic Lamina - special Laminate Configurations – Unidirectional, Thermally Quasi-Isotropic Laminates, Delamination, Matrix Cracking, and Durability, Interlaminar stresses, Edge effects, Fatigue and fracture, Environmental effects, Introduction to design of composite structures. **(4 Hours)**

.

(Total Lectures: 42 hours)

3. Books Recommended

1. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.
2. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
3. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998.
4. Autar K. Kaw "Mechanics of Composite Materials", , 2nd ed., CRC Press, 2006
5. I. M. Daniel, O. Ishai "Engineering Mechanics of Composite Materials", Oxford University Press, 2006.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	2
CO2	3	3	2	2	1	3
CO3	2	3	3	3	2	3
CO4	3	3	2	2	1	2
CO5	3	2	3	3	2	2

Course-wise Detailed Syllabus

Semester III

L	T	P	C
-	-	-	2

AM 801 Seminar/Project Work

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Explore the literature to identify a relevant problem in structural engineering.
CO2	Assemble the literature to compose a specific problem in practice.
CO3	Prepare report and presentation to demonstrate written and verbal communication skills.
CO4	Expose the study to demonstrate the understanding of chosen problem.

2. Syllabus

- The candidate is given state of art areas to be explored a specific problem especially with field/practical applications. Sponsored research areas can also be investigated. Industry related problems, Codal specification examinations, new areas of material research, are some of the key features of the seminar. The candidate will study, complete state of art literature review and present the same before the jury. The assessment will be done based on the above mentioned aspects.

3. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	0	2	1	2	3
CO2	3	2	3	1	2	3
CO3	1	3	2	2	1	2
CO4	2	2	3	3	2	2

Course-wise Detailed Syllabus

Semester III

AM 810 Dissertation Prelims

L	T	P	C
-	-	-	8

---

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Construct a problem statement in advanced structural engineering based on a survey of pertinent literature
CO2	Devise the objective and scope based on research gap identified through critical literature review
CO3	Develop the methodology including tools and techniques to be used in alignment with the scope and objectives
CO4	Execute the theoretical framework of Experimental/Analytical/Numerical investigations
CO5	Prepare the detailed report and presentation to exhibit written and oral communication skills

2. Syllabus

- The work is assigned to the students immediately after the second semester examination. Thus, the candidate starts working on the given problem during the summer vacation prior to commencement of third semester.

- The preliminary work involved is related to a state-of-art literature review, identification of the area and finalization of the specific problem, with clearly defined title. The presentation of the preliminary-Part 1 is addressed as the 1st stage seminar of the proposed dissertation work. The candidate is expected to present the plan of action and review of the published work related to the area.

- The candidate should submit the report of their 1st Stage and a presentation about the same will be conducted thereafter in front of internal examiners.

3. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2
CO2	3	2	3	3	3	3
CO3	3	2	3	2	3	3
CO4	3	1	3	3	3	3
CO5	0	3	3	0	2	1

Course-wise Detailed Syllabus

Semester IV

AM 810 Dissertation

L	T	P	C
-	-	-	12

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Plan the investigations and compile sufficient data to meet the goals
CO2	Analyze the data by employing the appropriate technique(s) to make relevant conclusions
CO3	Develop the analytical /numerical/empirical model using advanced tools and techniques
CO4	Organize the research work in order to prepare the dissertation report according to the specified format
CO5	Defend the project work using a PowerPoint presentation that exhibits the mastery on chosen topic

2. Syllabus

- After obtaining the approval along with necessary modification from the jury, the candidate proceeds for the second stage of the dissertation work. During this presentation the candidate should submit the report of their project till work. The second stage of dissertation work, which can be termed as the core part can be carried out at any of the advanced institutions, laboratories, centre-of-excellence places, with whom prior permission is obtained through MoU. The MoU can be with the industry, laboratories, and universities, all around the world. A presentation about the same will be conducted thereafter in front of internal examiners.

- Candidates for master's degrees should write and defend a thesis. The candidate should format the thesis as per the guidelines of Institution. The student will open the oral defense with a brief presentation of his or her findings in front of external examiners. After which the members of the thesis committee will question the candidate in an order determined by the advisor. The student should be evaluated upon both:
    1) The overall quality and significance of his or her thesis, and
    2) The oral defense of his or her findings.

3. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2
CO2	3	2	3	3	3	3
CO3	3	2	3	2	3	3
CO4	3	1	3	3	3	3
CO5	0	3	3	0	2	1