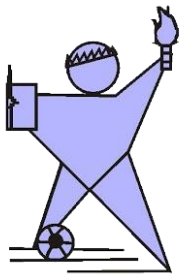
Scheme Structure

as per

AICTE Model Curriculum 2018

Master of Technology (M. Tech.)
(Structural Engineering)



IPS Academy
Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV)

M. Tech. in Structural Engineering

Semester-wise schemes for students admitted in 1st year in 2020-21 onwards.

1. **Total number of credits: 70**
2. **Structure of PG program.**

S. No.	Category	Suggested breakup of total credits, as per AICTE	Actual Breakup of credits
1	Program Specific Mathematics Course (PSMC)	00	00
2	Program Specific Core Course (PSCC)	12	16
3	Program Specific Elective Course (PSEC)	15	12
4	Open elective courses (OEC)	03	03
5	Mandatory Learning Courses (MLC)	02	04
6	Laboratory Courses (LC)	08	08
7	Liberal Learning Courses (LLC)	00	01
8	Skill Based Courses (SBC)	28	26
9	Audit Course (AUC)	00	00
	Total	**68**	**70**

CATEGORY OF COURSES

(i) PROFESSIONAL SPECIFIC CORE COURSES

S.No.	Course Code	Course Title	Hrs./ week			Credits	Semester
			L	T	P		
1	PSCC – MTSE101	Advanced Structural Analysis	3	1	0	4	I
2	PSCC – MTSE102	Advanced Solid Mechanics	3	1	0	4	I
3	PSCC – MTSE201	FEM in Structural Engineering	3	1	0	4	II
4	PSCC – MTSE202	Theory of Plates and Shells	3	1	0	4	II
						16	

(ii) PROFESSIONAL SPECIFIC ELECTIVE COURSES

S.No.	Course Code	Course Title	Hrs./ week			Credits	Semester
			L	T	P		
1	PSEC – MTSE101	Elective -I	3	0	0	3	I
2	PSEC – MTSE102	Elective -II	3	0	0	3	I
3	PSEC – MTSE201	Elective -III	3	0	0	3	II
4	PSEC – MTSE301	Elective - IV	3	0	0	3	III
Total credits						**12**	

(iii) PROFESSIONAL OPEN ELECTIVE COURSES

S.No.	Course Code	Course Title	Hrs./ week			Credits	Semester
			L	T	P		
1	OEC – MTSE201	Instrumentation and Measurement Techniques	3	0	0	3	II
Total credits						**3**	

(iv) MANDATORY LEARNING COURSE COURSES

S.No.	Course Code	Course Title	Hrs./ week			Credits	Semester
			L	T	P		
1	MLC – MTSE101	Structural Engineering Design Practice (Bridge Course)	2	0	0	2	I
2	MLC – MTSE201	Research Methodology & IPR	2	0	0	2	II
Total credits						**4**	

(v) LAB COURSE

S.No.	Course Code	Course Title	Hrs./ week			Credits	Semester
			L	T	P		
1	LC – MTSE101	Earthquake Engineering Lab	0	0	4	2	I
2	LC – MTSE102	Design Studio -I	0	0	4	2	I
3	LC – MTSE201	Instrumentation Lab	0	0	4	2	II
4	LC – MTSE202	Design Studio -II	0	0	4	2	II
					Total credits	**8**	

(vi) LIBERAL LEARNING COURSES

S.No.	Course Code	Course Title	Hrs./ week			Credits	Semester
			L	T	P		
1	LLC – MTSE301	Personality Development	1	0	0	1	III
					Total credits	**1**	

(vii) SKILL BASED COURSES

S.No.	Course Code	Course Title	Hrs./ week			Credits	Semester
			L	T	P		
1	SBC – MTSE301	Dissertation Part - I	0	0	20	10	III
2	SBC – MTSE401	Dissertation Part - II	0	0	32	16	IV
					Total credits	**26**	

(viii) AUDIT COURSES

S.No.	Course Code	Course Title	Hrs./ week			Credits	Semester
			L	T	P		
1	AUD – MTSE101	Disaster Management	2	0	0	0	I
2	AUD – MTSE201	Stress Management	2	0	0	0	II
					Total credits	**0**	

Semester-wise Scheme (1st to 4th Semester)

First Semester

S.No.	Course Code	Course Title	Hrs./ Week			Credits
			L	T	P	
1	PSCC – MTSE101	Advanced Structural Analysis	3	1	0	4
2	PSCC –MTSE102	Advanced Solid Mechanics	3	1	0	4
3	PSEC – MTSE101	Elective -I	3	0	0	3
4	PSEC – MTSE102	Elective -II	3	0	0	3
5	LC – MTSE101	Earthquake Engineering Lab	0	0	4	2
6	LC – MTSE102	Design Studio -I	0	0	4	2
7	MLC – MTSE101	Structural Engineering Design Practice (Bridge Course)	2	0	0	2
8	AUD – MTSE101	Disaster Management	2	0	0	0
					Total Credits	**20**

Second Semester

S.No.	Course Code	Course Title	Hrs./ Week			Credits
			L	T	P	
1	PSCC – MTSE201	FEM in Structural Engineering	3	1	0	4
2	PSCC –MTSE202	Theory of Plates and Shells	3	1	0	4
3	PSEC – MTSE201	Elective -III	3	0	0	3
4	OEC – MTSE201	Instrumentation and Measurement Techniques	3	0	0	3
5	LC – MTSE201	Instrumentation Lab	0	0	4	2
6	LC – MTSE202	Design Studio -II	0	0	4	2
7	MLC – MTSE201	Research Methodology & IPR	2	0	0	2
8	AUD – MTSE201	Stress Management	2	0	0	0
					Total Credits	**20**

	Elective-I (PSEC – MTSE101)	**Elective-II** (PSEC – MTSE102)	**Elective-III** (PSEC – MTSE201)
(A)	Structural Dynamics	Earthquake Analysis and Design of Structures	Advanced Steel Design
(B)	Advanced Foundation Design	Structural Assessment and Retrofitting	Concrete Technology
(C)	Prestressed and Precast Construction	Structural Optimization	Design of Bridge Structures

Third Semester

S.No.	Course Code	Course Title	Hrs./ Week			Credits
			L	T	P	
1	PSEC – MTSE301	Elective - IV	3	0	0	3
2	LLC –MTSE301	Personality Development	1	0	0	1
3	SBC – MTSE301	Dissertation Part - I	0	0	20	10
					Total Credits	**14**

	Elective-IV (PSEC – MTSE301)
(A)	Massive Open Online Course - I
(B)	Design of Masonry Structures
(C)	Prefabricated Structures
(D)	Design of Tall Structures

Fourth Semester

S.No.	Course Code	Course Title	Hrs./ Week			Credits
			L	T	P	
1	SBC – MTSE301	Dissertation Part - II	0	0	32	16
					Total Credits	**16**

IPS ACADEMY

Institute of Engineering and Science, Indore (M.P.)

A UGC Autonomous Institute,

Affiliated to Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, (M.P.)

Masters of Technology (M.Tech.) Civil Engineering

Specialization: Structural Engineering

Semester I [First Year]

First Semester (Autonomy) CE

S.No.	Course Code	Course Title	Maximum Marks Allotted					Total Marks	Hrs./Week			Total Credits
			Theory			Practical						
			End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	PSCC– MTSE101	Advanced Structural Analysis	70	20	10	-	-	100	3	1	0	**4**
2.	PSCC –MTSE102	Advanced Solid Mechanics	70	20	10	-	-	100	3	1	0	**4**
3.	PSEC –MTSE101	Elective -I	70	20	10	-	-	100	3	0	0	**3**
4.	PSEC –MTSE102	Elective -II	70	20	10	-	-	100	3	0	0	**3**
5.	LC – MTSE101	Earthquake Engineering Lab	-	-	-	60	40	100	0	0	4	**2**
6.	LC –MTSE102	Design Studio -I	-	-	-	60	40	100	0	0	4	**2**
7.	MLC–MTSE101	Structural Engineering Design Practice (Bridge Course)	70	20	10	-	-	100	2	0	0	**2**
8.	AUD –MTSE101	Disaster Management	70	20	10	-	-	100	2	0	0	**0**
		Total	420	120	60	120	80	800	16	2	8	**20**

Elective-I (PSEC – MTSE101)

(A) Structural Dynamics

(B) Advanced Foundation Design

(C) Prestressed & Precast Construction

Elective-II (PSEC – MTSE102)

(A) Earthquake Analysis and Design of Structures

(B) Structural Assessment and Retrofitting

(C) Structural Optimization

PSCC-MTSE101	Advanced Structural Analysis	3L:1T:0P (Hrs)	4 Credits

Objectives: The objective of this course is to make students to learn principles of Structural Analysis, To implement these principles through different methods and to analyse various types of structures. To evaluate the force and displacement parameters of the structures. Develop the computer programs using the direct stiffness method and Use the commercial software for the analysis.

Module 1 Fundamental concepts (10 Hrs)

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

Module 2 Analysis using Flexibility method (10 Hrs)

Force transformation matrix using Flexibility method, Development of global flexibility matrix for continuous beams, plane trusses and rigid plane frames, Analysis of continuous beams, plane trusses and rigid plane frames by flexibility method.

Module 3 Analysis using Stiffness Method (10 Hrs)

Displacement transformation matrix using Stiffness Method, Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames, Analysis of continuous beams, plane trusses and rigid plane frames by stiffness method

Module 4 Effects of temperature change and lack of fit (10 Hrs)

Related numerical problems by flexibility and stiffness method as in Module 2 and 3

Module 5 Solution techniques & Computer implementation (10 Hrs)

Solution techniques including numerical problems for simultaneous equations, Gauss elimination and Cholesky method. Bandwidth consideration. Introduction to PYTHON/MATLAB programming, Computer programs for beams, plane trusses, plane rigid jointed frames and grids, Use of commercial FEA software.

Course Outcomes:

Students will be able to

CO1. Understand the fundamental concepts of determinate and indeterminate structures

CO2. Apply the concept of Flexibility method of Structural Analysis.

