School of Engineering

Sri Satya Sai University of Technology and Medical Sciences, Sehore

Outcome Based Curriculum for

Post graduate Degree courses in Engineering & Technology

Department of Civil Engineering

Vision:

To be an excellent center for imparting quality higher education **in** Research work for a constantly changing societal needs with credibility, integrity and ethical standards.

Mission:

- Accomplish excellence in curricular, co-curricular activities with a committed faculty through teaching and research which creates technically competent and dedicated to serve their surroundings with pride.

Programme Educational Objectives:(POs)

PEO1: To expose the graduate students to advanced Structural Analysis, Structural Dynamics, allied theory in elasticity and plasticity, FEM etc.

PEO2: To impart training to graduate students in behavior and design of Advanced RC structures, behavior and design of Advanced Steel structure, latest procedures in earthquake resistant design practices and earthquake resistant design philosophies.

PEO3: To expose the graduate students to latest design codes, current national and international scenario on Structural Engineering and to motivate them in interdisciplinary involvement in problems related to Structural Design.

POs of the Programme: M.TECH. (**STRUCTURAL DESIGN**)

List of Program Outcomes (POs) of P.G. program in Structural Engineering:

PO-01: Scholarship of knowledge: Analyze, design, plan and research structural components and structural systems.

PO-02: Critical thinking: To achieve design goals and ensure the safety and comfort of users and occupants.

PO-03: Problem solving: Calculating the loads and the stresses acting on the building, analysis for the loads, design of sections of structures to sustain the loads, selection of materials, analysis of structures.

PO-04: Research skill: Site investigation, the structural engineers are involved in checking the condition of the soil for the construction of the project. kind of treatment required for the soil, testing the soil, develop the design ideas and detail.

PO-05: Usage of modern tools: Identify and analyze of structures by the software like ETABS, STAAD, SAP etc. Creating of models of complex structural engineering activities.

PO-06: Communication: Develop the design ideas and detail, the coordinate and consult other members like the site engineers, other design engineers, geotechnical engineers, landscape architects, architects, project managers etc.

PO-07: Project management and finance: Usually work as part of a team or as team leaders, therefore they need advanced soft skills, such as problem solving and planning skills as well. Manage projects in multidisciplinary environments.

PO-08: Lifelong learning: Apply the available solutions in physical environments and therefore need to be able to innovate, to find new ways of solving situations in a safe and efficient manner, which involves a great deal of creative thinking.

PO-09: Ethical practices and social responsibility: Technical skills to create, improve, and maintain "beautiful national land," "safe and comfortable livelihood," and "prosperous society".

PO-10: Independent and reflective learning: Structural engineers are gained through years of experience and some standard skills, more of safety issues, Proper knowledge of the National codes of the area.

PO-11: Individual and team work: One of the main duties of a licensed engineer is to monitor and evaluate the progress of work completed at a jobsite, and making sure staff are in compliance with design documents, project plans, and other rules and regulations.

PO-12: Conduct investigations of complex problems: Problems involve one or more of: design; planning; investigation and problem resolution; improvement of materials, components, systems or processes; engineering operations; project management; research, development and commercialization.

Program Specific Outcomes (PSOs) :

Students will be able to:

- ✓ To expose the graduate students to advanced courses in Analysis, and Design of RC, PSC and Steel structures as per the latest design codes, current national and international scenario on Structural Engineering.
- ✓ To motivate the graduate students to address the societal needs by interdisciplinary approach through advanced courses such as Finite Element Analysis, Plates & Shell structures, Structural Dynamics, Soil Dynamics, and allied courses.
- ✓ To enrich the graduate students to get hands on training on latest equipment / software to be industry ready / pursue advanced research.

POs and PSOs Mapping

Every course leads to some outcomes. All the courses must cover the stated list of PO/PSO outcomes. One way of verifying this to prepare a match matrix as shown below. In the table below * could also be a number- typically in (*) indicating level of attainment.

Semester wise PO's and SPO's Mapping

Semester	Name of the Courses/POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
		Scholarship of knowledge	Critical thinking	Problem solving	Research skill	Usage of modern tools	Communication	Project management and finance	Lifelong learning	Ethical practices and social responsibility	Independent and reflective learning	Individual and team work	Conduct investigations of complex problems			
Semester-Ist	Advanced Mathematics		*	*												
	Theory Of Elasticity And Plasticity	*	*	*							*					
	Optimization Techniques in Structural	*	*	*	*		*	*						*		
	Matrix Analysis of Structures	*		*	*		*		*		*		*			
	Advanced Concrete Technology	*	*	*			*	*	*	*	*				*	
	Lab -1 : CAD	*				*		*	*			*				*
	Lab -2 : Advanced Concrete Laboratory	*	*	*			*	*	*							*
Semester-IInd	Structural Dynamics	*	*	*			*			*	*					
	FEM in Structural Engineering	*	*	*	*	*		*	*		*		*	*	*	
	Design of steel Structures	*	*	*	*	*		*	*		*		*			
	Experimental Stress Analysis	*	*	*	*		*								*	
	Theory of Plates and Shells	*		*						*					*	
	Lab -1:structural engineering lab	*	*	*		*	*		*						*	
	Lab -2 Structural Software lab	*	*	*	*	*	*		*		*	*				*
Semester-IIIrd	Elective I A) Advanced Foundation Engineering	*					*						*			
	B) Design of Earth Quake Resistant Structures	*				*					*			*	*	
	C) Design & Analysis of Steel Structures	*		*		*								*		
	D) Building Structure & Construction Management						*	*	*						*	
	Elective II A) Design of Offshore Structures	*					*						*		*	
	B) Fracture Mechanism					*								*		
	C) Low cost Housing Techniques			*	*									*		
	D) Design of Bridges			*		*		*						*	*	
	Seminar						*									
	Dissertation part-I (Literature Review/problem formulation/Synopsis)	*	*		*	*	*	*	*			*	*		*	*

Semester-IVth	Dissertaion Part-II	*	*		*	*	*	*	*			*	*			

- **<u>Structure of Programme</u>:** To fulfill the need of development of all the POs/ GAs, as per above mapping, the following semester wise programme structure are as under.

