RAJASTHAN TECHNICAL UNIVERSITY, KOTA

COURSE SCHEME AND SYLLABUS

M. TECH.

STRUCTURAL ENGINEERING

M. Tech. Structural Engineering
Teaching and Examination Scheme
1st Year –I Semester

SN	Category	Course Code	Course Title	Contact hrs./ week L	T	P	Marks Exam Hrs.	IA	ETE	Total	Cr
1	PCC	1MST1-01	Advanced Structural Analysis	3	0	-	3	30	70	**100**	**3**
2		1MST1-02	Structural Dynamics	3	0	-	3	30	70	**100**	**3**
3		1MST1-03	Design of Advanced Concrete Structures	3	0	-	3	30	70	**100**	**3**
4	PEC	1MST2-11	Theory and Applications of Cement Composites	3	-	-	3	30	70	**100**	**3**
		1MST2-12	Theory of Thin Plates and Shells								
		1MST2-13	Design of Prestressed Concrete Structures								
5	PCC	1MCC3-21	Research Methodology & IPR	2	-	-	3	30	70	**100**	**2**
			Sub Total	14						**500**	**14**
6	PCC	1MST1-06	Model Testing Laboratory	-	-	4	-	60	40	**100**	**2**
7	PCC	1MST1-07	Structural Design Lab	-	-	4	-	60	40	**100**	**2**
	SODECA	1MST5-00	Social Outreach Discipline & Extra Curriculum Activities	-	-					**100**	**2**
			Sub- Total							**300**	**6**
			TOTAL OF I SEMESTER					**270**	**430**	**800**	**20**

***L**: Lecture, **T**: Tutorial, **P**: Practical, **Cr**: Credits, **ETE**: End Term Exam, **IA**: Internal Assessment*

PCC: Program Core Courses

PEC: Program Elective Courses

Electives Courses (3-4Nos.) should be relevant to the chosen specialization/branch

OES: Other Emerging Subjects: Research Methodology& IPR

It is decided common for all branches.

FW: Field Work Student is required to work in the organization/industry concerned with his/her course.

AC: Audit Course It is mandatory to pass the audit course. However, credit shall not be awarded.

M. Tech. Structural Engineering
Teaching and Examination Scheme
1st Year – II Semester

SN	Category	Course Code	Course Title	Contact hrs./ week L	T	P	Marks Exam Hrs.	IA	ETE	Total	Cr
1	PCC	2MST1-01	FEM in Structural Engg.	3	-	-	3	30	70	**100**	**3**
2		2MST1-02	Advanced Solid Mechanics	3	-	-	3	30	70	**100**	**3**
3	PEC	2MST2-11	Design of Industrial Structures	3	-	-	3	30	70	**100**	**3**
		2MST2-12	Design of High-Rise Structures								
		2MST2-13	Design of Masonry Structures								
4	PEC	2MST2-14	Analytical and Numerical Methods for Structural Engg.	3	-	-	3	30	70	**100**	**3**
		2MST2-15	Advanced Steel Design								
		2MST2-16	Structural Health Monitoring								
5	MCC	2MCC3-XX	Audit Course-I	2	0	0					
			Sub Total	**12**				**120**	**280**	**400**	**12**
6	PCC	2MST1-06	Advanced Concrete Technology Lab	-	-	4	-	60	40	**100**	**2**
7	PCC	2MST1-07	Statistical and Numerical analysis lab	-	-	4	-	60	40	**100**	**2**
8	REW	2MST4-50	Mini project with Seminar	-	-	4	-	60	40	**100**	**2**
	SODECA	2MST5-00	Social Outreach Discipline & Extra Curriculum Activities	-	-	-				**100**	**2**
			Sub- Total					**180**	**120**	**400**	**8**
			TOTAL OF II SEMESTER					**300**	**400**	**800**	**20**

***L**: Lecture, **T**: Tutorial, **P**: Practical, **Cr**: Credits, **ETE**: End Term Exam, **IA**: Internal Assessment*

PCC: Program Core Courses PEC: Program Elective Courses

Electives Courses (3-4Nos.) should be relevant to the chosen specialization/branch

OES: Other Emerging Subjects: Research Methodology & IPR

It is decided common for all branches.

FW: Field Work Student is required to work in the organization/industry concerned with his/her course.

MPS: Mini Project with Seminar

AC: Audit Course It is mandatory to pass the audit course. However, credit shall not be awarded.