CO3. Apply the concept of Stiffness Method of Structural Analysis.

CO4. Understand the Effects of temperature change and lack of fit in structure analysis.

CO5. Understand Solution techniques of FEA & Computer implementation of FEA program.

Text/Reference Books:

1. Reddy CS." Basic structural analysis". Tata McGraw-Hill Education; 2011.
2. Weaver and Gere, "Matrix Analysis of Framed Structures": CBS Publication.
3. Gupta SP. "Structural analysis: a matrix approach" Tata McGraw-Hill; 1981.
4. Vittorio Lora, "Python for Civil and Structural Engineers"
5. Pratap R. "Getting started with MATLAB: a quick introduction for scientists and engineers." New York: Oxford University Press; 2010.
6. Kassimali, "Matrix Analysis of Structures": Brookes/Cole Publishing Company
7. D. J. Dawe, "Matrix and Displacement Analysis of Structure"s: Oxford University Press
8. Rajsekeran, Sankarsubramanian, "Computational structural Mechanics", PHI
9. Gowrishankar S, Veena A, "Introduction to Python Programming", Chapman and Hall/CRC
10. Sedgewick R, Wayne K, Dondero R. "Introduction to programming in Python: An interdisciplinary approach". Addison-Wesley Professional; 2015 May 27.

PSCC-MTSE102	Advanced Solid Mechanics	3L:1T:0P	4 Credit

Course Objective:

Students shall be able to understand the basic concepts of theory of elasticity. They will be able to solve simple problems of elasticity and plasticity and will be able to apply numerical methods to solve continuum problems.

Module 1 Introduction to Elasticity (10 Hrs)

The Displacement, the Strain and the Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.

Module 2 The Strain Field & The Stress Field (10 Hrs)

Elementary Concept of Strain, Strain at a point, Principal Strains and Principal Axis, Compatibility Conditions. Stress at a point, Stress Components on an arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.

Module 3 Equations of Elasticity & Two-Dimensional Problems of Elasticity (10 Hrs)

Equations of Equilibrium, Stress-strain relations, Strain- displacement and compatibility relations, Boundary value Problems, Co-axiality of the Principal Directions. Plane Stress and Plane Strain Problems, Airy's stress function, Two-Dimensional Problems in Polar Coordinates.

Module 4 Torsion of Prismatic Bars (10 Hrs)

Saint Venant's Method, Prandtl's Membrane analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.

Module 5 Plastic Deformation (10 Hrs)

Elements of Plasticity, Strain-Hardening, Idealized stress-strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening,

Solution of simple Elasticity and Plasticity problems using computer programs

Course Outcomes:

On completion of this course, Students will be able to

CO1. Understand the concept of elasticity

CO2. Understand the principles of stress-strain behaviour of continuum

CO3. Apply equations of elasticity & two-dimensional problems of elasticity

CO 4. Understand concept of Torsion

CO5. Understand the concepts of plasticity.

Text Books: / Reference Books:

1. Timoshenko & Goodier, "Theory of Elasticity", McGraw Hill
2. Srinath L.S., Advanced Mechanics of Solids, 10th print, Tata McGraw Hill Publishing company, New Delhi, 1994
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers
4. Verma P.D.S, "Theory of Elasticity", Vikas Publishing Pvt. Ltd
5. Chenn W.P and Hendry D.J, "Plasticity for Structural Engineers", Springer Verlag
6. Valliappan C, "Continuum Mechanics Fundamentals", Oxford IBH Publishing Co. Ltd.
7. Sadhu Singh, "Applied Stress Analysis", Khanna Publishers
8. Xi Lu, "Theory of Elasticity", John Wiley.
9. A.R.Ragab, S.E.Bayoumi ,"Engineering Solid Mechanics", CRC Press,1999
10. M. Ameen, Narosa, "Computational Elasticity",2005
11. S. M. A. Kazimi, "Solid Mechanics", Tata McGraw Hill,1994
12. W.F. Hosford, " Fundamentals of Engineering Plasticity", Cambridge Press, 2013

PSEC-MTSE101(A)	Structural Dynamics	3L:0T:0P (Hrs)	3 Credits

Objectives: The objective of this course is to make students to learn principles of Structural Dynamics.To implement these principles through different methods and to apply the same for free and forced vibration of structures. To evaluate the dynamic characteristics of the structures

Module 1 Introduction (10 Hrs)

Introduction to Dynamic problems in Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, principle of virtual displacement and energy principles Dynamics of Single degree-of-freedom systems: Mathematical models of Single-degree-of-freedom systems system, Free vibration response of damped and undamped systems. Methods of evaluation of damping.

Module 2 Single-degree-of-freedom systems (10 Hrs)

Response of Single-degree-of-freedom systems to harmonic loading (rotation unbalance, reciprocating unbalance) including support motion, vibration isolation, transmissibility, Numerical methods applied to Single-degree-of-freedom systems – Duhamel integral, principle of vibration-measuring instruments– seismometer and accelerometer.

Module 3 Dynamics of Multi-degree freedom systems (10 Hrs)

Mathematical models of multi-degree-of-freedom systems, Shear building concept, free vibration of undamped multi-degree-of-freedom systems, Natural frequencies and mode shapes, orthogonality property of modes.

Module 4 Response of Shear buildings (10 Hrs)

Response of Shear buildings for harmonic loading without damping using normal mode approach. Response of Shear buildings for forced vibration for harmonic loading with damping using normal mode approach, condition of damping uncoupling.

Module 5 Dynamics of Continuous systems (10 Hrs)

Approximate methods: Rayleigh's method Dunkarley's method, Stodola's method. Dynamics of Continuous systems: Free longitudinal vibration of bars, flexural vibration of beams with different end conditions, Stiffness matrix, mass matrix (lumped and consistent); equations of motion for the discretised beam in matrix form.

Course Outcomes:

Students will be able to

CO1. Understand the Concept of degrees of freedom

CO2. Understand the principles Single-degree-of-freedom systems

CO3. Summarize the Solution techniques for dynamics of Multi-degree freedom systems.

CO4. Understand the concepts of damping in structures.

CO5. Understand various methods involved in dynamics of continuous systems.

Text/Reference Books:

1. Anil K. Chopra, "Dynamics of Structures-Theory and Applications to Earthquake Engineering", Pearson, 3rd Edition, 2011.
2. Gary Hart and Kevin Wong, "Structural Dynamics for Structural Engineers", John Wiley And Sons, 2000.
3. J. W. Smith, "Vibration of Structures. Application in Civil Engineering Design", Chapman and Hall, 1988.
4. Jagmohan L.Humar, "Dynamics of Structures", Prentice Hall, 1990.
5. Mario Paz and William Leigh, "Structural Dynamics - Theory and Computation", Updated With Sap 2000, 5th Edition, Kluwer Academic Publishers.
6. R. W. Clough and J. Penzien, "Dynamics of Structures", Tata Mc Graw Hill, 2nd Edition, 2003.

PSEC-MTSE101(B)	Advanced Foundation Design	3L:0T:0P (Hrs)	3 Credits

Objectives: Students will understand the fundamentals of wave propagation in soil media & to calculate the dynamic properties of soils using laboratory and field tests.

Module 1 Theory of Vibrations **(10 Hrs)**

Basic Definitions- Free and Forced Vibrations with and without Damping for Single Degree Freedom Systems- Resonance and its Effect, Magnification, Logarithmic Decrement, Transmissibility, Natural Frequency of Foundation - Soil system, Barkan's and IS methods, pressure bulb concept, Pauw's Analogy.

Module 2 Wave Propagation **(10 Hrs)**

Elastic Waves in Rods, Waves in Elastic Half Space, Dynamic Soil Properties, Field and Laboratory Methods of Determination – Uphole, Down Hole and Cross Hole Methods, Cyclic Plate Load Test, Block Vibration Test, Determination of Damping Factor.

Module 3 Machine Foundations **(10 Hrs)**

Machine Foundations: Types, Design criteria, permissible amplitudes and bearing pressure.

Module 4 Block Foundation **(10 Hrs)**

Block foundation: Degrees of freedom - analysis under different modes of vibration.

Module 5 Two DoF Systems & Vibration Isolation **(10 Hrs)**

Analysis of Two Degree freedom systems under free and forced vibrations -Principles of Design of Foundations for reciprocating and impact machines as per IS code. Vibration Isolation: Types and methods, Isolating materials and their properties.

Course Outcomes:

Students will be able to

CO1. Apply theory of vibrations to solve dynamic soil problems

CO2. Understand the fundamentals of wave propagation in soil media.

CO3. Analyze the behaviour of a machine foundation resting on the surface and embedded foundation.

CO4. Analyze the block foundation under different modes of vibrations.

CO5. Acquainted with types, methods & materials for vibration isolation systems.

Text/Reference Books:

1. P.Srinivasulu, G.V.Vaidyanathan, Handbook of Machine Foundations, Tata McGraw Hill.
2. Barken, "Dynamics of Bases and Foundations", McGraw Hill Publishing Co., New York.
3. Richart, Hall and Woods, "Vibration of Soils and Foundations", Prentice Hall, Eaglewood Cliffs, New Jersy, USA.
4. Joseph E. Bowles "Foundation Analysis and Design".
5. Kaniraj S.K., "Design aids in soil mechanics and foundation engineering".
6. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley,1980.

PSEC-MTSE101 (C)	Prestressed & Precast Construction	3L:0T:0P (Hrs)	3 Credits

Objectives: Students will be able to understand the basic aspects of pre-stressed concrete fundamentals, including pre and post-tensioning processes. Student will learn to analyze and design pre-stressed concrete flexural members, compression members and pre-stressed concrete bridges.

Module 1Introduction to prestressed concrete (10Hrs)

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 in IS 1343.

Module 2 Statically determinate PSC beams and indeterminate structures (10 Hrs)

Design for ultimate and serviceability limit states for flexure, and flexure combined with axial compression or tension; analysis and design for shear and torsion, code provisions. Transmission of pre-stress in pretensioned members; Anchorage zone stresses for post-tensioned members.Analysis and design -continuous beams andframes, choice of cable profile, linear transformation and concordancy.