<u>[L= Lecture, T = Tutorials, P = Practical's & C = Credits]</u>

Total Credits*= 104

***Definition of Credit:**

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (Lab)/week	1 Credit

- **Scheme of Exanimation (Civil Engineering) Academic Year 2019-20**
  I SEMESTER

S.No.	Subject Code	Subject Name	Periods per week			Credits	Maximum marks (Theory Slot)			Maximum Marks (Practical Slot)		Total Marks
			L	T	P		End Sem. Exam	Tests (Two)	Assignments/ Quiz	End Sem. Practical / Viva	Practical Record/ assignment/Quiz/Presentation	
1.	MTSD 101	Advanced Mathematics	3	1	-	4	70	20	10	-	-	100
2.	MTSD 102	Theory Of Elasticity And Plasticity	3	1	-	4	70	20	10	-	-	100
3.	MTSD 103	Optimization Techniques in Structural	3	1	-	4	70	20	10	-	-	100
4.	MTSD 104	Matrix Analysis of Structures	3	1	-	4	70	20	10	-	-	100
5.	MTSD 105	Advanced Concrete Technology	3	1	-	4	70	20	10	-	-	100
6.	MTSD 106	Lab -1 : CAD	-	-	6	6	-	-	-	90	60	150
7.	MTSD 107	Lab -2 : Advanced Concrete Laboratory	-	-	6	6	-	-	-	90	60	150
		Total	15	5	12	32	350	100	50	180	120	800

L: Lecture- T: Tutorial- P: Practical

II SEMESTER

S.No.	Subject Code	Subject Name	Periods per week			Credits	Maximum marks (Theory Slot)			Maximum Marks (Practical Slot)		Total Marks
			L	T	P		End Sem. Exam	Tests (Two)	Assignments/ Quiz	End Sem. Practical / Viva	Practical Record/ assignment/Quiz/Presentation	
1.	MTSD-201	Structural Dynamics	3	1	-	4	70	20	10	-	-	100
2.	MTSD-202	FEM in Structural Engineering	3	1	-	4	70	20	10	-	-	100
3.	MTSD-203	Prestressed concrete	3	1	-	4	70	20	10	-	-	100
4.	MTSD-204	Experimental Stress Analysis	3	1	-	4	70	20	10	-	-	100
5.	MTSD-205	Theory of Plates and Shells	3	1	-	4	70	20	10	-	-	100
6.	MTSD-206	Lab -1:structural engineering lab	-	-	6	6	-	-	-	90	60	150
7.	MTSD-207	Lab -2 Structural Software lab	-	-	6	6	-	-	-	90	60	150
		Total	15	5	12	32	350	100	50	180	120	800

L: Lecture- T: Tutorial- P: Practical

III SEMESTER

S.No.	Subject Code	Subject Name	Periods per week			Credits	Maximum marks (Theory Slot)			Maximum Marks (Practical Slot)		Total Marks
			L	T	P		End Sem. Exam	Tests (Two)	Assignments/ Quiz	End Sem. Practical / Viva	Practical Record/ assignment/Quiz/Presentation	
1.	MTSD-301	Elective I	3	1	-	4	70	20	10	-	-	100
2.	MTSD-302	Elective II	3	1	-	4	70	20	10	-	-	100
3.	MTSD-303	Seminar	-	-	4	4	-	-	-	-	100	100
4.	MTSD-304	Dissertation part-I (Literature Review/problem formulation/Synopsis)	-	-	8	8	-	-	-	120	80	200
		Total	6	2	12	20	350	140	40	120	180	500

L: Lecture- T: Tutorial- P: Practical

Elective-I (MTSD-301)

A) Advanced Foundation Engineering

B) Design of Earth Quake Resistant Structures

C) Design & Analysis of Steel Structures

D) Building Structure & Construction Management

Elective –II (MTSD-302)

A) Design of Offshore Structures

B) Fracture Mechanism

C) Low cost Housing Techniques

D) Design of Bridges

IV SEMESTER

S.No.	Subject Code	Subject Name	Periods per week			Credits	Maximum marks (Theory Slot)			Maximum Marks (Practical Slot)		Total Marks
			L	T	P		End Sem. Exam	Tests (Two)	Assignments/ Quiz	End Sem. Practical / Viva	Practical Record/ assignment/Quiz/Presentation	
1.	MTSD-401	Dissertaion Part-II	-	-	20	20	-	-	-	300	200	500
		Total	-	-	20	20	-	-	-	300	200	500

L: Lecture- T: Tutorial- P: Practical

Course Content

I SEMESTER

Advanced Mathematics
MTSD 101

MTSD 101	Advanced Mathematics	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-
- To familiarize the students in the field of differential equations.
- To enable them to solve boundary value problems associated with engineering applications using transform methods.
- To expose the students to the concepts of calculus of variations.
- To introduce conformal mappings and their applications to fluid flows and heat flows.
- To give the students a complete picture of tensor analysis.

Unit 1 : **12 Hr**
Partial Differential Equation: Solution of Partial Differential Equation (PDE) by separation of variable method, Numerical solution of PDE (Laplace, Poisson's, Parabola) using finite difference Methods.

Unit 2 : **13 Hr**
Matrices And Linear System Of Equations: Solution of linear simultaneous equations by Gaussian elimination and its modification, Crout's triangularization method, Iterative methods-Jacobins method, Gauss-Seidal method, Determination of Eigen values by iteration.

Unit 3 : **15 Hr**
Calculus Of Variations: Euler-Lagrange's differential equation, The Brachistochrone problems and other applications. Isoperimetric problem, Hamilton's Principle and Lagrange's Equation, Rayleigh-Ritz method, Galerkin method.

Unit 4 : **12 Hr**
Fuzzy Logic: Operations of fuzzy sets, fuzzy arithmetic & relations, fuzzy relation equations, fuzzy logics. MATLAB introduction, programming in MATLAB scripts, functions and their application.

Unit 5 : **10 Hr**
Reliability: Introduction and definition of reliability, derivation of reliability functions, Failure rate, Hazard rate, mean time t future & their relations, concepts of fault tolerant analysis.

Outcomes:
On successful completion of the course, the students will be able to
- develop the mathematical methods of applied mathematics and mathematical physics
- solve boundary value problems using integral transform methods
- apply the concepts of calculus of variations in solving various boundary value problems
- apply conformal mappings in fluid flows and heat flow problems
- familiarize with the concepts of tensor analysis.

Reference Books:

1. Higher Engineering Mathematics - by Dr. B.S. Grewal; Khanna Publishers
2. Calculus of Variations - by Elsgole; Addison Wesley.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Introductory Methods of Numerical Analysis by S.S. Shastry,
5. Calculus of Variations - by Galfand & Fomin; Prentice Hall.
6. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
7. Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.
8. Numerical Solution of Differential Equation by M. K. Jain
9. Numerical Mathematical Analysis By James B. Scarborogh
10. Fuzzy Logic in Engineering by T. J. Ross
11. Fuzzy Sets Theory & its Applications by H. J. Zimmersoms

Theories of Elasticity and Plasticity
MTSD 102

MTSD 102	Theory Of Elasticity And Plasticity	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-

- To develop the ability to use the principles of theory of elasticity in engineering problems and to introduce theoretical fundamentals of theory of plasticity

UNIT-I **12 Hr**

Introduction: Elasticity - notation for forces and stresses - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - plane stress - plane strain - differential equations of equilibrium - boundary conditions - compatibility equations - stress function - boundary condition.

UNIT II : **15 Hr**

Two dimensional problems in rectangular coordinates - solution by polynomials - SaintVenant's principle - determination of displacements - bending of simple beams - application of corier series for two dimensional problems - gravity loading. Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions - simple symmetric and asymmetric problems - general solution of two- dimensional problem in polar coordinates - application of general solution in polar coordinates.