M. Tech. Structural Engineering

Teaching and Examination Scheme2nd Year – III Semester

SN	Category	Course		Contact hrs./week			Marks				Cr
		Code	Title	L	T	P	Exam Hrs.	IA	ETE	Total	
1	PEC	3MST2-11	Advanced Concrete Technology (MOOC)	3	0	0	3	30	70	**100**	**3**
		3MST2-12	Design of Plates and Shells								
		3MST2-13	Bridge Design and Construction Practices.								
2	MCC	3MCC3-XX	Open Elective (MOOC or Institute)	3	0	0	3	30	70	**100**	**3**
3	MCC	3MCC3-XX	Audit Course-II	2	0	0					
4	REW	3MST4-60	Dissertation phase I/ Industrial project	0	0	20	-	240	160	**400**	**10**
		TOTAL OF III SEMESTER						**300**	**300**	**600**	**16**

L*: Lecture,* ***T****: Tutorial,* ***P****: Practical,* ***Cr****: Credits,* ***ETE****: End Term Exam,* ***IA****: Internal Assessment*

PEC: Program Elective Courses **OE**: Open Elective**PSD**: Industrial Project/Seminar/Pre-Dissertation

M. Tech. Structural Engineering
Teaching and Examination Scheme
2nd Year – IV Semester

PRACTICAL & SESSIONAL											
SN	**Category**	**Course**		**Contact hrs./week**			**Marks**				**Cr**
		Code	**Title**	**L**	**T**	**P**	**Exam Hrs.**	**IA**	**ETE**	**Total**	
1	REW	4MST4-70	Dissertation phase II	0	0	32	-	360	240	**600**	**16**
		TOTAL OF IV SEMESTER				**32**		**360**	**240**	**600**	**16**

***L**: Lecture, **T**: Tutorial, **P**: Practical, **Cr**: Credits, **ETE**: End Term Exam, **IA**: Internal Assessment*
PSD: Industrial Project/Seminar/Dissertation

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year –I Sem. (Structure Engg.)

Exam Hrs:3 **1MST1-01: Advanced Structural Analysis** **Credit:3**

SN	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	**1**
2.	Static and kinematic indeterminacy, Principle of virtual work, Force-displacement Relationship and methods, element approach.	**8**
3.	**Stiffness Matrix Assembly of Structures:** Stiffness and flexibility Matrix in local and Global Coordinates, Boundary Condition Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces.	**9**
4.	**Applications to Simple Problems:** Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach.	**12**
5.	**Boundary Value Problems (BVP):** Approximate Solution of Boundary Value Problems, Modified Galerkin Method for One-Dimensional BVP, Matrix Formulation of the Modified Galerkin Method.	**10**
	Total	**40**

TEXT BOOK:

1. Matrix Analysis of Framed Structures, Weaver and Gere. CBS Publication

REFERENCE BOOKS:

1. The Finite Element Method, Lewis P. E. and WardJ. P., Addison-Wesley Publication Co.
2. Computer Methods in Structural Analysis, MeekJ. L., E and FN, Span Publication.
3. The Finite Element Method, Desai and Abel, CBS Publication.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA
Course Syllabus
M. Tech – I Year – I Sem. (Structure Engg.)

Exam Hrs:3 **1MST1-02: Structural Dynamics** **Credit:3**

S. No.	Content	Contact Hours
1.	**Introduction**: Objective, scope and outcome of the course.	1
2.	**Introduction to Dynamics of Structures**: Types of Dynamic Loads, Static vs Dynamic Analysis; Basic Concept of Vibration: Mass, Stiffness and Damping, Torsional Stiffness, Equivalent Stiffness; Mathematical Modeling: Degrees of Freedom, Continuous System, Lumped Mass Idealization; Free and Forced Vibrations; Consequences of Vibration and its Control; Simple Harmonic Motion: Vector representation of S.H.M; (1hr).	4
3.	**Free Vibrations of Undamped SDOF System;** Free Body Diagram; Formulation of Differential Equation of Motion by Newton's Law of Motion, D'Alembert's Principle and Energy Approach, Natural Frequency and Time Period of Vibration;Various methods of Solution of Differential Equation of Motion. Torsional Vibration.	4
4.	**Free Vibrations of Damped SDOF System:** Types of Damping, Formulation and Solution of Differential Equation of Motion, Characteristic Equation, Critical Damping; Critically Damped, Over Damped and Under Damped System: Characteristic of their Resulting Response, Damped Natural Frequency; Logarithmic Decrement.	6
5.	**Forced vibration (under Harmonic Excitation)**: Undamped and Underdamped SDOF System: Formulation and Solution of Differential Equation of Motion; Dynamic Magnification Factor, Frequency Ratios and Damping Factors, and Phase angles.	5
6.	**Base Excited Vibrations:** Underdamped SDOF System: Formulation and Solution of Differential Equation of Motion and its Solution; Transmissibility and vibration Isolation. Application to Rotary and Reciprocating Unbalance; Seismic Instrument: Basic Principle, Types of Seismic Instruments.	5
7.	**Two Degree of Freedom Systems**: Formulation of equations of motion. Undamped free vibrations and Principle Mode of Vibration and mode shapes: Analysis of Dynamic response, Normal co-ordinates, Uncoupled equations of motion, Orthogonal, properties of normal modes; Coordinate Coupling: Static and Dynamic Coupling.	6
8.	**Introduction to MDOF Systems**: Selection of the degrees of Freedom, Evaluation of structural property matrices; Undamped Free Vibrations; Formulation of the MDOF equations of motion, Solutions of Eigen value problem for natural frequencies; Approximate Methods of Determining Fundamental Frequencies: Basic Procedure of Stodola Method, Dunkerley's Method.	5
9.	**Introduction to Continuous Systems**: Flexural vibrations of beams: Elementary case, Derivation of governing differential equation of motion, Analysis of undamped free vibrations of beams in flexure: Natural frequencies and mode-shapes of simple beams.	4
	Total	40