Module 3 Composite construction and analysis and design of prestressed concrete (10Hrs)

Composite construction with precast PSC beams and cast in-situ RC slab –Analysisand design, creep and shrinkage effects. Partial prestressing - principles, analysis anddesign concepts, crack-width calculations, design of pipes, tanks and spatial structures -slabs, grids, folded plates and shells. Use of relevant codes of practice.

Module 4 Frame Analysis and Behavior of Structural Components (10Hrs)

Types of precast concrete structures, simplified frame analysis, sub structuring method, strength and serviceability requirements, connection designs, stabilizing methods, standard design of beam, column and slab: Construction of roof and floor slabs, wall panels, columns, shear walls, joints and connections, classification of joints, joints for different structural connections, beam and column - connections types and classifications

Module 5 Production and Hoisting (10Hrs)

Production technology, Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening Hoisting technology, equipment for hoisting and erection, techniques for erection of members like beams, slabs, wall panels and columns, vacuum lifting pads.

Course Outcomes:

Students will be able to

CO1.Identify various prestressed structural elements and apply analytical skills to evaluate performance of prestressed structural elements

CO2. Analyze prestressed structural elements with various considerations.

CO3. design and detail prestressed structural elements for various loading conditions.

CO4. Identify materials used for precast concrete and analyze the structural elements of precast concrete

CO5. Illustrate production and erection methods of precast elements

Text/Reference Books:

1. T.Y. Lin, "Design of Prestressed Concrete Structures", Asia Publishing House, 1955.
2. N. Krishnaraju, "Prestressed Concrete", Tata McGraw Hill, New Delhi, 1981.
3. Y. Guyan, "Limited State Design of Prestressed Concrete", Applied Science Publishers.
4. Srinath. L.S., "Advanced Mechanics of Solids", Tata McGraw-Hill Publishing Delhi Co ltd., New Delhi.
5. S. Ramamrutham, "Prestressed concrete", Dhanpat Rai & Sons, Delhi.
6. Precast Concrete Structures, Kim.S. Elliott,2002, Butterworth-Heinemann, An imprint of Elsevier Science.
7. Precast concrete structures, Hubert Bachmann and Alfred Steinle' First edition, 2011, Ernst &Sohn, GmbH&Co., ISBN978-3-433-60096-2.
8. Multi –Storey Precast Concrete Framed Structures, Kim.S.Elliot and Colin K Jolly, 2nd Edition, November 2013, Wiley-Blackwell, ISBN: 978-1-4051-0614-6.
9. PCI Journal– Proposed Design Requirements for Precast Concrete, Prestressed Concrete Institute, PCI Committee on Building Code and PCI Technical Activities Committee.

PSEC- MTSE102(A)	Earthquake Analysis and Design of Structures	3L:0T:0P (Hrs)	3Credits

Objectives: To understand the behavior of the structure subjected to earthquake forces and earthquake resistant design of the structure.

Module 1 Introduction to Earthquake & Seismic Effects on Structures. (10 Hrs)

Earthquake, Causes of earthquake, Elastic rebound theory, Seismic waves, Earthquake Size, Internal structure of earth, Seismicity in India, Classification of earthquake, Seismic effects on structure, Inertia forces in structures, Twisting effect, Seismic design philosophy of buildings, ductility , Load path, Earthquake effect on RC frame building, Earthquake effects on Masonry buildings, importance of beam column joint.

Module 2 Indian Earthquakes (10 Hrs)

Learning from earthquakes, Historical development and current status of earthquake engineering in India, Case studies of most hazardous earthquakes and retrofitting techniques.

Module 3 Earthquake Resistant Design of RC Frame Buildings. (10 Hrs)

Seismic and dynamic Equilibrium, Structural Modelling, Code based seismic method of structural analysis and design, Introduction to IS1893-2016, Introduction to IS 13920-2016, Design examples.

Module 4 Earthquake Resistant Design of Masonry Buildings. (10 Hrs.)

Seismic Performance of masonry buildings during past earthquakes, Behavior of brick masonry Structures: Behavior of brick masonry walls, box action, Different types of Bands, Elastic properties of masonry assemblage, Lateral load analysis of masonry buildings, Introduction to confined masonry buildings.

Module 5 Seismic Performance Assessment Methods (10 Hrs)

Introduction to linear static analysis, linear dynamic analysis, nonlinear static analysis, nonlinear dynamic analysis, Seismic performance of different types of structures using pushover analysis, time history analysis, incremental dynamic analysis.

Course Outcomes:

Students will be able to

CO 1. Understand earthquake & seismic effects on structures

CO 2. Study the past earthquake and retrofitting techniques

CO 3. Apply the concept of ductile detailing in RC structures.

CO 4. Design earthquake resistant masonry buildings.

CO 5. Understand the various seismic performance assessment methods of structures.

Text/Reference Books and IS Codes:

1. Manish Shrikhande & Pankaj Agrawal, "Earthquake resistant design of structures", PHI, 3rd Edition, 2006
2. S. K. Duggal, "Earthquake resistance design of structures", Oxford University Press, 2nd Edition 2005.
3. Park & Pauly, "Reinforced Concrete Structures", John Willy & Son's, 2nd Edition, 1975.
4. C V R Murthy, "Earthquake Tips", NICEE, 2002.
5. IITK-GSDMA EQ26 –V-3.0 "Design Example of a Six Storey Building", 2008.
6. IS: 13920 (1993), Code of Practice for Ductile Detailing of RC Structures.
7. IS: 4326 (1993), Code of Practice for Earthquake Resistant Design and Construction of Buildings.
8. IS: 13827 (1993), Improving Earthquake Resistance of Earthen Buildings.
9. IS: 13828 (1993), Guide lines for Improving Earthquake Resistance of low Strength Masonry Buildings.

Web Materials:

1. http://www.cdeep.iitk.ac.in/nptel
2. http://www.nptel.iitm.ac.in

PSEC-MTSE102(B)	Structural Assessment & Retrofitting	3L:0T:0P (Hrs)	3 Credits

Objectives: The objective of this course is to make students learn principles of Structural health monitoring and retrofitting, to implement these principles through different methods such as electrical impedance, wave propagation and advanced signal processing techniques to evaluate the structural health monitoring of the structures and retrofit the structure.

Module 1 Introduction to SHM & Smart Materials (10 Hrs)

Motivation and objectives of structural health monitoring, Working principles of smart materials used for sensors and actuators, Structural Health Monitoring verses Non Destructive Testing, Piezoelectric materials (Constitutive relation, unimorph, bi-morph, Electromechanical coefficient, resonance/anti-resonance), Electrostrictive materials (Constitutive relation, sensor, actuator, figures of merit), Magnetostrictive materials (Constitutive relation, sensor, actuator, figures of merit), Optical Fiber (Fiber Bragg grating, strain sensing, ultrasonic sensing).

Module 2 Damage Diagnostic Methods in SHM (10 Hrs)

Vibration response, Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method

Electrical impedance method, Beam model, Plate Model,

Wave propagation methods; Bulk waves/Lamb waves, Reflection and transmission, Wave tuning/mode selectivity, Migration imaging, Phased array imaging, Focusing array/SAFT imaging.

Module 3 Advanced signal processing methods in SHM (10 Hrs)

Wavelet, Neural networks, Vector support machine. Applications of structural health monitoring in aerospace including sandwich composite structures, civil infrastructures, pipelines, rotating machinery.

Module 4 Retrofitting Material and Performance Requirements (10 Hrs)

Materials for repair-Premixed cement concrete and mortars, polymer modified mortars and concrete, epoxy and epoxy systems, polyester resins, coatings - Rehabilitation and retrofitting methods-repair options, performance requirements of repair systems, important factors to be considered for selection of repair methods. Identifying a suitable repair option for certain damage in a structure - Repair stages, Repair methods-guniting, shortcreting, polymer concrete system,

reinforcement replacement, strengthening concrete by surface impregnation, polymer and epoxy overlays

Module 5 Repair & Rehabilitation strategies (10 Hrs)

Repair methods- Resin/polymer modified slurry injection, plate bonding technique, ferrocement jacketing, RCC jacketing, propping and supporting - Repair methods- fiber wrap technique, foundation rehabilitation methods, chemical and electrochemical method of repair. Repair/Rehabilitation strategies- Stress reduction technique, repair and strengthening of columns and beams - Rehabilitation strategies-Compressive strength of concrete, cracks/joints, masonry, foundation, base isolation.

Course Outcomes:

Students will be able to

CO1. Understand concepts in structural health monitoring, Repair and Rehabilitation strategies

CO2. Understand vibration control methods, electrical impedance methods and wave propagation methods in structural health monitoring.

CO3. Understand advanced signal processing methods.

CO4. Understand retrofitting material and performance requirements.

CO5. Understand repair & rehabilitation strategies.

Text/Reference Books:

1. V. Giurgiutiu, "Structural Health Monitoring with Piezoelectric Wafer Active Sensor"s", Academic Press.
2. B. Culshaw, "Smart Structures & Materials", Artech House, Boston.
3. A. V. Srinivasan, D. M. Macfarland, "Smart Structures: Analysis & Design", University Press, Cambridge, UK.
4. Chang FK. "Structural health monitoring: current status and perspectives". CRC Press; 1998 Apr 24.
5. Wild P. "Industrial sensors and applications for condition monitoring". Mechanical Engineering Pub.; 1994.
6. Armer, G.S.T (Editor), "Monitoring and assessment of structures", Spon, London.

7. Wu, Z.S. (Editor), “Structural health monitoring and intelligent infrastructure”, Volumes 1 and 2, Balkema.
8. Harris, C.M., “Shock vibration handbook”, McGraw-Hill.
9. Rao, J.S., “Vibratory condition monitoring of machines”, Narosa Publishing House, India.
10. R.N. Raikar, “Learning from failures - Deficiencies in Design, Construction and Service” Rand Centre (SDCPL), Aikar Bhavan, Bombay, 1987.
11. Santhakumar A.R., “Concrete Technology” Oxford University Press, New Delhi, 2007.
12. “CPWD Handbook on Repair and Rehabilitation of RCC buildings”, Govt of India Press, New Delhi, 2014.
13. ACI Handbook on Repair and Rehabilitation of RCC buildings
14. ICI Handbook on Repair and Rehabilitation of RCC buildings

PSEC-MTSE102 (C)	Structural Optimization	3L:0T:0P (Hrs)	3 Credits

Objectives: The objective of this course is to make students learn principles of optimization, implementing the optimization concepts for the structural engineering problems and to evaluate different methods of optimization.