UNIT III. **13 Hr**

Analysis of stress and strain in three dimensions - principal stresses - stress ellipsoid – director surface - determination of principal stresses - max shear stresses – homogeneous deformation – principal axes of strain rotation. General Theorems: Differential equations of equilibrium - conditions of compatibility - determination of displacement - equations of equilibrium in terms of displacements - principle of super position - uniqueness of solution - the reciprocal theorem.

UNIT IV. **12 Hr**

Torsion of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections – other elementary solution - membrane analogy - torsion of rectangular bars - solution of torsion problems by energy method - use of soap films in solving torsion problems - hydro dynamical analogies - torsion of shafts, tubes , bars etc. Bending of Prismatic Bars: Stress function - bending of cantilever - circular cross section - elliptical cross section - rectangular cross section - bending problems by soap film method - displacements.

UNIT V. **7 Hr**

Theory of Plasticity: Introduction - concepts and assumptions - yield criterions.

Outcomes:

On completion of this course, the student is expected to be able to

- Derive and write the fundamental equations of elasticity describing the linear behavior of element and develop constitutive models based on material behavior
- Demonstrate the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems
- Solve torsion problems in circular and non-circular cross-sections
- Analyse beams resting on elastic foundations
- Solve analytically the simple boundary value problems with elasto-plastic and strain hardening properties

REFERENCES

1. Theory of Elasticity by Timeshanko, McGrawhill Publications.
2. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.
3. Theory of Elasticity by Y.C.Fung.
4. Theory of Elasticity by Gurucharan Singh.

Optimization Techniques in Structure
MTSD : 103

MTSD 103	Optimization Techniques in Structural	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-

- To study the optimization methodologies applied to structural engineering.

UNIT I **11 Hr**
Introduction to Optimization: Introduction - Historical developments - Engineering applications of Optimization - Statement of an Optimization problem - Classification of Optimization problems - Optimization Techniques. Optimization by calculus: Introduction - Unconstrained functions of a single variable - Problems involving simple constraints - Unconstrained functions of several variables - treatment of equality constraints - Extension to multiple equality constraints - Optimization with inequality constraints - The generalized NewtonRaphson method.

UNIT II **13 Hr**
Linear Programming: Introduction - Applications of linear programming - standard form of a linear programming problem - Geometry of linear programming problems - Definitions and theorems - Solution of a system of Linear simultaneous equations - Pivotal reduction of a general system of equations - Motivation of the Simplex Method - Simplex Algorithm - Two phases of the simplex method. non-Linear Programming: Introduction - Unimodal Function - Unrestricted search - Exhaustive search - Dichotomous search - Interval Halving method - Fibonacci method - Golden section method - Comparison of elimination methods - Unconstrained optimization techniques - Direct search methods - Random search methos - grid search method - Univariate method - Powell's method - Simplex method - Indirect search methods - Gradient of a function - Steepest descent method - Conjugate gradient - Newton's method.

UNIT III **12 Hr**
Dynamic Programming: Introduction - Multistage decision processes - concept of sub-optimization and the principle of optimality - computational procedure in dynamic programming - example illustrating the Calculus method of solution - example illustrating the Tabular of solution - conversion of a final value problem into an initial value problem - continuous dynamic programming - Additional applications.

UNIT IV **12 Hr**
Network Analysis: Introduction - Elementary graph theory -Network variables and problem types Minimum-cost route - Network capacity problems - Modification of the directional sense of the network.

UNIT V **10 Hr**
Application of Optimization techniques to trusses, Beams and Frames

Outcomes:
On completion of the course, the student is expected to be able to
- Apply the knowledge of engineering fundamentals to formulate and solve the engineering problems by classical optimization techniques.
- Identify, formulate and solve engineering problems by linear and non-linear programming.
- Analyse the problem and reducing G.P.P to a set of simultaneous equations.
- Apply the Engineering knowledge to understand the concept of dynamic programming.
- Design various structural elements with minimum weight.

REFERENCES
1. Optimization: Theory and Applications by S.S.Rao.
2. Numerical Optimization Techniques for Engineering Design with applications by G.N.Vanderplaats.
3. Elements of Structural Optimization by R.T.Haftka and Z.Gurdal.
4. Optimum Structural Design by U.Kirsch.
5. Optimum Design of Structures by K.I.Majid.
6. Introduction to Optimum Design by J.S.Arora.

Matrix Analysis of Structures
MTSD 104

MTSD 104	Matrix Analysis of Structures	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-

• The main objective is to expand the student knowledge of the stiffness and flexibility methods studied in the basic structural analysis courses. This course is also expected to enable a good understanding of how standard software packages and students will be able to implement the method developing their own computer program to analyze structures.

Unit I : **12 Hr**

Introduction of matrix methods of analysis – Static Indeterminacy and kinematic indeterminacy – Degree of freedom co-ordinate system – Structure idealization stiffness and flexibility matrices – Suitability. Element stiffness matrix for truss element, beam element and Torsional element- Element force - displacement equations Element flexibility matrix – Truss, Beam, frame and Torsional element – force Displacement equations.

Unit II : **10 Hr**

Flexibility method – Strain energy and member forces – Deformation of a Structure Compatibility condition – Analysis of plane pin – jointed truss – continuous beams.

Unit III : **12 Hr**

Stiffness method – member and global stiffness equation – coordinate transformation and global assembly – structure stiffness matrix equation – analysis of simple pin jointed trusses – continuous beams – rigid jointed plane frames Direct stiffness method for continuous beams and simple frames.

Stiffness method – development of grid elemental stiffness matrix – coordinate transformation. Examples of grid problems – tapered and curved beams – idealizing the beam stiffness solutions – curved beam element stiffness matrix.

Unit IV : **12 Hr**

Additional topics in stiffness methods – discussion of band width – semi band width – static condensation – sub structuring – inertial and thermal stresses- Beams on elastic foundation by stiffness method. Multi-storied frames – shear walls necessity – structural behavior of large frames with and with out shear wall – approximate methods of analysis of shear walls – tall structures – limitation of rigid frames with and without shear walls Different types of very tall frames.

Unit V : **10 Hr**

Space frames – Analysis of in filled frames in tall building – Secondary effects in the analysis of tall building - effects of axial deformations – effect of shearing forces in the analysis of shear wall.

Outcomes:

• The student after undergoing this course will be able to:
• To understand analysis of structures and adopt an appropriate structural analysis technique .
• Determine response of structures by classical, iterative and matrix methods

REFERENCES:

1. Matrix analysis of structures- Robert E Sennet- Prentice Hall- Englewood cliffs-New Jercy
2. Advanced structural analysis-Dr. P. Dayaratnam- Tata McGraw hill publishing company limited.
3. Indeterminate Structural analysis- C K Wang
4. Matrix methods of structural Analysis – Dr. A.S. Meghre & S.K. Deshmukh – Charotar publishing hour.
5. Analysis of tall buildings by force – displacement – Method M.Smolira – Mc. Graw Hill.
6. Foundation Analysis and design – J.E. Bowls.

Advanced Concrete Technology

MTSD 105

MTSD 105	Advanced Concrete Technology	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:
•To study the properties of concrete making materials, tests, mix design, special concretes and various methods for making concrete.