TEXT BOOKS:

1. Dynamics of Structures by Clough and Penzien, McGraw Hill, New York
2. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
3. Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi.

REFERENCE BOOKS:

1. Theory of vibrations by W.T. Thomson CBS Publishers and Distributors.
2. Structural Dynamics by Roy. R. Craig John willey& fours.
3. I.S: 1893 (Part 1) - 2016, "Code of practice for Earthquake resistant design of Structures

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – I Sem. (Structure Engg.)

Exam Hrs:3 **1MST1-03: Design of Advanced Concrete Structures** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Limit State Design:** Revision of Basic Concepts of Limit State Design of Prismatic Members in Flexure, Shear & Bond. Limit State Analysis and Design of Continuous Beams using Coefficient, Reinforcement Detailing & Curtailment provisions as per Code.	3
3	**Redistribution of Moment:** Concept of Redistribution of Moments in Fixed & Two Span Continuous Beams.	3
4	**Serviceability Requirements:** Limit State of Serviceability of Beams and Slabs in Deflection. Calculation of Deflection due to Loads, Shrinkage & Creep; Calculation of Crack Width as per IS Code.	5
5.	**Flat Slabs:** Direct design method: Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns. Shear in Flat Slabs-Check for one way and two-way shears. Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip sketch showing reinforcement details.	6
6	**Yield Line Analysis:** Yield Line Analysis for slabs: Upper bound and lower bound theorems – yield line criterion – Virtual work and equilibrium methods of analysis – For square and circular slabs with simple and continuous end conditions, special aspects, introduction to Hillerborg's strip method	6
7	**Columns and Footing:**Design of Slender Columns. Analysis and Design of (i) Isolated Footing subjected to Axial Load and Moment (ii) Combined Rectangular Footing for Two Columns subjected to Axial Loads and moments. Reinforcement Detailing	5
8	**Retaining walls:**Structural behavior of retaining walls, Analysis and design of Counterfort Retaining Wall, Stability of Retaining Walls, Reinforcement Detailing.	6
9	**Ribbed Floor and Shell Roofs:** Introduction to Structural Behavior and Construction & Design Features of Ribbed floor, Shell Roofs and Stresses in Simple Semicircular Shell. **Stair Case:** Types and Planning of Staircases, Analysis and Design of Staircase spanning longitudinally on Waist slab. Reinforcement detailing.	5
	Total	40

TEXT BOOKS:

1. "Reinforced Concrete Design" S. Unnikrishna Pillai &Devdas Menon; Tata Mc. Graw-Hill Publishing Company Ltd. New Delhi 2010.
2. "Advanced Reinforced Concrete" P.C. Varghese Prentice Hall of INDIA Private Ltd. 2008.
3. "Limit State Theory and Design of Reinforced Concrete" Dr. S. R. Karve and V.L Shah. Standard Publishers, PUNE 2004.

REFERENCE BOOKS:

1. "Design of Reinforced Concrete Structures" by N.Subramanian, Oxford University Press.
2. Reinforced concrete structural elements – behaviour, Analysis and design by P. Purushotham, Tata Mc.Graw-Hill, 1994.
3. Design of concrete structures – Arthus H. Nilson, David Darwin, and Chorles W. Dolar, Tata Mc. Graw-Hill, 3rd Edition, 2005.
4. Reinforced Concrete design by KennathLeet, Tata Mc. Graw-Hill International, editions, 2nd edition, 1991.
5. "Design Reinforced Concrete Foundations" P.C. Varghese Prentice Hall of INDIA Private Ltd.
6. IS 456-2000

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – I Sem. (Structure Engg.)

1MST2-11: Theory and Applications of Cement Composites

Exam hrs:3 **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course	1
2.	**Introduction:** Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.	7
3.	**Mechanical Behavior:** Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.	10
4.	**Cement Composites:** Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON,PolymerConcretes,PreparationofReinforcement,CastingandCuring. **Application of Cement Composites:** FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behavior, Constitutive relationship, Elastic Constants.	10
5.	**Mechanical Properties of Cement Composites:** Behavior of Ferrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.	6
6.	**Analysis and Design of Cement Composite Structural Elements:**Ferrocement, SIFCON and Fiber Reinforced Concrete.	6
	Total	40

TEXT BOOKS:

1. Fibre Reinforced Cement Composites, P. N. Balaguru and S P Shah, Mc Graw Hill, 1992.

REFERENCE BOOKS:

1. Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998.
2. Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
3. New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman & Hall, 1983.
4. Fibre Reinforced Cementitious Composites- ArnonBentur, Sidney Mindees, CRC Press, 1990.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – I Sem. (Structure Engg.)