Module 1 Introduction **(10 Hrs)**

Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques.

Module 2 Linear Programming **(10 Hrs)**

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

Module 3 Non-linear programming & **Constrained Nonlinear Programming** **(10 Hrs)**

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

Module 4 Geometric and Dynamic Programming **(10 Hrs)**

Geometric programming: Geometric programming, conversion of NLP as a sequence of LP/ geometric programming. Dynamic programming: Dynamic programming conversion of NLP as a sequence of LP/ Dynamic programming.

Module 5 Structural Engineering Applications **(10 Hrs)**

Methods for optimal design of structural elements, continuous beams and single storied frames

using plastic theory, Minimum weight design for truss members, Fully stressed design, Optimization principles to design of R.C. structures such as multi-storey buildings, water tanks and bridges. Structural optimization for transient (dynamic) problems.

Course outcomes:

On completion of this course, students are able to:

CO1. Understand engineering applications of optimization.

CO2. Understand the concept of linear programming.

CO3. Understand non-linear programming & constrained nonlinear programming.

CO4. Apply geometric programming & dynamic programming.

CO5. Understands the optimization principles to design of R.C. structures

Text/Reference Books:

1. Spunt, "Optimum Structural Design", Prentice Hall
2. Rao, S.S. (2014), "Engineering Optimization: Theory and Practice, New Age International,
3. Uri Krisch, "Optimum Structural Design", McGraw Hill
4. Richard Bronson, "Operation Research", Schaum's Outline Series
5. Bhavikatti S.S.- "Structural optimization using sequential linear programming", Vikas publishing house
6. Raphael T. Haftka, ZaferGürdal, (2012), "Elements of Structural Optimization, Series in Solid Mechnics and its Applications", Vol. 11, Springer Science & Business Media, Netherlands.
7. Osvaldo M. Querin, Mariano Victoria, Cristina Alonso Gordoa, Rubén Ansola, PascualMartí, (2017), "Topology Design Methods for Structural Optimization", Butterworth-Heinemann.
8. Andrej Cherkaev, (2012), "Variational Methods for Structural Optimization", Vol.140, Applied Mathematical Sciences, Springer Science & Business Media, Netherlands.

LC –MTSE101	Earthquake Engineering Lab	0L:0T:4P (Hrs)	2Credits

Objectives: The main objectives of earthquake engineering are to foresee the potential consequences of strong earthquakes on urban areas and civil infrastructure, with various structural arrangements and to understand the effectiveness of various structural arrangements underground shakings.

Sr. No	Practical Name	Application
1	Lump mass with equal height	To understand effect of frequency and present travel on structure having equal height
2	Lump mass with variable height	To understand effect of frequency and present travel on structure having variable height
3	Lump mass with different material	To understand effect of frequency and present travel on structure having different material
4	Lump mass with different thickness	To understand effect of frequency and present travel on structure having different thickness
5	Single degree freedom system	To understand behavior of multi degree of freedom system under lateral load
6	Multi degree freedom system	To understand behavior of single degree of freedom system under lateral load
7	Building without structural control system	To understand behavior of Uncontrolled structure under earthquake
8	Building with X-Bracing	To understand behavior of building having X-Bracing under earthquake
9	Building with Shear wall	To understand behavior of building having shear wall under earthquake
10	Pounding Effect	To understand pounding effect of structure
11	Liquefaction of Soil	To understand liquefaction of soil under dynamic loading

Course Outcomes:

Students will be able to

CO1. Understand effect of frequency on structure having equal and variable height.

CO2. Understand effect of frequency on structure having different material and different thickness.

CO3. Understand behavior of single and multi-degree of freedom system under lateral load.

CO4. Understand the effectiveness of various structural arrangements underground shakings.

LC-MTSE102	Design Studio-I	0L:0T:4P (Hrs)	2 Credits

Objectives: Practical training for conducting experiments related to structural engineering. Capability to use software's for analysis, design and detailing and experimental data.

Course Contents:

Engineering design principles, interactive design using workstations, and software tools. Programming languages (C++, Python, and MATLAB etc.), data structures and their design, Computer graphics, introduction to GKS, Starbase Libraries. Computer aided drafting, data base management system, simulation and optimization. Applications in Civil Engineering, structural design. Analysis for gravity and seismic loadings by using STAAD/SAP/ETAB/ ABAQUS/ ANSYS/MIDAS GEN.

Course Outcomes:

Students will be able to

CO1. Computational thinking development through creative programming

CO2. IS Code based modeling

CO3. Analyze & Design the structures and interpret the results

CO4. Understand the overall Behavior of Structure Component and its design

MLC –MTSE101	Structural Engineering Design Practice (Bridge Course)	2L:0T:0P (Hrs)	2 Credits

Objective: Students will be able to analyze the special structures by understanding their behavior and will be able to design and prepare detail structural drawings for execution citing relevant IS codes.

Module -1

Theory and Design of silos, bunkers, grid floors, aqueduct, folded plates, flat slabs, Design of shells. Beams on elastic foundation

Module -2

Structural steels, Plastic analysis and design for rectangular frames, gable frames. Beam columns.

Module -3

Gantry girder, Design of plate girders.

Course outcomes:

On completion of this course, students are able to:

CO1. Understand the design concept of different structures.

CO2. Learn analysis and design of structural steel structures..

CO3. Learn analysis and design of Plates and Girders.

References:

1. P. C. Varghese, “Advanced Reinforced Concrete Design”; Prentice Hall of India, New Delhi.
2. B.C. Punmia, A. K. Jain, Arun K. Jain, “Reinforced concrete structures” Vol II, Laxmi Publications, New Delhi.
3. T.Y. Lin and N. H. Burns, “Design of Prestressed Concrete Structures”, John Wiley Publication.
4. N. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co.
5. Design of steel structures – Vol II by Ramchandra. Standard Book House Delhi.
6. Design of Steel Structures -- A.S. Arya, J.L. Ajmani; Nemchand and Bros. Roorkee
7. Structural Analysis and design of Tall Buildings --Bungale S. Taranath; Mc Graw Hill International Edition
8. The Steel Skeleton Vol II Plastic Behaviour and Design - J.F. Baker, M.R. Horne, J. Heyman, ELBS.
9. “Plastic Methods of Structural Analysis” by Neal B.G. Chapman and Hall London.
10. SP – 6 (BIS) , IS 800 (2007), IS:456

AUD- MTSE101	Disaster Management	2L:0T:0P (2hrs)	0Credits

Objectives: To understand the conceptual applications of principles of management to mitigate various disasters.

Module 1 Understanding Disaster (08 Hrs)

Understanding Disasters, Disaster Management, Disaster Management Cycle, Key Phases of disaster management, Acceptable risk, Capacity, Capacity development, Contingency planning, Coping capacity, Critical facilities, Disaster risk, Disaster risk reduction, Emergency services, Environmental impact assessment, Hazard, Mitigation, Preparedness, Recovery, Response, Retrofitting, Risk, Sustainable development, Vulnerability.

Module 2 Types, Trends, Causes, Consequences and Control of Disaster (10 Hrs)

Geological Disasters (earthquakes, landslides, tsunami, mining), Hydro Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves). Biological Disasters (epidemics, pest attacks, forest fire). Technological Disasters (chemical, industrial, radiological, nuclear) and Man-made Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters

Module 3 Economic and Financial Aspect of Disaster Management (12 Hrs)

Financial Planning and control of disaster mitigation and management implementation programmes. Comparative analysis models for disaster mitigation and management. Budgeting, Identifying sources of funds and provision of funds. Economic consequences of disaster and intangible economic impacts of disaster. Principles of economic recovery and strategies for economic recovery. Financial recovery from disaster- disaster insurance, natural disaster relief arrangements and public disaster appeals.

Module 4 Strategic Disaster Management (12Hrs)

Understanding the application of the principles and procedures of strategic management in the domain of disaster mitigation and management. Strategy formulation, understanding strategic intent, vision, mission for better forecasting of disaster threats and their prevention and strategic

management of disaster. Strategic management principles, methods and tools. planning, organizing, leadership and monitoring and evaluation of all role-players in disaster management.

Course Outcomes:

Students will be able to

CO 1. Understand disasters, disaster preparedness and mitigation measures

CO 2. To gain understand approaches of Disaster Risk Reduction (DRR) and the relationship between vulnerability, disasters, disaster prevention and risk reduction.

CO 3. Understand the economic and financial aspect of .disaster management.

CO 4. Understand the different strategies involved in disaster management.

Text/Reference Books and IS Codes:

1. Weihrich, H. and Koontz, H Management, "A Global Perspective", , McGraw Hill, New York, 1st Edition, 1996.
2. Kapur Anu and Neti , "Disasters in India: Studies of Grim Reality", Rawat Publication, 1st Edition, 2005
3. H. N. Srivastava & G. D. Gupta, "Management of Natural Disasters in developing countries", Daya Publishers, Delhi, 2nd Edition 2006.
4. Disaster Management Act 2005, Publisher by Govt. of India.
5. National Disaster Management Policy, 2009, Govt. of India.
6. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
7. Mrinalini Pandey, "Disaster Management", Wiley India Pvt. Ltd, 1st Edition 2012

Web Materials:

1. www.nidmindia.nic.in
2. http://quake.usgs.gov

IPS ACADEMY

Institute of Engineering and Science, Indore (M.P.)

A UGC Autonomous Institute,

Affiliated to Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, (M.P.)