UNIT-I **11 Hr**
Concrete Making Materials : Cement – Bogue's Compounds – Hydration Process – Types of Cement – Aggregates – Gradation Charts – Combined Aggregate – Alkali Silica Reaction – Admixtures – Chemical and Mineral Admixtures.

UNIT-II **13 Hr**
Fresh And Hardened Concrete: Fresh Concrete – workability tests on Concrete – Setting Times of Fresh Concrete – Segregation and bleeding. Hardened Concrete: Abrams Law, Gel space ratio, Maturity concept – Stress strain Behaviour – Creep and Shrinkage – Durability of Concrete – Non Destructive Testing of Concrete.

UNIT – III **12 Hr**
High Strength Concrete – Microstructure – Manufacturing and Properties – Design of HSC Using Entroy Shaklok method – Ultra High Strength Concrete. High Performance Concrete – Requirements and Properties of High Performance Concrete – Design Considerations

UNIT – IV **13 Hr**
Special Concretes: Self Compacting concrete, Polymer Concrete, Fibre Reinforced Concrete – Reactive Powder Concrete – Bacterial Concrete - Requirements and Guidelines – Advantages and Applications. Concrete Mix Design: Quality Control – Quality Assurance – Quality Audit - Mix Design Method – BIS Method – DOE Method – Light Weight Concrete, Self Compacting Concrete.

UNIT – V **10 Hr**
Form work – materials – structural requirements – form work systems – connections – specifications – design of form work – shores – removal of forms - shores – reshoring – failure of form work.

Outcomes:
On completion of the course, the student is expected to be able to
• Develop knowledge on various materials needed for concrete manufacture
• Apply the rules to do mix designs for concrete by various methods
• Develop the methods of manufacturing of concrete.
• Explain about various special concrete
• Explain various tests on fresh and hardened concrete.

REFERENCES:
1. Special Structural concretes by Rafat Siddique, Galgotia Publications 2000.
2. Design of Concrete Mixes by N.Krishna Raju, CBS Publications, 2000.
3. Concrete: Micro Structure by P.K.Mehta, ICI, Chennai.
4. Properties of Concrete by A.M.Neville, ELBS publications Oct 1996.
5. Concrete Technology by A.R. Santhakumar, Oxford University Press
6. Concrete Technology by M.S.Shetty, S.Chand & Co 2009.
7. Concrete Technology by M.L. Gambhir, Tata McGraw-Hill Publishing Company Limited.
8. Building Construction by J.K.Mckay, Pearson Publications.

II SEMESTER

MTSD - 201
Structural Dynamics

MTSD 201	Structural Dynamics	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-
• To make the students understand the basics of structural dynamics and earthquake engineering and to develop the ability to design a earthquake resistant structure

UNIT 1 **13 Hr**
Single Degree of Freedom System: Free and forced vibrations, Linear Viscous Damper, Coulomb Damper: Response to harmonic excitation, rotating unbalance and support excitations, Vibration isolation and transmissibility, single degree of freedom system as vibro-meter and accelerometer, response to periodic and arbitrary excitation.

UNIT-II **10 Hr**
Duhamels integral. Impulse response function, Laplace transforms Fourier transform methods. Frequency response function. Phase-Plane Techniques. Critical Speed of rotors. Energy methods, Rayleighs method, Equivalent viscous damping.

UNIT-III **12 Hr**
Two Degree of Freedom System. Matrix Formulation, Free Vibration, Beat phenomenon. Principle of damped and un-damped vibration absorbers.

UNIT-IV **12 Hr**
Multi Degree of Freedom System: Matrix formulation, stiffness and flexibility influence coefficients, eigenvalue problem, normal modes and their properties. Matrix iteration technique for eigenvalue and Eigen vectors, Free and forced vibration by modal analysis.

UNIT-V **12 Hr**
Continuous System: Axial vibration of bar, torsion of shafts, transverse vibration of strings and bending vibration beams. Forced vibration. Normal mode method. Lagrangles equation. Approximate methods of Rayleigh-Ritz, Galerkin etc.

Outcomes:
On completion of this course, the student is expected to be able to

• Do vibration analysis of system/structures with single degree of freedom and can explain the method of damping the systems
•Do dynamic analysis of system/structures with Multi degrees of freedom under free and forced vibration
• Derive a mathematical model of continuous system and do a dynamic analysis under free and forced vibration
• Explain the causes and effect of earthquake
• Design masonry and RC structures to the earthquake forces as per the recommendations of IS codes of practice

Reference Books:

1. RW Clough, J Penzien, Dynamics of structures
2. D G Fertia, Dynamics and vibration of Structures
3. J M Biggs, Introduction to structural dynamic

MTSD - 202

FEM in Structural Engineering

MTSD 202	FEM in Structural Engineering	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-

• To make the students understand the basics of the Finite Element Technique, and to cover the analysis methodologies for 1-D, 2-D and 3-D Structural Engineering problems.

UNIT-I **9 Hr**

Introduction to Finite Element Method: General Applicability and Description of Finite Element Method Comparison with other methods.

UNIT 2 **12 Hr**

Solution of Finite Element Method: Solution of Equilibrium Problems, Eigen value problems, propagation problems, computer implementation of Gaussian eliminations, Choleskis decomposition, Jocobis and Ranga Kutta Method.

UNIT 3 **13 Hr**

General Procedure of Finite Element Method: Descretization of the domain, Selection of Shapes, Types and Number of elements, node numbering technique, Interpolation Polynomials, their selection and derivation in terms of global and local coordinates, Convergence requirements. Formulation of Element Characteristic matrices and vectors, Variational approach. Assembly of Element matrices and Vectors and Derivation system equations, computation of element resultants.

UNIT-IV **10 Hr**

Iso-parametric Formulation: Lagrange and Hermite interpolation functions, Isoparametric Elements, Numerical Integration.

UNIT-V **12 Hr**

Static Analysis: Formulation of equilibrium equation, Analysis of truss, Frames, Plane Stress and Plane Strain Problems Plates and Shells.

Outcomes:

• On completion of the course, the student is expected to be able to
• Formulate a finite element problem using basic mathematical principles
• Explain the various types of elements and Select the appropriate element for modelling
• Analyse a frame using truss element
• Formulate and analyse two and three dimensional solid finite element problems
• Analyse a shells, thick and thin plate and explain dynamic analysis in FEM

Reference Books:

1. Weaver, Johnson, Finite element and structural analysis
2. HC Martin, Matrix structural analysis
3. CF Abel, CS Desai, Finite element methods
4. Buchanan, Finite element Analysis (schaum Outline S), TMH
5. Krishnamurthy, Finite element analysis, TMH)

MTSD – 203

Design of steel Structures

MTSD 203	Prestressed concrete	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-

• Ability to perform analysis and design of steel members and connections
Assignments: Weekly problem sets are assigned.
• Ability to design steel structural systems
Assignment: Students design a steel structure located in Pocatello, Idaho.
• Familiarity with professional and contemporary issues
Assignments: Students write two professional papers.