Exam Hrs:3 **1MST2-12:Theory of Thin Plates and Shells** **Credits:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Introduction:** Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, AssumptionsinShellTheory, DisplacementFieldApproximations, StressResultants,Equation of Equilibrium using Principle of Virtual Work, BoundaryConditions.	9
3	**Static Analysis of Plates**: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.	10
4.	**Circular Plates:** Analysis under Axis- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.	10
5.	**Static Analysis of Shells: Membrane Theory of Shells** - Cylindrical, Conical and Spherical Shells**.** **Shells of Revolution with Bending** R**esistance** - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels. Thermal Stresses in Plate/ Shell.	10
	Total	40

TEXT BOOKS:

1. Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.
2. Design and Construction of Concrete Shell Roofs, Ramaswamy G.S., CBS Publishers and Distributors Pvt Ltd.

REFERENCES BOOKS:

1. Stresses in Plates and Shells, UguralAnsel C., McGraw Hill.
2. Thin Elastic Shells, KrausH., John Wiley and Sons.
3. Theory of Plates, ChandrashekharaK., Universities Press.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – I Sem. (Structure Engg.)

Exam Hrs:3 1MST2-13: Design of Pre-stressed Concrete Structures Credit:3

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	**1**
2.	**Introduction to prestressed concrete:** types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions.	**6**
3.	**Statically determinate PSC beams:** design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.	**7**
4.	Transmission of prestress in pretensioned members; Anchorage zone stresses for posttensioned members. **Statically indeterminate structures -** Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.	**9**
5.	**Composite construction with precast PSC beams and cast in-situ RC slab -** Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack- width calculations	**7**
6.	Analysis and design of prestressed concrete pipes, columns with moments.	**10**
	Total	**40**

TEXT BOOKS:

1. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.

REFERENCES BOOKS:

1. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
2. Limit State Design of Prestressed Concrete, Guyan Y., Applied Science Publishers, 1972.
3. IS: 1343- Code of Practice for Prestressed Concrete, IS:456 Code of Practice Plain and Reinforced Concrete.
4. IRC: 112

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – I Sem. (Structure Engg.)

Exam Hrs:3 **1MCC3-21: Research Methodology & IPR** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	7
3.	Effective literature studies approach, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	8
4.	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	8
5.	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	8
6.	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR.	8
	Total	40

REFERENCE BOOKS:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

1MST1-06: Model Testing Lab

Lab: 4 hrs/week,

1. Verify Strain energy concept by finding displacement in a curved member apparatus.
2. Verify unsymmetrical bending concept using cantilever beam apparatus.
3. Plot influence line diagram for deflection in a simply supported beam
4. Verify Muller Breslau principal of influence line diagram in portal frame.
5. Calculate support reaction in a two hinge /three hinge Arch.
6. Response of structures and its elements against horizontal and vertical loadingevents.
7. Determine forces in a members of pinjointed truss apparatus.
8. Study buckling behavior of columns with apparatus.
9. Study behavior of a rigid joint (through an apparatus)

1MST1-07: Structural Design Lab

Lab: 4hrs/week

1. Analyse RCC framed structures by Equivalent Frame Method (EFM)
2. Analyse a typical intermediate floor of a four storeyed office multi-bay building through EFM.
3. Analyse a four storeyed multi bay (in both the directions) RCC residential /commercial framed structure for different load combinations and determination of design forces, moments etc.
4. Structural design as a RCC building for the forces and moments etcdetermined in exercise no 3 by IS Codes.
5. Reinforcement detailing of the structure designed at exercise no 4 as per IS codes.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – II Sem. (Structure Engg.)

Exam Hrs:3 2MST1-01: Finite Element Method in Structural Engineering Credit:3

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Introduction:** Concept of FEM, Applications and advantages, Steps in finite element method, Discretization, types of elements and shape functions. Review: Matrix algebra and solution of simultaneous equations. **Finite element analysis of 1-D problems**: formulation by different approaches (direct method and potential energy); Derivation of elemental equations and their assembly, solution and its postprocessing.	7
3.	Basic Principal of Structural Mechanics, Element Properties, Finite Element formulation Introduction of Ritz method and Galerkin Method.	8
4.	1-D and 2-D problems from Structural Mechanics: Bar, Plane stress and plane strain problems, Axisymmetric problems. Bending of beams, analysis of truss and frame.	8
5.	Higher order elements, Isoperimetric formulation, Serendipity and Lagrange family elements, Numerical integration, convergence Criteria.	8
6.	1-D steady state heat conduction and fluid flow: Derivation of elemental equations, Application of boundary conditions.	8
7	Brief Introduction of Eigen –Value Problems & Nonlinear Problems: Review of iterative and incremental procedure for material and geometrical nonlinearity.	
	Total	**40**

TEXT BOOKS:

1. CS KRISHNAMOORTHY, Finite Element Analysis,Tata McGraw Hill.
2. M. Rama NarshimaReddy,K.Srinivasa Reddy, Finite Element Methods in Civil Engineering.SCITECH PUBLICATION (INDIA)PVT LTD.