Masters of Technology (M.Tech.) Civil Engineering

Specialization: Structural Engineering

Semester II [First Year]

Second Semester (Autonomy) CE

S.No.	Course Code	Course Title	Maximum Marks Allotted					Total Marks	Hrs./Week			Total Credits
			Theory			Practical						
			End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	PSCC–MTSE201	FEM in Structural Engineering	70	20	10	-	-	100	3	1	0	**4**
2.	PSCC–MTSE202	Theory of Plates and Shells	70	20	10	-	-	100	3	1	0	**4**
3.	PSEC–MTSE201	Elective -III	70	20	10	-	-	100	3	0	0	**3**
4.	OEC– MTSE201	Instrumentation and Measurement Techniques	70	20	10	-	-	100	3	0	0	**3**
5.	LC–MTSE201	Instrumentation Lab	-	-	-	60	40	100	0	0	4	**2**
6.	LC–MTSE202	Design Studio -II	-	-	-	60	40	100	0	0	4	**2**
7.	MLC–MTSE201	Research Methodology & IPR	70	20	10	-	-	100	2	0	0	**2**
8.	AUD –MTSE201	Stress Management	70	20	10	-	-	100	2	0	0	**0**
		Total	420	120	60	120	80	800	16	2	8	**20**

Elective-III (PSEC – MTSE201)

(A) Advanced Steel Design

(B) Concrete Technology

(C)Design of Bridge Structures

PSCC-MTSE201	FEM in Structural Engineering	3L:1T:0P (Hrs)	4 Credits

Objectives: The objective of this course is to make students to learn principles of Analysis of Stress and Strain, To apply the Finite Element Method for the analysis of one and two dimensional problems and to evaluate the stress and strain parameters and their inter relations of the continuum.

Module 1 **(10 Hrs)**

Basic concepts of elasticity, Kinematic and Static variables for various types of structural problems, approximate method of structural analysis, Rayleigh, Ritz method, Finite difference method, Finite element method. Variation method and minimization of Energy approach of element formulation. Principles of finite element method, advantages & disadvantages, Finite element procedure. Finite elements used for one, two & three dimensional problems, Element aspect ratio, and mesh refinement vs. higher order elements, Numbering of nodes to minimize band width.

Module 2 **(10 Hrs)**

Nodal displacement parameters, Convergence criterion, Compatibility requirements, Geometric invariance, Shape function, Polynomial form of displacement function. Generalized and Natural coordinates, Lagrangian interpolation function, shape functions for one, two & three dimensional elements.

Module 3 **(10 Hrs)**

Isoparametric elements, Internal nodes and higher order elements, Serendipity and Lagrangian family of Finite Elements, Sub-parametric and Super parametric elements, Condensation of internal nodes, Jacobian transformation Matrix. Development of strain-displacement matrix and stiffness matrix, consistent load vector, numerical integration.

Module 4 **(10 Hrs)**

Application of Finite Element Method for the analysis of one & two dimensional problems, Analysis of simple beams and plane trusses, Application to plane stress / strain / axis symmetric problems using CST & Quadrilateral Elements

Module 5 **(10 Hrs)**

Application to Plates & Shells, Choice of displacement function (C0, C1 and C2 type), Techniques for Non-linear Analysis.

Course Outcomes:

Students will be able to

CO1. Achieve Knowledge of basic concepts of elasticity and finite elements.

CO2. Use Finite Element Method for structural analysis.

CO3. Understand the concepts of matrix and vector.

CO4. Solve continuum problems using finite element analysis.

CO5. Learn the state of stress in a continuum.

Text/Reference Books:

1. Krishnamoorthy C S, "Finite Element Analysis"- Tata McGraw Hill
2. Desai C and Abel J F, "Introduction to the Finite Element Method"- East West Press Pvt. Ltd., 1972
3. Bathe K J, "Finite Element Procedures in Engineering Analysis"- Prentice Hall
4. Rajasekaran. S, "Finite Element Analysis in Engineering Design"-Wheeler Publishing
5. Cook R D, Malkan D S & Plesta M.E, "Concepts and Application of Finite Element Analysis" - 3rd Edition, John Wiley and Sons Inc., 1989
6. Shames I H and Dym C J, "Energy and Finite Element Methods in Structural Mechanics"- McGraw Hill, New York, 1985
7. P. Seshu: "Finite Element Analysis": Prentice-Hall of India.
8. A. D. Belegundu and T. R. Chandrupatla:" Finite Element Methods in Engineering": Prentice-Hall of India
9. Y. M. Desai, T. I. Eldho and A. H. Shah: "Finite Element Method with Applications in Engineering"-PEARSON
10. D. V. Hutton: "Fundamentals of Finite Element Analysis": TATA McGRAWHILL
11. J. N. Reddy: "An Introduction to Finite Element Method": TATA McGRAWHILL
12. Zeinkeiwich O.C.,R.L.Tayler " The Finite Element Method for Solid and Structural Mechanics", Butterworth-Heinemann, (2013).

PSCC-MTSE202	Theory of Plates and Shells	3L:1T:0P (Hrs)	4 Credits

Objectives: The objective of this course is to make students to learn different methods of analysis and design of plates and shells and detail them critically also to evaluate the performance of spatial structures.

Module 1 Introduction to Plate Theory **(10 Hrs)**

Thin and Thick Plates, Small and Large Deflection Theory of Thin Plate, Assumptions in Analysis of Thin Plates, Slope Curvature Relations, Moment - Curvature Relations, Stress Resultants, Governing Differential Equations for Bending of Plates, Various Boundary Conditions.

Module 2 Navier's and Levy's Solution, Circular Plates **(10 Hrs)**

Rectangular Plates Subjected to Uniformly Distributed Load, Sinusoidal Load for Different Boundary Conditions. Analysis of Circular Plates under Axis-Symmetric Loading, Moment Curvature Relations, Governing Differential Equation in Polar Co-Ordinates, Simply Supported and Fixed Edges, Distributed Load, Ring Load, a Plate with Hole at Center.

Module 3 Introduction to Shell Structures **(10 Hrs)**

Classification of Shells on basis of Geometry, Thin Shell Theory, Equation of Shell Surfaces, Stress Resultants, Stress- Displacement Relations, Compatibility and Equilibrium Equations.

Module 4 Membrane Analysis **(10 Hrs)**

Equation of Equilibrium for Synclastic Shells, Solution for Shells Subjected to Self Weight and Live Load, Cylindrical Shells - Equation of Equilibrium, Open Shells With Parabolic, Circular, Elliptical Directrix, Simple Problems, Shells With Closed Directrix-Circular, Elliptical-Simple Problems, Problems on Pipes Carrying Fluid/Liquid Under Pressure, Just Filled & Partly Filled.

Module 5 Bending of Cylindrical Shells **(10 Hrs)**

Symmetrically Loaded Circular Cylindrical Shells, Beam Theory, Finsterwalder's Theory, D.K.J. Theory- Donnell's Equation, Characteristic Equation, Schorer's Theory.

Course Outcomes:

Students will be able to

CO1. Understand and derive governing differential equation bending of plates.

CO2. Understand the solution technique Navier's and Levy's solution for plates

CO3. Understand the shell structures and its equations

CO4. Understand membrane theory for internal forces in different shells.

CO5. Understand bending of cylindrical shells and its theory

Text/Reference Books:

1. S. Timoshenko and W. Krieger, "Theory of Plates and Shells", Mc Grew Hill.
2. Ansel C. Ugural, "Stresses in Plates and Shells", Mc Graw Hill.
3. G. S Ramaswamy, "Design and Construction of Concrete Shell Roofs", CBS Publications.
4. Chandrashekhara K., "Analysis of Concrete Shells", New Age International Edition.
5. Chandrashekhara K., "Analysis of Plates", New Age International Edition.
6. Reddy, J. N.; "Theory and Analysis of Elastic Plates and Shells", Taylor & Francis.
7. R. Szilard, "Theory and analysis of plates - classical and numerical methods", Prentice Hall,1994
8. Chatterjee.B.K. ,"Theory and Design of Concrete Shell", Chapman & Hall, New York-third edition, 1988

PSEC-MTSE201 (A)	Advanced Steel Design	3L:0T:0P (Hrs)	3 Credits

Objective: Understand the background to the design provisions for hot-rolled and cold-formed steel structures, including the main differences between them. Proficiency in applying the provisions for design of columns, beams, beam-columns. Design structural sections for adequate fire resistance.

Module 1 Laterally Unrestrained Beams **(10 Hrs)**

Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono- symmetric and non- uniform beams – Design Examples. Concepts of -Shear Center, Warping, Uniform and Non-Uniform torsion.

Module 2 Beam- Columns in Frames **(10 Hrs)**

Behaviour of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 – Examples.

Module 3 Steel Beams with Web Openings **(10 Hrs)**

Shape of the web openings, practical guide lines, and Force distribution and failure patterns, Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties, Vierendeel girders (design for given analysis results)

Module 4 Cold formed steel sections **(10 Hrs)**

Techniques and properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 801& 811 code provisions- numerical examples, beam design, column design.

Module 5 Fire resistance **(10 Hrs)**

Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Methods of fire protection, Fire resistance ratings- Numerical Examples.

Course Outcomes:

Students will be able to

CO1. Achieve knowledge of lateral buckling of beams.

CO2. Understand the provisions for design of columns, beams, beam-columns

CO3.Understand concept of steel beams with web openings

CO4. Understand the cold-formed steel structures and design

CO5. Understand the concepts of fire resistance steel Structure.

Text/Reference Books:

1. N. Subramanian, “Design of Steel Structures”, Oxford,IBH
2. Duggal.S.K., “Design of Steel Structure”, Tata McGraw-Hill Education, 2000
3. IS 1641, 1642,1643
4. IS 800: 2007, IS 811
5. INSDAG Teaching Resource Chapter 11 to 20: www.steel-insdag.org
6. W.W. Yu, "Cold-Formed Steel Design", John Wiley & Sons.
7. IS 801: 1975, Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction.
8. BS 5950-5:1998, Structural Use of Steelwork in Building: Code of Practice for Design of Cold Formed Thin Gauge Sections.