UNIT 1 **12 Hr**

Introduction to Limit States: Introduction, Standardization, allowable stress design, limit state design, partial safety factors, concept of section, classification; Plastic, compact semi compact & slender.

UNIT 2 **14 Hr**

Columns: Basic concepts, strength curve for an ideal strut, strength of column members in practice effect of eccentricity of applied loading. Effect of residual stresses, concept of effective lengths, no sway columns, torsional and torsion flexural buckling of columns, Robertson's design curve, modification to Robertson approach, design of columns using Robertson approach.

UNIT 3 **13 Hr**

Laterally Restrained Beams: Flexural & shear behavior, web buckling & web crippling, effect of local buckling in laterally restrained plastic' or 'compact' beams, combined bending & shear, unsymmetrical bending. Unrestrained Beams: Similarity of column buckling of beams, lateral torsional buckling of symmetric section, factors affecting lateral stability, buckling of real beams , design of cantilever beams, continuous beams.

UNIT 4 **11 Hr**

Beams Columns: Short & long beam columns, effects of slenderness ratio and axial force on modes of failure, beam column under biaxial bending, strength of beam columns, local section failure & overall member failure.

UNIT 5 **12 Hr**

Beams Subjected to Torsion and Bending: Introduction, pure torsion and warping, combined bending torsion, capacity check, buckling check, design methods for lateral torsional buckling.

Outcomes:

• Understanding of the ASD and LRFD design philosophies and behavior of structural steel
• Ability to analyze and design of tension members
• Ability to analyze and design of columns
• Ability to analyze and design of beams
• Ability to analyze and design of beam-columns
• Ability to analyze and design of simple bolted and welded connections

Reference Books:

1. Morsis L.J. Plum, D.R., Structural Steel Work Design
2. Sinha D.A. , Design of Steel Structures
3. Yu, W.W. , Cold Formed Steel Structures Design

MTSD-204
Experimental Stress Analysis

MTSD 204	Experimental Stress Analysis	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-

• Recognize the various techniques available to measure the stress and Strains using different sources.
• Realize the working of recording instruments and data logging methods
• Distinguish the principles of photo elasticity in two dimensional stress analyses

UNIT 1 **13 Hr**

Introduction to stress analysis by strain measurement, mechanical strain gages, Moire fringe method, Brittle coatings for stress indication, circuitry for resistance strain gages, calibrating strain gages, temperature compensation of circuitry, indication and recording equipments, unbalance of bridge systems, balanced bridge systems, reference bridge systems, constant current strain indicators, multichannel recording systems.

UNIT 2 **12 Hr**

Introduction to stress analysis by photo elasticity, optical theory, stress optical relationship, equipment and models, static stress analysis (2-D, 3-D techniques), stress analysis by photo elastic strain gages

UNIT 3 **13 Hr**

Conditions for crack growth, fracture mechanics and strength of solids, stress and displacement fields in the vicinity of crack tip, the Griffith Orowan-Irwin concept, stable and unstable crack growth, the integral variation principle in crack theory, some more model representations, cracks in linearly elastic bodies,

UNIT 4 **12 Hr**

Stress intensity factor, basic numerical methods for calculating the stress intensity factor, calculation of stress intensity factor for double cantilever beam specimen by FEM, the method of section for an approximate calculation of stress intensity factor, some material characteristics used for evaluation of crack propagation resistance.

UNIT 5 **12 Hr**

Solution of some plane and three dimensional problems, constructional crack arrest, system of cracks, stress intensity factors for some practical important cases, shell with a crack trajectory.

Outcomes:

Upon completion of this course the student will be able to:
• Understand the overall concepts of stress/strain analysis by experimental means.
• Familiar with the theory and practice of common experimental stress analysis Methods including moire methods, photo elasticity
• Acquire the knowledge on Brittle and bi-refrigent coatings and working of strain gauges.

Reference Books:

1. Dove, Adams, Experimental stress analysis and motion
2. Heteny, Experimental stress analysis
3. Dally, Rilay, Experimental stress analysis
4. VZ Panon, M Morozove, Elastic-plastic fracture mechanics

MTSD-205
Theory of Plates and Shells

MTSD 205	Theory of Plates and Shells	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-
• To enable the student analyse and design thin shell structures including domes, hyperbolic, paraboloid, elliptic and cylindrical shells.

UNIT 1 **12 Hr**
Theory of Plates: Bearing of long rectangular plates to the cylindrical surface with different edge conditions. Pure bending of plates-Differential equations of equilibrium. Theory of small deflections of laterally loads plates. Boundary conditions, moment curvature relationship.

UNIT 2 **10 Hr**
Analysis of rectangular plates, Navier�s and levy solutions, exact theory of plates, symmetrical bending of circular plates, continuous rectangular plates.

UNIT 3 **10 Hr**
Special and approximate methods of theory of plates, singularities, use of influence surfaces, use of infinite integrals and transforms, strain energy methods, experimental methods.

UNIT 4 **12 Hr**
Theory of Shells: Classification of shells, Gaussian curvature, General theory of cylindrical shells, membrane theory and bending theory for cylindrical shells, long and short shells, shells, shells with and without edge beams, Fourier loading.

UNIT 5 **12 Hr**
Equation of equilibrium for shells of surface of revolution, Reduction to two differential equations of second order. Spherical shells, membrane theory for shells of double curvature-syn-elastic and anti-elastic. Cylindrical shells, Hyperbolic-parabolic shells, funicular shells.

Outcomes
On completing the course the student should be able to:
• analyse and design thin shell structures including domes, hyperbolic, paraboloid, elliptic and cylindrical shells
• formulate Finite Element Equations for solution of the structural response of plate bending problems and obtain solutions to shell structures

Reference Books:
1. S Timoshenko, S Woinowasky K, Theory of Plates and Shells

III SEMESTER

MTSD-301

Advanced Foundation Engineering

MTSD 301(A)	**Advanced Foundation Engineering**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:-

• To design various types of foundations to fulfill the required criteria.

UNIT 1 **12 Hr**

Soil Exploration: Introduction, Methods of exploration, Direct Methods and techniques of exploration, Methods of boring types of samples, Disturbance of soil sample, Soil samplers and sampling techniques, Ground water observations, Boring records, Spacing and depth of bore holes, Indirect methods of soil exploration, Penetration tests, Geophysical methods, Dynamics methods, Sequence of exploration programs.

UNIT 2 **13 Hr**

Shallow Foundations: Introduction, General Requirements, Depth of foundation, Bearing capacity, Eccentric Inclined loads, Bearing capacity of stratified soils, Settlement of footings, Settlement of footings from constitutive laws, Settlement and tilt of eccentrically loaded footings, Allowable settlement, Plate bearing test, Standard penetration test Effect of water table, shallow foundation classification, Modulus of sub-grade reaction, Beams on elastic foundation, Raft foundation.