REFERENCE BOOKS:

1. Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
2. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
3. Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
4. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.
5. Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
6. Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – II Sem. (Structure Engg.)

Exam Hrs :3 **2MST1-02: Advanced Solid Mechanics** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course .	1
2.	**Introduction to Elasticity:** Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity. **Strain and Stress Field:** Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Hydrostatic and Deviatoric Components.	6
3.	**Equations of Elasticity:** Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems.	5
4	**Two-Dimensional Problems of Elasticity:** Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.	7
5	**Torsion of Prismatic Bars:** Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.	7
6	**Plastic Deformation:**Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, Von Mises Yield Criterion.	5
7.	**Miscellaneous Topics:** Unsymmetrical bending, beams on elastic foundation,bending of bars with initial curvature, rings hooks etc.	9
	Total	40

TEXT BOOKS:

- Theory of Elasticity, Timoshenko S. and GoodierJ. N., McGrawHill, 1961.
- Advanced Mechanics of Solids, SrinathL.S., Tata McGrawHill,2000.

REFERENCE BOOKS:

- Elasticity, Sadd M.H., Elsevier,2005.
- Engineering Solid Mechanics, RagabA.R., BayoumiS.E., CRCPress,1999.
- Computational Elasticity, AmeenM., Narosa,2005.
- Solid Mechanics, KazimiS. M. A., Tata McGrawHill,1994.
- Theory of Plasticity by J.ChakrabartyButterworth-Heinemann Publications.
- *THEORY OF ELASTICITY AND PLASTICITY by H. JANE HELENA PHI PUBLICATIONS.*

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – II Sem. (Structure Engg.)

Exam Hrs:3 **2MST2-11: Design of Industrial Structures** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Steel Gantry Girders** – Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.	6
3.	**Portal Frames –** Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures – Lightweight Structures.	7
4.	**Steel Bunkers and Silos –** Design of square bunker – Jansen's and Airy's theories – IS Code provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.	9
5.	**Chimneys –** Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.	7
6.	**Water Tanks –** Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts – **Design of pressed steel water tank –** Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation.	10
	Total	40

TEXT BOOKS:

1. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.

REFERENCE BOOKS:

1. Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009.
2. Design of Steel Structures, N Subramaniyan, Oxford Publications.
3. Limit state Design in Structural Steel by Shiyekar M.R, PHI Publications.
4. Design of Steel Structures by Dr. P.DayaratnamS.Chand Publications.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – II Sem. (Structure Engg.)

Exam Hrs:3 **2MST2-12: Design of High-Rise Structures** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	**1**
2.	Design of Framed Structures, Shear Wall.	**4**
3.	Design of transmission/ TV tower, Mast and trestles: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.	**8**
4	Analysis and Design of RC and Steel Chimney, Foundation design for varied soil strata.	**6**
5	**Tall Buildings**: Structural Concept, Configurations, various systems, Wind and Seismic loads, Dynamic approach, structural design considerations For Gravity and IS code provisions. Firefighting design provisions**.**	**10**
6	Modelling and Analysis on Structural Analysis Software.	**7**
7	Application of software in design.	**4**
	Total	**40**

TEXT BOOKS:

1. *Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.*
2. *Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers, New Delhi, 2002.*
3. *Illustrated Design of Reinforced ConcreteBuildings(GF+3storeyed), Shah V. L. &Karve S. R., Structures Publications, Pune, 2013*

REFERENCE BOOKS:

1. *Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.*
2. *Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991.*
3. *High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.*
4. *Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi*

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – II Sem. (Structure Engg.)

Exam Hrs:3 **2MST2-13: Design of Masonry Structures** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Introduction:** Historical Perspective, Masonry Materials, Masonry DesignApproaches,Overview of Load Conditions, Compression Behavior of Masonry, Masonry Wall Configurations, Distribution of LateralForces.	6
3.	**FlexuralStrength** ofReinforcedMasonryMembers:Inplane andOut-of-planeLoading. **Interactions**:StructuralWall,ColumnsandPilasters,RetainingWall,PierandFoundation.	9
4.	**Shear Strength** and Ductility ofReinforced Masonry Members.	9
5.	**PrestressedMasonry-** StabilityofWalls,CouplingofMasonryWalls,Openings,Columns, Beams.	8
6.	**Elasticand InelasticAnalysis**,ModelingTechniques,StaticPushoverAnalysisanduseof Capacity DesignSpectra.	7
	Total	40

TEXT BOOKS:

1) Brick and Reinforced Brick Structures by P Dayaratnam,P Sarah, Medtech publication, 2017.
2) Structural Masonary by K S Jagdish, IK International Publication.