PSEC-MTSE201 (B)	Concrete Technology	3L:0T:0P (Hrs)	3 Credits

Objective: The course is designed to provide advanced level knowledge on properties of concrete and its performance based on the behavior of ingredients and environmental conditions.

Module 1 Materials And Their Properties (10 Hrs)

Review of properties of cement, their physical and chemical properties, special purpose cements, Classification and properties of aggregates, soundness of aggregates, alkali aggregate reaction, thermal properties of aggregates, Importance of shape and Surface area and grading, gap graded and aggregates. Admixtures & construction chemicals, Use of Fly Ash, Silica Fumes, Metakaolin & GGBS in concrete, Introduction to prestressed concrete.

Module 2 Properties of Concrete (10 Hrs)

Rheological behavior of concrete, requirements of workability of concrete, Durability & Effect of environmental conditions, Strength & maturity of hardened concrete, Impact, Dynamic and fatigue behaviour of concrete, shrinkage and creep of concrete, behaviour of concrete under fire.

Module 3 Permeability and durability of concrete (10 Hrs)

Permeability and Durability of concrete, Parameters of durability of concrete, chemical attack on concrete, Production of concrete; batching mixing, transportation, placing, compaction of concrete. Special methods of concreting and curing, Hot weather and cold weather concreting, Guniting (Shotcreting).

Module 4 Concrete Mix Design (10 Hrs)

Concrete mix design, Basic considerations and choice a mix proportions, various methods of mix designs including IS Code method. Quality control and quality assurance of concrete, Acceptance criteria, Quality management in concrete construction, Inspection and testing of concrete. Non-destructive testing of concrete, core test and load test.

Module 5 Special Concrete (10 Hrs)

Special concrete such as high strength, Lightweight, heavy weight, vacuum processed concrete, Mass concrete, high performance concrete, Pumpable concrete, Self-Compacting concrete, Air entrained concrete, Ferro cement, fiber reinforced concrete, Polymer impregnated concrete. Jet concrete. Recycling & re-use of industrial waste material. Deterioration and repair technology of

concrete, Distress and type of repairs, crack sealing techniques

Course Outcomes:

Students will be able to

CO1. Understand the concrete constituents and their properties.

CO2. Understand the fresh and hardened properties of concrete.

CO3. . Understand the various durability properties of concrete.

CO4. Understand, Analyze and Evaluate the Concrete mix design.

CO5. Learn various types of special concrete and their uses.

Text/Reference Books:

1. Neville, A.M., "Properties of Concrete", Pearson Education Asia (P) Ltd, England, 2000.
2. Shetty , M.S., "Concrete Technology", S.Chand& Company New Delhi
3. P. Kumar Mehta, Paul J.N. Monterio, CONCRETE: "Microstructure, Properties and Materials", Tata McGraw Hill
4. A.R.Santhakumar, (2007) "Concrete Technology"-Oxford University Press, New Delhi, 2007
5. Gambhir "Concrete Technology" Tata McGraw Hill
6. Short A and Kinniburgh.W, "Light Weight Concrete"- Asia Publishing House, 1963
7. Aitcin P.C. "High Performance Concrete"-E and FN, Spon London 1998
8. Rixom.R. and Mailvaganam.N., "Chemical admixtures in concrete"- E and FN, Spon London 1999
9. Rudnai.G., "Light Weight concrete"- Akademiaikiado, Budapest, 1963
10. http://qcin.org/CAS/RMCPC/

PSEC-MTSE201 (C)	Design of Bridge Structures	3L:0T:0P (Hrs)	3 Credits

Objective: The objective of this course is to make students to learn principles of Structural Design to design different types of bridge structures and to detail the structures and to evaluate performance of the bridge structures.

Module 1 Introduction **(10 Hrs)**

Historical Developments, Site Selection for Bridges, Planning and layout of bridges: Hydraulic design - Geological and geotechnical considerations, Classification of Bridges Forces on Bridges. Bridge substructures: Abutments, piers and wing walls Balanced Cantilever Bridge: Introduction and proportioning of components.

Module 2 Slab Bridge **(10 Hrs)**

Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, working out the worst combination of loading, Moment Distribution, Calculation of BM & SF, Structural Design of Slab Culvert, with Reinforcement Details.

Module 3 T Beam Bridge Slab Design **(10 Hrs)**

Proportioning of Components Analysis of interior Slab & Cantilever Slab Using IRC Class AA Tracked, Wheeled Class A Loading, Structural Design of Slab, with Reinforcement Detail. T Beam Bridge Cross Girder Design: Analysis of Cross Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading A Loads, Structural Design of Beam, with Reinforcement Detail.

Module 4 T Beam Bridge Main Girder Design **(10 Hrs)**

Analysis of Main Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading Using COURBON'S Method, Analysis of Main Girder Using HENDRY-JAEGER and MORICE-LITTLE Method for IRC Class AA Tracked vehicle only, BM & SF for different loads, Structural Design of Main Girder With Reinforcement Details

Module 5 PSC Bridges , Sub-structure & Foundation **(10 Hrs)**

Introduction to Pre and Post Tensioning, Proportioning of Components, Analysis and Structural Design of Slab, Analysis of Main Girder using COURBON's Method for IRC Class AA tracked vehicle, Calculation of pre-stressing force, cable profile and calculation of stresses, Design of

End block and detailing of main girder.Piers, Columns and towers, Analysis and design, Shallow and deep foundations, Caissons, Abutments and retaining walls. Bridge appurtenances: Expansion joints, Design of joints, Types and functions of bearings - Design of elastomeric bearings.

Course Outcomes:

Students will be able to

CO1. Understand the selection, planning and layout of bridge.

CO2. Understand the design concept of slab bridge.

CO3. Understand the Analysis and design T beam bridge slab.

CO4. Understand the Analysis and design T beam bridge main girder.

CO5. Understand the Analysis and design PSC bridges, sub-structure & foundation

Text/Reference Books:

1. Essentials of Bridge Engineering- D Johnson Victor, Oxford & IBH Publishing Co New Delhi
2. Design of Bridges- N Krishna Raju, Oxford & IBH Publishing Co New Delhi
3. Principles and Practice of Bridge Engineering- S P Bindra Dhanpat Rai & Sons New Delhi IRC 6
4. Standard Specifications and Code of Practice For Road Bridges- Section II Loads and Stresses, The Indian Road Congress New Delhi
5. IRC 21 “Standard Specifications and Code of Practice for Road”
6. Bridges-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
7. IS 456 “Indian Standard Plain and Reinforced Concrete Code of Practice”- (Fourth Revision) BIS New Delhi
8. IS 1343 “Indian Standard Prestressed Concrete Code of Practice”- BIS New Delhi
9. Raina V.K., “Concrete Bridge Practice”- Tata McGraw Hill
10. Bakht B & Jaeggar, “Bridge Analysis Simplified”- McGraw Hill

11. Ponnuswamy. S, “Bridge Engineering”- Tata McGraw Hill.
12. Derrick Beckett, “An Introduction to Structural Design of Concrete Bridges”- Surrey University Press
13. All Relevant codes & Specification published by IRC & BIS

OEC-MTSE201	Instrumentation and Measurement Techniques	3L:0T:0P (Hrs)	3 Credits

Objectives: To get a basic understanding of experimental methods (e.g. strain gages, photo elasticity and non destructive tests) commonly used in experimental solid mechanics.

Module 1 Introduction To Various Measurement Systems & Sensors (10 Hrs)

Principles of measurements, Accuracy, Sensitivity and range of measurements, calibration and sensitivity, Sensor system elements, transducer and devices, Different types of sensors, Modifying and transmitting method. Mechanical, Hydraulic, Electrical and Electronic System.

Module 2 Electrical Resistance Strain Gauges (10 Hrs)

Principle of operation and requirements, Types and their uses, Materials for strain gauges, Calibration and temperature compensation, cross sensitivity, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators, Rosette analysis, stress gauges, load cells, Data acquisition, six component balance.

Module 3 Photo-Elasticity (10 Hrs)

Nature of light, Wave theory of light - optical interference , Stress optic law – effect of stressed model in plane and circular polariscopes, Isoclinics & Isochromatics, Fringe order determination Fringe multiplication techniques, Calibration photoelastic model materials.

Module 4 Two Dimensional & Three Dimensional Photo-Elasticity Gauges (10 Hrs)

Separation methods: Shear difference method, Analytical separation methods, Model to prototype scaling, Properties of 2D photo-elastic model materials, Materials for 2D photo elasticity**.** Stress freezing method, Scattered light photo-elasticity, Scattered light as an interior analyzer and polarizer, Scattered light polariscope and stress data Analyses.

Module 5 Non Destructive Testing 10 Hrs)

Non destructive testing as per IS codes. Rebound hammer test. Ultrasonic pulse velocity Concrete testing. Penetration methods. Pull off and pull out test.

Course Outcomes:

Students will be able to

CO1. Achieve knowledge of various measurement systems and sensors.

CO2. Achieve knowledge of stress and strain measurements in loaded components.

CO3. Understanding various concepts of photo elasticity.

CO4. Understand the two dimensional & three dimensional photo-elasticity gauges

CO5. Understand the techniques of measurement &. Knowledge in NDT in stress analysis.

Text/Reference Books:

1. Dally, J.W., and Riley, W.F., "Experimental Stress Analysis", McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., "Experimental Stress Analysis", Tata McGraw Hill, New Delhi, 1984.
3. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 1996.
4. Reference Books:
5. Hetenyi, M., "Hand book of Experimental Stress Analysis", John Wiley and Sons Inc., New York, 1972.

LC-MTSE201	Instrumentation Lab	0L:0T:4P (Hrs)	2 Credits

Objectives: The objective of the course is to introduce the fundamentals of Electronics Instruments and Measurement providing an in-depth understanding of Measurement errors, Bridge measurements, Digital Storage Oscilloscope, Function Generator and Analyzer, Display devices, Data acquisition systems and transducers.

Module 1 Sensors & Transducer

Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

Module 2 Temperature & Proximity Sensors

Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

Module 3 Data Acquisition Methods

Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.