UNIT 3 **13 Hr**

Pile Foundation: Introduction, Uses of piles, Types of piles, pile drivers, Bearing capacity of piles, Static analysis, Pile load test, Dynamic methods, Other methods, 24 Negative skin friction, Pile group, Ultimate bearing capacity of pile groups, Settlement of pile group, Influence of pile cap. Laterally loaded piles, Ultimate resistance, Elastic methods, Pile groups under lateral load, batter pile under lateral load, Batter pile groups under inclined loads, pile under dynamic loads.

UNIT 4 **13 Hr**

Coffer Dams: Introduction, types of Coffer Dams, Design data for cellular cofferdam, Stability analysis of cofferdam, Interlock stresses. Foundations in black cotton soils basic foundation problems associated with black cotton soils. Lime column techniques principles and execution. Under reamed piles-principle of functioning of under reamed pile-Analysis and structural design of under reamed pile. Use of Cohesive Non Swelling (CNS) layer below shallow foundations.

UNIT 5 **14 Hr**

Machine Foundations : Introduction, Criteria for satisfactory action of a machine foundation, Definitions, Degrees of freedom of a block foundation, Analysis of block foundation, Theory of linear weightless spring, Equivalent soil springs, Vertical vibration, Rocking vibration, Vibration in shear, Simultaneous rocking sliding and vertical vibrations for a foundation, Indian standard on design and construction of foundations for reciprocating machines, Foundations for impact type machines, Indian Standard on design and construction of foundations for impact type machines, Analysis of block foundation based on elastic half space theory.

Outcome:

on completion of this course student will be able

• Design shallow and deep foundations for various types of structures
• Design piles and pile caps
• Design well foundation for bridge piers and related structures
• Gain knowledge on design and construction of machine foundation
• Design foundations for bridges, towers and chimneys.

References Books:

1. Bowles, Foundation: Analysis and Design, McGraw Hill Book CO. Inc.
2. Peck , R.B. , W.E. Hanson and T.H. Thornburn, Foundation Engineering, Wiley , New York
3. Foundation Design and Construction-Tomlinson Foundation Design-Teng.
4. Geotechnical Engg – C.Venkatramaiah
5. Foundation Engineering by Brije.M.Das, Printice Hall Publishers.

MTSD-301(B)
Design of Earth quake Resistant Structures

MTSD 301(A)	Design of Earth quake Resistant Structures	3L:1T:0P	4 credits	4Hrs/Week

Preamble: -

• This course integrates information from various engineering and scientific disciplines in order to provide a rational basis for the design of earthquake-resistant structures.

UNIT 1 **10 Hr**
Seismic Strengthening of Existing Buildings: Cases histories-Learning from earthquakes, seismic strengthening procedures. Selection of materials and types of construction form of superstructure – framing systems and seismic units – devices for reducing. Earthquake loads,

UNIT 2 **12 Hr**
Torsion & Rigidity: Rigid Diaphragms, Torsional moment, Center of mass and center of rigidity torsion effects. Lateral Analysis of Building Systems: Lateral load distribution with rigid floor diaphragms, moment resisting frames, shear walls, lateral stiffness of shear walls, shear wall-frame combination, examples.

UNIT 3 **11 Hr**
Concept of Earthquake Resistant Design: Objectives of seismic design , Ductility, Hysteric response & energy dissipation, response modifications factor, design spectrum, capacity design, classification
of structural system, IS code provisions for seismic design of structures, multi-storied buildings, design criteria, P-A effects, storey drift, design examples ductile detailing of RCC structures.

UNIT 4 **12 Hr**
Seismic Design of Special Structures: Elevated liquid storage tanks, Hydrodynamic pressure in tanks, stack like structures, IS-1893 code provisions for bridges; Superstructures, substructures, submersible bridges, dams; Hydrodynamic effect due to reservoir, concrete gravity dams.

UNIT 5 **12 Hr**
Engineering Seismology: Basic terms, seismic waves, earthquake magnitude and intensity, ground
motion, dynamic response of structures, normalized response spectra, seismic coefficients and seismic zone coefficients. Characteristics of Wind and Earthquake forces and its method of analysis.

Outcome:

Introduction to Disaster and disaster management
• Basic knowledge of dynamics and methods of dynamic analysis
• Blast and fire resistant design of structures
• Earthquake resistant design of structures
• Design of shear wall
• Retrofitting, rehabilitation and strengthening of structures

Reference Books:

1. Chopra A.K., Dynamics of Structures', Theory & Applications to Eqrthquake
Engineering , Prentice Hall India, New Delhi-1995
2. Clough & Penzien, Dynamics of Structures , McGraw Hill Book CO. Inc.
3. Paz M, Structural Dynamics, , Van Nostrand Reinhold, New York
4. Paz, M, International Handbook of Earthquake Engineering, Chapman & Hall, New York.
5. IS-1893-1984, Indian Standard Criteria for Earthquake Resistant Design of Structures,
B.I.S., New Delhi.
6. IS-4326-1993, Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings, B.I.S., New Delhi.

MTSD-301(C)
Design & Analysis of steel Structures

MTSD 301(A)	Design & Analysis of steel Structures	3L:1T:0P	4 credits	4Hrs/Week

Preamble: -

• To study the behaviour of members and connections, analysis and design of Industrial buildings and to study the design of with cold formed steel and plastic analysis of structures.

UNIT 1 **13 Hr**

Matrix Method Analysis: Flexibility and stiffness matrices-Force displacement relationships for axial force, couple, torsional moments – stiffness method of analysis and flexibility method of analysis. Equation Solvers: Solution of system of linear algebraic equations-direct inversion method-gauss elimination method-Cholesky method-banded equation solvers frontal solution technique

UNIT 2 **12 Hr**

Columns: Basic concepts, strength curve for an ideal strut, strength of column members in practice effect of eccentricity of applied loading. Effect of residual stresses, concept of effective lengths, no sway columns, torsional and torsion flexural buckling of columns, Robertson‟s design curve, modification to Robertson approach, design of columns using Robertson approach.

UNIT 3 **12 Hr**

Laterally Restrained Beams: Flexural & shear behavior, web buckling & web crippling, effect of local
buckling in laterally restrained plastic‟ or „compact‟ beams, combined bending & shear, unsymmetrical bending. Unrestrained Beams: Similarity of column buckling of beams, lateral torsional buckling of symmetric section, factors affecting lateral stability, buckling of real beams , design of cantilever beams, continuous beams.

UNIT 4 **10 Hr**

Beams Columns: Short & long beam columns, effects of slenderness ratio and axial force on modes of failure, beam column under biaxial bending, strength of beam columns, local section failure & overall member failure.

UNIT 5 **10 Hr**

Beams Subjected to Torsion and Bending: Introduction, pure torsion and warping, combined bending torsion, capacity check, buckling check, design methods for lateral torsional buckling.