REFERENCE BOOKS:

1) Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2ndEdn,
2 MasonryStructures:BehaviorandDesign,HamidAhmadA.andDrysdaleRobertG.,1994.
3) Mechanics of Masonry Structures, Editor: Maurizio Angelillo,2014.
4) Earthquake-resistant Design of Masonry Buildings,TomaeviMiha, Imperial College Press, 1999.
5) Design of Masonary Structures By A.W Hendry Sinha, Taylor and Francis Publications.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – II Sem. (Structure Engg.)

2MST2-14: Analytical and Numerical Methods for Structural Engineering

Exam Hrs:3 **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Fundamentals of Numerical Methods:** Error Analysis, Polynomial Approximations and Interpolations, Curve Fitting; Interpolation and extrapolation. Solution of Nonlinear Algebraic and Transcendental Equations	10
3.	**Elements of Matrix Algebra:** Solution of Systems of Linear Equations, Eigen Value Problems.	7
4.	**Numerical Differentiation & Integration:** Solution of Ordinary and Partial Differential Equations.	10
5.	**Finite Difference scheme and its applications.**	5
6.	**Computer Algorithms:** Numerical Solutions for Different Problems.	7
	Total	40

TEXT BOOKS:

1) Computer Oriented Numerical Methods by V Rajaraman, PHI Publications.
2) Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.
3) Numerical Methods for Engineering and Science, SaumyenGuha, Rajesh Srivastava, Oxford University Press.

REFERENCE BOOKS:

1. An Introduction to Numerical Analysis, Atkinson K.E., J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
3. Numerical Methods for Engineers by Chapra and Steven , McGraw Hill Publications.
4. Applied Numerical Analysis, Curtis F Gerald, Patrick O. Wheatley, Pearson, 2008.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – II Sem. (Structure Engg.)

Exam Hrs:3 **2MST2-15: Advanced Steel Design** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Properties of Steel:** Mechanical Properties, Hysteresis, Ductility. **Hot Rolled Sections:** compactness and non-compactness, slenderness, residual stresses.	6
3.	**Design of Steel Structures**: Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift. **Stability of Beams:** Local Buckling of Compression Flange &Web, Lateral Torsional Buckling.	7
4.	**Stability of Columns:** Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis.	9
5.	**Method of Designs:** Allowable Stress Design, Plastic Design, Load and Resistance Factor Design; **Strength Criteria:** Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor, Effective Length, PM Interaction, Biaxial Bending, Joint Panel Zones**.**	7
6.	**Drift Criteria:**P-Δ Effect, Deformation Based Design.	10
7.	**Connections:** Welded, Bolted, Beam Column joint Small Moment resistant, Column Foundation, Splices.	
	Total	40

TEXT BOOKS:

1. Limit state Design in Structural Steel by Shiyekar M.R PHI Publications.
2. IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
3. Teaching Learning Material From Insdag .http://www.steel-insdag.orgpdf.

REFERENCE BOOKS:

1. Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
2. Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
3. The Steel Skeleton- Vol. II, Plastic Behavior and Design - Baker J. F., Horne M. R., Heyman J., ELBS.
4. Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.
5. SP – 6 - Handbook ofStructural Steel Detailing, BIS,1987

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – I Year – II Sem. (Structure Engg.)

Exam Hrs:3 **2MST2-16: Structural Health Monitoring** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Structural Health:** FactorsaffectingHealthofStructures,CausesofDistress,RegularMaintenance. **Structural Health Monitoring:** Concepts, Various Measures, Structural Safetyin Alteration.	6
3.	**Structural Audit:** Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHMProcedures.	8
4.	**Static Field Testing:** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	9
5.	**Dynamic Field Testing:** Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	7
6.	**Introduction to Repairs and Rehabilitations of Structures:** Case Studies (Site Visits), piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.	9
	Total	40

TEXT BOOKS:

1. Repair and Rehabilitation of concrete Structures by Modi,PoonamI.patel,Chirag N.PHI Publication.
2. Concrete Structures Repair, Rehabilitation and Rettrofitting by J.Bhattacharjee CBS Publication.

REFERENCE BOOKS:

1. StructuralHealth Monitoring, DanielBalageas, ClausPeterFritzen, AlfredoGüemes,John Wiley and Sons,2006.
2. HealthMonitoringofStructuralMaterialsandComponentsMethodswithApplications, Douglas E Adams, John Wiley and Sons,2007.
3. StructuralHealthMonitoringandIntelligentInfrastructure, Vol1,J.P.Ou,H.LiandZ.D.Duan, Taylor and Francis Group, London, UK,2006.
4. StructuralHealthMonitoringwithWaferActiveSensors,VictorGiurglutiu,AcademicPressInc, 2007.