Module 4 Intelligent Sensors

General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

Module 5 Photoelasticity

Light and Optics as Related to Photoelasticity Behavior of Light, Polarized Light, Plane Polarizers,, Wave Plates, Arrangement of Optical Elements in a Polariscopic, Analysis Techniques: Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, separation Techniques, Sealing Model to Prototype Stresses. Three Dimensional Photoelasticity:

Locking in Model Deformation Slicing the Model and Interpretation of the Resulting Fringe Pattern, Effective Stresses. the Shear Difference Method in Three Dimensions.

Course Outcomes:

Students will be able to

CO1. Understand the use of various sensors & transducer

CO2. Understand the use of various temperature & proximity sensors

CO3. Learn about the different types of data acquisition methods

CO4. Understand the use of various smart sensors

CO5. Learn about the photoelasticity and fringe patterns

Text/Reference Books:

1. DVS Murthy, "Transducers and Instrumentation", PHI 2nd Edition 2013
2. D Patranabis, "Sensors and Transducers", PHI 2nd Edition 2013.
3. S. Gupta, J.P. Gupta , "PC interfacing for Data Acquisition & Process Control", 2nd ED / Instrument Society of America, 1994.
4. Gary Johnson / Lab VIEW Graphical Programing II Edition / McGraw Hill 1997.
5. Arun K. Ghosh, "Introduction to measurements and Instrumentation", PHI, 2012.
6. A.D. Helfrick and W.D. cooper, "Modern Electronic Instrumentation & Measurement Techniques", PHI – 2001
7. Hermann K.P. Neubert, "Instrument Transducers" 2012, Oxford University Press.
8. J.W. Dally and W.F. Riley, "Experimental Stress Analysis", 2nd Ed. MGH.
9. Mubin Khanna, "Experimental Stress Analysis", 2003.
10. Dureli, "An Introduction to Experimental Stress and Strain Analysis".
11. Srinath et.al. "An Introduction to Experimental Stress Analysis" - MGH.
12. J.Srinivas, "Stress analysis-An introduction to experimental techniques"-Narosa Publishers 2015.
13. Jindal, "Experimental stress analysis", Pearson Publishers, 2018.
14. Experimental stress analysis for mFreddi, Olmi, Cristofolini,aterials and structures, 2019

LC-MTSE202	Design Studio -II	0L:0T:4P (Hrs)	2 Credits

Objectives: Practical training for conducting experiments related to structural engineering. Capability to use software's for analysis, design and detailing and experimental data.

Course Description :

Review of testing methods of cement, coarse aggregate and fine aggregate as per Indian Standards. Study of various instruments used for determining the material properties of concrete, steel etc. Designing concrete mix as per Indian standards and experimental study the results of fresh and hardened concrete by casting and testing simple compression, tension and flexural members. Study of instruments used for determining the durability of materials. Analysis, design and detailing of a high rise building with special emphasis to earthquake. Analysis, design and detailing of Steel Industrial Building / Steel Multi-storey building. Design of steel Bridge / storage structures/ towers/ribbed floor slab systems

Course Outcomes:

Students will be able to

CO1. Computational thinking development through creative programming or material testing

CO2. IS Code based modeling.

CO3. Study & Design the structures/material and interpret the results

CO4. Understand the overall Behavior of Structure Component/ Material and its design

MLC-MTSE201	Research Methodology & IPR	2L:0T:0P	02 Credits

Course Objective:
Understand some basic concepts of research and its methodologies, identify appropriate research topics and select and define appropriate research problem and parameters

Course Content:

Module 1 **(08 hrs)**

Research Formulation and Design: L-9 Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, researchdatabases, identifying gap areas from literature and research database.

Module 2 **(08 hrs)**

Data Collection And Analysis: Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

Module 3 **(10 hrs)**

Soft Computing: L-9 Computer and its role in research, Use of statistical software SPSS,GRETL etc. in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

Module 4 **(10 hrs)**

Research Ethics, IPR And Scholarly Publishing: Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

Module 5 **(10 hrs)**

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

Course Outcomes:
After completion of this course, the students are able to:

Co1. Develop understanding on various kinds of research, objectives of doing research, researchprocess, research designs and sampling.
CO2. Have basic knowledge on qualitative research techniques.
CO3. Have adequate knowledge on measurement & scaling techniques as well as the quantitativedata analysis.
CO4. Understand the ethics used in research approach.
CO5. Apply the knowledge of research methodology for report writing.

List of Text Book:

1. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
6. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
7. Satarkar, S.V., 2000. Intellectual property rights and Copy right. Ess Publications.

List of Reference Book:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Course Category	Subject Title	Subject Code	L	T	P	Credit
Audit Courses	Stress Management	AUD-MTSE201	2	0	0	0

Course Objectives

The objective of this course is to enable students to consider the management of work place stress at an individual and organizational level and will help to develop and implement effective strategies to prevent and manage stress.

Course Outcomes

Monitor effectiveness of stress management technique and revise to meet current needs

Module-I

Introduction to Stress

Introduction to stress: Meaning, Definition, Eustress and Distress, Types of stress: Acute stress, Episodic Acute stress and chronic stress, signs and Symptoms

Module -II

Sources of stress

Psychological, Social, Environmental, Academic, Family and Work stress

Module - III

Impact of stress

Physiological Impact of stress -Autonomic Nervous System Changes, Changes in Brain, General adaptive syndrome (GAD), Quality of sleep, Diet and Health effects (ii) Psychological Impact of stress - Impaired Mental functions, Poor memory (iii) Social Impact of stress - Stressful Life Events, Social support and health

Module - IV

Stress and Coping

Coping Mechanisms: - Coping Mechanisms: Appraisal focused, Emotional focused and Problem focused

Module –V

Stress Reduction Techniques

Use of Audio and Video Aids , Cultural Activities, Autogenic Training, Biofeedback, Relaxation, Yoga and Meditation

Course Outcomes:

Students will be able to

CO1. Module -1 makes students acquainted with fundamentals of Stress management for the purpose of improving everyday functioning.

CO2. Students will learn various sources of stress like psychological, Social, Environmental, Academic family and work for the smooth functioning of day to day life.

CO3. To enable study of stress as a subjective experience and to enable practical approach with measurable levels of stress, using various physiological tests.

CO4. To describe a number of self-help approaches to stress-prevention and resilience-building through cognitive-behavioral therapy and understanding of stress whether it can be positive or negative and ways to deal with it.

CO 5. Students will learn to prepare a report that promotes healthy and low-stress environment.

Text Books:

1. Greenberg, J. S. (2017). Comprehensive Stress Management (14th edition). New York: McGraw Hill.
2. Roy, Sumita. (2005) Managing Stress: Handle, Control, Prevent Sterling Publisher
3. Davis M. (2000) *The Relaxation and Stress Reduction Work Book*, New Harbinger inc.
4. Simmons M., Daw W. (1994) *Stress, Anxiety, Depression: a Practical Workbook,* Winslow Press.
5. Tyler M. (1999) *Stress Management Training for Trainers Handbook*, Living with Stress Ltd
6. Udai, Y. (2015). Yogasan aur pranayam. New Delhi: N.S. Publications

Reference Books:

1. Cooper K. (1991) *Overcoming Hypertension*, Bantam Books.
2. Hambly K., Muir A. (1997) *Stress Management in Primary Care*, Butterworth Heinemann.
3. Jones H. (1997) *I'm too Busy to be Stressed*, Hodder and Stoughton
4. Payne R. (1995) *Relaxation Techniques: a Practical Handbook for Healthcare Professionals,* Churchill Livingstone.
5. Steinmetz J. (1980) *Managing Stress Before it Manages You*, Bull Publishing.

IPS ACADEMY

Institute of Engineering and Science, Indore (M.P.)

A UGC Autonomous Institute,

Affiliated to Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, (M.P.)

Masters of Technology (M.Tech.) Civil Engineering

Specialization: Structural Engineering

Semester III [Second Year]

Third Semester (Autonomy) CE

S.No.	Course Code	Course Title	Maximum Marks Allotted					Total Marks	Hrs./Week			Total Credits
			Theory			Practical						
			End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	PSEC –MTSE301	Elective - IV	70	20	10	-	-	100	3	0	0	**3**
2.	LLC –MTSE301	Personality Development	70	20	10	-	-	100	1	0	0	**1**
3.	SBC – MTSE301	Dissertation Part - I	-	-	-	120	80	200	0	0	20	**10**
		Total	140	40	20	120	80	400	4	0	20	**14**

Elective-IV (PSEC – MTSE301)

(A) Massive Open Online Course - I

(B) Design of Masonry Structures

(C) Prefabricated Structures

(D) Design of Tall Structures

PSEC-MTSE301(A)	Massive Open Online Course - I	3L:0T:0P (Hrs)	3 Credits

Objective: Student use MOOCs to learn for a variety of reasons, including: career development, changing careers, college preparations, supplemental learning, lifelong learning, corporate eLearning & training, and more.

Course Content:

Massive Open Online Courses (MOOCs) are free online courses available for anyone to enroll. MOOCs provide an affordable and flexible way to learn new skills, advance your career and deliver quality educational experiences at scale.

Course Outcomes:

Students will be able to learn new skills, advance your career and deliver quality educational experiences at scale.

PSEC-MTSE301 (B)	Design of Masonry Structures	3L:0T:0P (Hrs)	3 Credits

Objective: The objective of this course is to make students to learn performance of masonry structures, To design the masonry structures for earthquake resistance. To evaluate the strength and stability of the masonry structures.

Module 1 Introduction, Masonry units, materials and types (10 Hrs)

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

Module 2 Strength of Masonry in Compression (10 Hrs)

Behaviour of Masonry under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context, Failure theories of masonry under compression. Effects of slenderness and eccentricity, effect of rate of absorption, effect of curing, effect of ageing, workmanship on compressive strength

Module 3 Flexural and shear bond, flexural strength and shear strength (10 Hrs)

Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating flexural and shear strength

Module 4 Design of load bearing masonry buildings (10 Hrs)

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

Module 5 Earthquake resistant masonry buildings (10 Hrs)

Behaviour of masonry during earthquakes, concepts and design procedure for earthquake

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

Course Outcomes:

Students will be able to

CO1. Achieve knowledge of masonry materials properties and type.