Outcomes:
On completion of the course, the student is expected to be able to
• Design the steel members such as purlins, gable wind girders, base plates subjected to combined forces
• Explain and design the different types of steel connections such as welded, bolted and moment resisting connections
• Analyse and design the industrial structures such as trusses, portal frames subjected to seismic forces 4. Explain the effect of axial force and shear force on steel structures and analyse the continuous beams, frames using plastic theory
• Evaluate the behaviour and design of compression and flexural members

Reference Books:
1. Morsis L.J. Plum, D.R., Structural Steel Work Design
2. Sinha D.A. , Design of Steel Structures
3. Yu, W.W. , Cold Formed Steel Structures Design
4.John L.Meek., Matrix Strucstural Analysis, McGraw Hill Book company.
5. Structural Analysis by Pundit & Gupta
6. Structural Analysis by C.S.Reddy.
7. Structural Analysis – R.C.Hibbeler

MTSD-301(D)
Building Structure & Construction Management

MTSD 301(A)	**Building Structure & Construction Management**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble: -

• To prepare students for entry-level management positions in the construction industry.

UNIT-1
Types constructions-public and private contract managements – scrutinizing tenders and acceptance of tenders, contracted, changes and terminating of contract – subcontracts construction organizations – organizational chart-Decentralization payrolls and records – organization chart of a construction company.
UNIT-2
Construction Practices and Resource Management– Time Management – bar chart, CPM, PERT – Progress report, Basic concepts equipment management, material management inventory control.
UNIT-3
Accounts Management – Basic concepts, Accounting system and book keeping, depreciation, Balance sheet, profit and loss account, internal auditing. Quality control by statistical methods, sampling plan and control charts, safety requirements.
UNIT-4
Cost and Financial Management – Cost volume relationship, cost control system, budget concept of valuation, cost of equity capital management cash. Labor and industrial; laws – payment of wages act. Contract labor, workmen‟ s compensation, insurance, industrial disputes act.
UNIT-5
Behavior of tall structures under static and dynamic loads, model analysis. Shear walls, Frame
Structures, Coupled shear walls, Tabular Structures, Ductility and reinforcement details at joint. Design Criteria and Modeling of tall structures, case studies.

Outcomes:
A graduate of the Construction Management major should be able to:
• successfully apply business and management skills in positions within the construction industry.
• apply technical skills and knowledge in mathematics, science, construction, and technology in support of planning, analyzing, and solving construction problems.
• use industry resources including associations and organizations, professional publications, and governmental data to analyze, evaluate, and apply current trends within the industry.
• practice informed decision-making in personal and professional endeavors.
• manage a quality construction project from start to completion while maintaining budget, schedule, and safety requirements.

Reference Books:
1. Coull, Smith, Design of tall buildings
2. Taranath, Design of tall buildings
3. Construction Management and planning by B.Sengupata and H.Gula(Tata McGraw Hill)
4. Construction Management by Atkinson(Elsevier)
5. in principle land practice by EEC beech(Longman)
6. Robert Schultheis, Mary Summer "management information systems-The Management View."TATA Mc Graw Hill Edition, New Delhi.
7. Kwakye, A.A , Construction Project Administration Addison Wesley Longman, London.
8. Keith Davis, Human Behavior at Work, Mc Graw Hill, USA.
9. Sehroeder, R.G., Operations Management, Mc Graw Hill, USA.
10. james C.Van Horne, Financial Management and Policy, Prentice Hall of India Pvt.Ltd., 4th Ed., NewDelhi.

MTSD-302(A)

Design of Offshore Structures

MTSD 301(A)	Design of Offshore Structures	3L:1T:0P	4 credits	4Hrs/Week

Preamble: -

• To impart knowledge about the concept of wave theories, forces, offshore foundation, analysis and design of jacket towers, pipes and cables

UNIT-1 **10 Hr**

Loads and structural forms of different types of offshore structures; Elements of single d.o.f. system subjected to free and forced vibration.

UNIT-2 **12 Hr**

Analysis for transient and steady state force; Equivalent damping for nonlinear systems; Dynamics of multi d.o.f. systems; Eigen values and vectors; Iterative and transformation methods.

UNIT-3 **11 Hr**

Mode superposition. Fourier series and spectral method for response of single d.o.f. systems; Vibrations of bars, beams and cones with reference to soil as half space.

UNIT-4 **10 Hr**

Behavior of concrete gravity platform as a rigid body on soil as a continuum; short and long term statistics of wind;

UNIT-5 **13 Hr**

Static wind load; Effect of size, shape and frequency; Aerodynamic admittance function and gust factor, spectral response due to wind for various typres of structures; Wave loads by Morisons equation; Static and dynamic analysis of fixed structures; Use of approximate methods.

Outcome:

On completion of the course, the student is expected to be able to

• Develop the concept of wave theories
• Apply the knowledge of wave forces and offshore structures
• Explain the modeling for offshore structure and its foundation
• Analyse offshore structures by means of static and dynamic methods
• Design of jacket towers, mooring cables and pipelines

Reference Books:

1.Brebbia C.A. Walker, Dynamic Analysis of Offshore Str., Newnes Butterworth
2.Sarpakaya T and Isaacson M., Mechanics of wave forces on offshore structures, Van Nostrand Reinhold New York,
3.Hallam M.G. Heaf N.J. and Wootton, L.R., Dynamics of Marine Structures, CIRIA Publications Underwater Engg., Group , London
4.Graff W.J., Introduction to offshore Structures, Gulf Publishing Co., Houston, Taxas
5.Clough R.W. and Penzine J., Dynamic of Structures - II Ed., McGraw Hill Book CO.
6.Simiu E. and Scanlan R.H., Wind Effects on Structures, Wiley, New York 1978
7.Codes of Practice (latest versions) , Such as API RP-2A ,Bureau Veritas etc.
8.Proceedings of Offshore Technology Conference (OTC) Behavior of Offshore

MTSD-302(B)
Fracture Mechanism

MTSD 301(A)	**Fracture Mechanism**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble: -

• The course will treat linear and nonlinear fracture mechanics principles and their applications to structural design. Fracture phenomena in metals and nonmetals will be discussed and testing methods will be highlighted. In the end computer assisted techniques for fracture study will be discussed.

UNIT 1 **12 Hr**
Summary of Basic Problems and Concepts: Introduction - A crack in a structure - The stress at a crack tip - The Griffith criterion The crack opening displacement criterion - Crack Propagation – Closure. The Elastic Crack-Tip Stress Field : The Airy stress function - Complex stress functions - Solution to crack problems - The effect of finite size - Special cases - Elliptical cracks - Some useful expressions

UNIT 2 **13 Hr**
The Crack Tip Plastic Zone: The Irwin plastic zone correction - The Dugdale approach - The shape of the plastic zone - Plane stress versus plane strain - Plastic constraint factor - The thickness effect. The Energy Principle: The energy release rate - The criterion for crack growth - The crack resistance (R curve) - Compliance , The J integral (Definitions only)

UNIT 3 **12 Hr**
Plane Strain Fracture Toughness: The standard test - Size requirements - Non-Linearity – Applicability Plane Stress and Transitional Behaviour: Introduction - An engineering concept of plane stress – The R curve concept

UNIT 4 **10 Hr**
The Crack Opening Displacement Criterion: Fracture beyond general yield - The crack tip opening displacement - The possible use of the CTOD criterion

UNIT 5 **10 Hr**
Determination of Stress Intensity Factors: Introduction - Analytical and numerical methods – Finite element methods, Experimental methods.