2MST1-06: Advanced Concrete Lab

List of Experiments/Assignments:

1. Determination of bond strength of specimens with M25 Grade and M50 Grade concrete.
2. Preparation of M40 Grade pumpable concrete with superplasticizer and supplementary cementitious materials
3. Preparation of M60 Grade self- compacting concrete and testing it for properties in fresh and hardened states.
4. Determinestress-straincurveof highstrengthconcrete specimens (M60 or higher grade).
5. Determine correlationbetweencubestrength,cylinder strength, split tensile strength and modulus ofrupture with normal strength concrete and high strength concrete mixes
6. Non-Destructive testing of existingconcrete members through rebound hammer, Ultrasonic pulse velocity meter, resistivity meter, carbonation test and core test.
7. Behavior of Reinforced Concrete Beam specimen- measurement of strains at various levels through LVDTs, strain Gages- determination of moment curvature relationship

TEXT BOOKS:

1. Concrete Technology, Shetty M. S., S. Chand and Co.,2006.

REFERENCE BOOKS:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall,2012.
2. Reinforced Concrete Structures, R.Park And T.Paulay Willey &Sons , INC.

2MST1-07: STATISTICAL AND NUMERICAL ANALYSIS LAB

1. Newton’s forward interpolation method
2. Newton’s backward interpolation method
3. Lagrange’s interpolation method
4. Newton Raphson method
5. Solution of ODE by Runge-Kutta method
6. Calculation of eigen values and eigen vector method
7. Analysis of variance
8. Linear regression analysis
9. Multiple regression analysis

STRUCTURAL ENGINEERING

2MST4-50: MINI PROJECT WITH SEMINAR

Student is required to work on mini project concerned with his/her and also deliver a seminar of the same.

S No.	Some suggested topics are:
1	Analysis and design a G + 5 Building with the proper Detailed Drawings.
2	Analysis and design a G + 7 Structure with the different lateral load resisting systems.
3	Present Live observations on site construction and safety.
4	Repair and rehabilitation report over the old monuments of the city.
5	Condition Assessment of reinforced Concrete high-level Bridges in your city and Recordation's for Rehabilitation and strengthening
6	Condition Assessment of Steel high level Bridges in your city and Recordation's for Rehabilitation and strengthening
7.	Study of Ready-Mix Concrete plants in your city and preparation of comprehensive reports.

Note: *The student can take real time problem, collect data, analyze and present in a seminar. Latest developments in the area of Structural Engineering can be studied from literature and presented in the form of seminar.*

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – II Year – III Sem. (Structure Engg.)

Exam Hrs:3 **2MST5-00: Design of Plates and Shells** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	**1**
2.	Prismatic folded Plate Systems: analysis and design of RCC folded plate roofs. Introducing to stability of plates and stiffened plates	**5**
3.	Shell behaviour, shell surfaces and characteristics, equilibrium equations in curvilinear co-ordinates. Stress-strain and force displacement relations. Membrane analysis of shells of revolution and cylindrical shells under different loads. Shallow shells, membrane solution of elliptic paraboloids and hyperboloids. Solution of some typical problems.	**10**
4.	Approximate Solutions, Analysis and Design of Cylindrical Shells with and without edge beams	**10**
5.	Approximate Design methods for Doubly Curved Shells, HYPAR shells, Helicoids etc	**7**
6.	Structural design and detailing of various types of RCC shell roofs and folded plates through software	**7**
	Total	**40**

TEXT BOOKS:

1. DesignandConstructionof Concrete ShellRoofs, RamaswamyG.S.,,2005.
2. DesignofReinforcedConcreteShells&Folded Plate, VargheseP.C., PHI.
3. Advanced Reinforced Concrete Design, N Krishna Raju, CBS Publishers and Distributors

REFERENCE BOOKS:

1. Theory of Platesand Shells,TimoshenkoandWoinowsky-KriegerS.,TataMcGrawHill Edition,2010.
2. DesignofPlateandShellStructures, Jawad MaanH.,Springer Science.

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – II Year – III Sem. (Structure Engg.)

Exam Hrs:3 3MST2-11: ADVANCED CONCRETE TECHNOLOGY Credit:3

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Concrete containing supplementary cementitious materials:** Specifications of fly ash, silica fume and GGBFS for use in concrete, reaction mechanism, properties of fresh and hardened concrete.	6
3	**Microstructure of Concrete:** Basics, Scanning Electron Microscopy, Applications of EDX with SEM, TEM	3
4	**Concretes of Today and Trends:** Characteristics and detail understanding of mix proportioning, properties and placement of RMC, Self-compacting concrete, Architectural concrete with materials, admixtures, applications and properties in fresh and hardened concrete.	9
5	**3D Concrete Printing**: 3 D printing in construction, extrusion based 3D concrete printing, powder based 3 D concrete printing, building applications, concrete mixtures for additive construction, concrete formwork for 3D printing, case studies of applications (in Europe)	6
6	**Durability of concrete:** Carbonation, chloride ingress, corrosion, sulphate attack, freezing and thawing: Factors affecting, effects, mechanisms, Corrosion mapping, prevention and control.	10
7	**Creep and Shrinkage**: Factors affecting, effects, mechanisms, control etc.	5
	Total	40

TEXT BOOKS:

1) A.M. Neville, "Properties of Concrete", Pearson Education, 1995

REFERENCE BOOKS:

1) 3D Concrete Printing Technology: Construction and Building Applications, Jay G. Sanjayan, Ali Nazari, BehzadNematollahi, Butterworth- Heinemann (Elsevier).
2) A.M. Neville & J.J. Brooks, "Concrete Technology", Addison- Wesley, 1999
3) P.K. Mehta & P.J.M. Monterio, "Concrete and its Microstructure", ICI, 1999
4) ACI Manual of Concrete practice.
5) Handbook of Analytical Techniques in Concrete Science and Technology by V. S Ramachandran and James J.Beaudoin.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – II Year – III Sem. (Structure Engg.)

Exam Hrs:3 **3MST2-12: Design of Plates and Shells** **Credit:3**

Sr/No.	Content	Contact Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	**1**
2.	Prismatic folded Plate Systems: analysis and design of RCC folded plate roofs. Introducing to stability of plates and stiffened plates	**5**
3.	Shell behaviour, shell surfaces and characteristics, equilibrium equations in curvilinear co-ordinates. Stress-strain and force displacement relations. Membrane analysis of shells of revolution and cylindrical shells under different loads. Shallow shells, membrane solution of elliptic paraboloids and hyperboloids. Solution of some typical problems.	**10**
4.	Approximate Solutions, Analysis and Design of Cylindrical Shells with and without edge beams	**10**
5.	Approximate Design methods for Doubly Curved Shells, HYPAR shells, Helicoids etc	**7**
6.	Structural design and detailing of various types of RCC shell roofs and folded plates through software	**7**
	Total	**40**

TEXT BOOKS:

1. Designand Construction of Concrete Shell Roofs, RamaswamyG.S.,,2005.
2. Design of Reinforced Concrete Shells & Folded Plate, Varghese P.C., PHI.
3. Advanced Reinforced Concrete Design, N Krishna Raju, CBS Publishers and Distributors

REFERENCE BOOKS:

1. Theory ofPlatesandShells,TimoshenkoandWoinowsky-KriegerS.,TataMcGrawHill Edition,2010.
2. Design of Plateand Shel lStructures, Jawad MaanH., Springer Science.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Course Syllabus

M. Tech – II Year – III Sem. (Structure Engg.)

Exam Hrs:3 **3MST2-13: Bridge Design and Construction Practice** **Credit:3**

Sr/No.	Content	Hours
1.	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2.	**Introduction –** Classification and components of bridges– layout and planning. **Structural forms of RC bridge decks** –Analysis of slab decks, beam and slab decks, cellular decks, design.	6
3.	**Standard specifications for Bridges** – IRC loadings for road bridges – design of RC slab, skew slab and box culverts. Design of T beam bridges – balanced cantilever bridges – rigid frame bridges – Arch bridges – bow string girder bridges, fly overs.	8
4.	Introduction to long span bridges: cable stayed bridges and suspension bridges, instability in bridges.	9
5.	**Forces on Piers and Abutments** – Design of piers and abutments – types of wing walls, Special provisions for forces on abutments in case of integral bridges, relevant design features, types of bearings – design of bearings for conventional types and modern bridges.	8
6.	**Integral bridges:** Introduction with case studies of such bridges constructed in south Asia after 2000.	4
	Construction practice of RC bridges Including Form Traveler.	4
	Total	40

TEXT BOOKS:

1. N.Krishna Raju, Design of bridges, Oxford & IBH publishing Co. Ltd., New Delhi.

REFERENCE BOOKS:

1.E.C. Hambly, Bridge deck behaviour, Chapman and Hall, London
2. E.J. O'Brien and D.L. Keogh, Bridge deck analysis, E& FN Spon, New York
3. D.Johnson Victor, Essentials of bridge engineering, Oxford & IBH publishing Co. Ltd., New Delhi.
4. Jaikrishna and O. P Jain, Plain and reinforced concrete-vol.II, NemChnand&Bros,Roorkee.
5. IRC: 5, Standard specifications and code of practice for road bridges, Sections I to V, Indian Roads Congress, New Delhi.
6. Indian railway standard code of practice for the design of steel or wrought iron bridge carrying rail, road or pedestrian traffic, Govt. of India, Ministry of Railways, 2000.
7. IS: 800-2007.