Outcomes:
On completion of the course the student should be able to-
• Predict material failure for any combination of applied stresses.
• Estimate failure conditions of a structure.
• Determine the stress intensity factor for simple components of simple geometry
• Predict the likelihood of failure of a structure containing a defect.

Reference Books:
1. Elementary engineering fracture mechanics - David Broek, Battelle, columbus laboratories, columbus, Ohieo, USA
2. Fracture and Fatigue Control in Structures - john M.Barsom, Senior consultant United states Steel corporation & Stanley T.Rolfe, Ross H.Forney Professor of Engineering University of Kansas.& Stanley T.Rolfe, Ross H.forney Professor of Engineering, University of Kansas .

MTSD-302(C)
Low cost Housing Techniques

MTSD 301(A)	**Low cost Housing Techniques**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble: -

• To introduce the students the planning and design of large-scale buildings with high degree of complexity by understanding architectural, socio-cultural, and economic issues connected with architecture. lntegrated approach to design encompassing site planning, building design, environment and services. Major Project-Housing projects, lnstitutional building projects involving Campus planning etc'.. Short project - Design of related areas of Major project.

UNIT 1 **12 Hr**

Housing Scenario : Introduction - Status of urban housing - Status of Rural Housing. Introduction to Existing finance system in India - Government role as facilitator - Status of Rural Housing Finance - Impediments in housing finance and related issues .
Land Use and Physical Planning for Housing: Introduction - Planning of urban land - Urban land ceiling and regulation act - Efficiency of building bye laws - Residential Densities

UNIT 2 **14 Hr**

Housing the Urban Poor: Introduction - Living conditions in slums - Approaches and strategies for housing urban poor . Development and Adoption of Low cost Houing: Introduction - Adoption of innovative cost-effective construction techniques - Adoption of precast elements in partial prefatroices - Adopting of total prefactcation of mass housing in India- General remarks on pre cast roofing/flooring systems - Economical wall system - Single Brick thick load bearing wall - 19cm thick load bearing masonery walls - Half brick thick load bearing wall - Flyash gypsym brick for masonary - Stone Block masonery - Adoption of precast R.C. plank and join system for roof/floor in the building

UNIT 3 **10 Hr**

Alternative Building Materials for Low cost Housing: Introduction - Substitute for scarce materials – Ferrocement - Gypsum boards - Timber substitutions - Industrial wastes - Agricultural wastes - Alternative building maintenance

UNIT 4 **11 Hr**

Low Cost Infrastructure Services: Introduction to - Present status - Technological options - Low cost
sanitation - Domestic wall - Water supply, energy Rural Housing: Introduction to traditional practice of rural housing-continuous Mud Housing technology Mud roofs - Characteristics of mud - Fire treatment for thatch roof - Soil stabilization - Rural Housing programs

UNIT 5 **13 Hr**

Housing in Disaster Prone Areas: Introduction – Earthquake - Damage to houses - Disaster prone areas - Type of Damages and Repairs of non-engineered buildings - Repair and restoration of earthquake Damaged non-engineered buildings recommendations for future constructions Requirement‟ s of structural safety of thin precast roofing units against Earthquake forces Status of R& D in earthquake strengthening measures - Floods, cyclone, future safety.

Outcomes:

• At the end of the course, the students sttall have acquired knowledge of the process involved in addressing a design problem with emphasls on slte planning.

Reference Books:

1. Building materials for low – income houses – International council for building research studies and documentation.
2. Hand book of low cost housing by A.K.Lal – Newage international publishers.
3. Properties of concrete – Neville A.M. Pitman Publishing Limited, London.
4. Light weight concrete, Academic Kiado, Rudhai.G – Publishing home of Hungarian Academy of Sciences.
5. Low cost Housing – G.C. Mathur.
6. Modern trends in housing in developing countries – A.G. Madhava Rao, D.S. Ramachandra Murthy & G.Annamalai.

MTSD-302(D)
Design Of Bridges

MTSD 301(A)	Design Of Bridges	3L:1T:0P	4 credits	4Hrs/Week

Preamble: -

• The objective is to equip the students with a thorough understanding of the behaviour and design of bridges. Various applied loads, such as truck load, impact, horizontal braking/centrifugal forces, wind and seismic loads are discussed thoroughly. Background to design equations for different types of bridges and relevant modern research will also be discussed to provide the students with solid understanding of the topics covered.

UNIT 1 **11 Hr**
Introduction : Classification, investigations and planning, choice of type – economic span length – IRC specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.

UNIT 2 **12 Hr**
Design of Box Culverts : General aspects – Design loads – Design moments, shears and thrusts – Design of critical section.
Design of Slab Bridges–:Effective width of analysis – workings stress design and detailing of slab bridges for IRC loading.

UNIT 3 **13 Hr**
T-BEAM Bridges: Introduction – wheel load analysis – B.M. in slab – Pigaud‟ s theory – analysis of longitudinal girders by Courbon‟ s theory working stress design and detailing of reinforced concrete T-beam bridges for IRC loading.
Prestresssed Concrete Bridges: General features – Advantages of Prestressed concrete bridges – pretensioned Prestressed concrete bridges – post tensioned Prestressed concrete Bridge decks. Design of post tensioned Prestressed concrete slab bridge deck.

UNIT 4 **14 Hr**
Bridge Bearings : General features – Types of bearings – forces on bearings basis for selection of bearings – Design principles of steel rocker and roller bearings and its design – Design of elastometric pad bearing detailing of elastometric pot bearings.
Piers and Abutments: General features – Bed block – Materials for piers and abutments – typies of piers – forces acting on piers – Design of pier – stability analysis of piers – general features of abutments – forces acting on abutments – stability analysis of abutments.

UNIT 5 **10 Hr**
Bridge Foundations: General Aspects – Types of foundations – Pile foundations – well foundations – caisson foundations.

Outcomes:
• The students are expected to be able to understand the load-carrying capacity of various types of bridges, upon learning the structural responses to different kinds of loads. They should be able to design short and medium span bridges, with confidence using existing codes of practice, taking into account of the structural strength, service life and durability. It is also expected that the student would know the limitations of the design methods used.

Reference Books:
1. Essentials of bridges engineering – D.Hohnson Victor oxford & IBH publishers co-Private Ltd.
2. Design of concrete bridges MC aswanin VN Vazrani, MM Ratwani, Khanna publishers.
3. Bridge Engineering – S.Ponnuswamy.
4. BRowe, R.E., Concrete Bridge Design, C.R.Books Ltd., London.
5. Taylor F.W., Thomson, S.E., and Smulski E., Reinforced concrete Bridges, John wiley and sons, New york.
6. Derrick Beckett, an Introduction to Structural Design of concrete bridges, surrey University; press, Henlely – thomes, oxford shire.
7. Bakht.B.and Jaegar, L.G. bridge Analysis simplified, Mc Graw Hill.
8. Design of Bridges – N.Krishna Raju – Oxford & IBH
9. Design of Bridge structures – FR Jagadeesh, M.A. jaya Ram – Eastern Economy edition.