CO2. Understand the behavior of masonry under compression

CO3. Understand the masonry flexural and shear bond, flexural strength and shear strength.

CO4. Analyze and design the load bearing masonry buildings.

CO5. Understand the behavior of masonry during earthquakes

Text/Reference Books:

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

PSEC-MTSE301 (C)	Prefabricated Structures	3L:0T:0P (Hrs)	3 Credits

Objective: To get introduced to the concepts of prefabrication, types and its systems. To have a knowledge about the structural behaviour of prefabricated structures. To obtain knowledge in design of cross section and the joints in structures. To have a detailed knowledge in designing and detailing of various prefabricated units. To possess a comprehensive knowledge in design of structures subjected to earthquake.

Module 1 Fundamentals of Prefabricated Structures (10 Hrs)

Types of prefabrication, prefabrication systems and structural schemes - Need for prefabrication - Principles - Materials - Disuniting of structures - Handling and erection - Elimination of erection stresses.

Module 2 Prefabricated Components (10 Hrs)

Production, Transportation & erection- Shuttering and Mould design - Dimensional tolerances - Erection of R.C. Structures, Total prefabricated buildings - Structural behaviour of precast structures - Large panel constructions - Construction of roof and floor slabs - Wall panels - Columns - Shear walls.

Module 3 Design Principles (10 Hrs)

Design of cross section based on efficiency of material used - Problems in design - joint flexibility - Allowance for joint deformation - Design of expansion joints.

Module 4 Structural Members (10 Hrs)

Design and detailing of boot reinforcement in beams, composite plank floor and corbel - Dimensioning and detailing of joints for different structural connections - industrial structures and water tanks.

Module 5 Design for Abnormal Loads (10 Hrs)

Progressive collapse - Codal provisions Equivalent design loads for considering abnormal effects such as earthquakes, cyclones. Structural Integrity – alternate load path.

Course Outcomes:

Students will be able to

CO1. Understand the fundamentals of prefabricated structures

CO2. Learn about the prefabricated components.

CO3. Design the cross section and joints of prefabricated units.

CO4. Apply the knowledge of prefabrication in designing and detailing of prefabrication units.

CO5. Design the structures for abnormal loads using the codal provisions.

Text/Reference Books:

1. Hass, A.M. (1983), Precast Concrete, Design and Applications, Taylor & Francis, UK.
2. Phillips, W.R. and Sheppard, D.A. (1980), Plant cast, Precast and Prestressed Concrete, McGraw Hill, New York.
3. A.S.G Bruggeling, G.F Huyghe, "Prefabrication with Concrete", CRC Press, January 1991
4. IS 8916, " Building Design & Erection Using Prefabricated Concrete" , 208
5. R.L Gilbert, N.C Mickeborough, " Design of Prestressed Concrete", Taylor & Francis
6. Architectural Precast Concrete, Prestressed Concrete Institute, third edition 2007
7. Kim S. Elliott , Colin Jolly, "Multi-Storey Precast Concrete Framed Structures". Wiley-Blackwell, 2014.
8. Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc., 1994.
9. Haas, A.M. "Precast Concrete Design and Applications", CRC Press Publishers, 1990.
10. Promislow, V "Design and Erection of Reinforced Concrete Structures", MIR Publishers, Moscow 1986.
11. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete", Netherland BetorVerlag, 1978.
12. Koncz T., "Manual of precast concrete construction", Vols. I, II and III, Bauverlag, GMBH, 1971.
13. MOKK, Laszlo, "Prefabricated concrete for industrial and public structures", C. R. Books, 1964.

PSEC-MTSE301 (D)	Design Of Tall Structures	3L:0T:0P (Hrs)	3 Credits

Objectives: The objective of this course is to make students to learn principles of stability of tall buildings, To design the tall buildings for earthquake and wind resistance. To evaluate the performance of tall structures for strength and stability

Module 1 Design Criteria: **(8 Hrs)**

Design philosophy, loading, sequential loading, and materials – high performance concrete, fiber reinforced concrete, lightweight concrete, design mixes. Loading and Movement: Gravity loading: Dead and live load, methods of live load reduction, Impact, Gravity loading, Construction loads.

Module 2 Earthquake and Wind loading: **(8 Hrs)**

Static and dynamic approach, Analytical and wind tunnel experimentation method. Earthquake loading: Equivalent lateral force, modal analysis, combinations of loading, working stress design, Limit state design, Plastic design. Criteria for structural safety of tall concrete buildings.

Module 3 Behavior of Various Structural Systems: **(8 Hrs)**

Factors affecting growth, Height and structural form; High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, Outrigger – braced and hybrid mega system.

Module 4 Analysis and Design: **(8 Hrs)**

Modeling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis for member forces; drift and twist, computerized general three dimensional analyses.

Module 5 Stability of Tall Buildings: **(8 Hrs)**

Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first order and P-Delta analysis, Transnational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation. Structural elements: sectional shapes, properties and resisting capacities, design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire

Course outcomes:

On completion of this course, students are able to:

CO1. Understand the design philosophy and concrete properties.

CO2. Understand the earthquake and wind loading.

CO3. Learn the behavior of various structural systems.

CO4. Study the Modeling for approximate analysis and subsystem interaction

CO5. Understand the concepts of buckling analysis of frames.

Text/Reference Books:

1. Taranath B.S, “Structural Analysis and Design of Tall Buildings”- McGraw Hill
2. Wilf gang Schuller, “High rise building structures”- John Wiley
3. Bryan Stafford Smith & Alexcoull, “Tall building structures Analysis and Design”- John Wiley
4. T.Y Lin & D.Stotes Burry, “Structural concepts and system for Architects and Engineers”- John Wiley
5. Lynn S.Beedle, “Advances in Tall Buildings”- CBS Publishers and Distributors.
6. Dr. Y.P. Gupta – Editor, “Proceedings National Seminar on High Rise Structures- Design and Construction practices for middle level cities”- New Age International Limited

Subject Title	Subject Code	L	T	P	Credit
Personality Development	**LLC-MTSE301**	**1**	**0**	**0**	**1**

Course Objectives:
The course will help students to learn effective communication skills, group and team building skills. It will help them to learn the goal setting process and thus become more effective in achieving it.

Course Outcomes:
The outcome of this course will be to make students aware about the different facets of self. It will also help them learn skills to strengthen their inner capacities so that they are able to understand themselves, think and act effectively to lead.

Course Contents:

Module-I

Introduction to Soft Skills

Importance of Soft Skills, Effective Communication Skills, Verbal: Oral and Written, Merits and Demerits. Non Verbal: Kinesics, Proxemics, Haptics, Chronemics, Paralanguage, Sign/Symbol, Meta Communication, and Cultural differences in Non-Verbal Communication

Module-II

Aspects of Communication

Process of Listening, Types of Listening, Barriers to Listening, Strategies to Develop Listening Skills, Listening Comprehension, Culture as Communication, Communicating across Cultures, Communication Breakdown and ways to overcome

Module-III

Interpersonal Skills

Introduction and Importance to Interpersonal Skills, Personal Attributes, Interpersonal Attributes, Decision making, Creative Problem Solving, Dealing with Glossophobia, , Logical Reasoning
Tony Buzan's Mind Mapping Techniques: Argumentation, Inductive, Deductive reasoning, Persuasion

Module-IV

Group Behavior

Leadership skills, Team Management, Group Dynamics, Negotiation, Assertiveness, Emotional Intelligence

Module-V

Practical Approach to Soft Skills and Interpersonal Skills

Case Studies, SWOC Analysis and Goal Setting, Mindfulness Training, Brain Storming, Group Discussion, Team Building Activities.

Course Outcomes:

Students will be able to

CO1. Students will able to develop knowledge, skills and interpret their soft skills and practice correct body language.

CO2. The students will analyze necessary listening skills in order to follow and comprehend discourse such as presentations, conversations, interviews, discussions and will able to distinguish among multicultural communication

CO3. The student will be able to demonstrate effective interpersonal communication in a variety of settings and solve a problem by applying appropriate problem-solving techniques.

CO4. Students will develop an understanding of change processes and be able to think critically about obstacles to change.

CO5. The students will be able to practice effective communication skills and presentation skills

Text Books:

1. Soft Skills by G.S. Chouhan and Sangeeta Sharma, Wiley, New Delhi, 2016 Communication Skills by Sanjay Kumar and Pushplata, OUP, New Delhi, 2011
2. Communication Skill for Engineers and Scientist by Sangeeta Sharma and Vinod Mishra, PHI Learning, New Delhi, 2015
3. Developing Communication Skill by Krishna Mohan, Meera Banerji, McMillan India Limited,2018
4. Effective Listening Skills by Kratz, Abby Robinson. Toronto: ON: Irwin Professional Publishing, 1995.
5. Soft Skill for Everyone by Jeff Butterfield, Cengage Leaning, New Delhi, 2010

Reference Books:

1. Theories of Personality by Hall, Calvin S. et al. . New Delhi: Wiley. rpt. 2011.
2. Corporate Conversations by Holtz, Shel. New Delhi: PHI. 2007.
3. The Art of Public Speaking by Lucas, Stephen E. McGraw-Hill Book Co. International Edition, 11th Ed. 2014.
4. Winning at Interviews by Thorpe, Edgar and Showick Thorpe. Pearson Education. 2004.
5. Business Communication for Managers by Penrose, John M., et al. New Delhi: Thomson South Western. 2007

SBC-MTSE301	Dissertation Part - I	0L:0T:20P (Hrs)	10 Credits

Course Objective: To impart knowledge on

1. Developing analytical skills of the students to address any specific structural related problems.
2. Select suitable experimental method to solve structural engineering problems.

Project work Guidelines:

Each student should take up the project individually based on their area of interest

There will a project review committee and reviews will be conducted

At the end of the Phase I, he/she should be able to come with clear idea of the how to execute their project.

Course Outcome:

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

CO1. Use state of art technology for solving structural engineering problems.

CO2. Carry out literature survey and narrow down the problem to solve it by experimental methods or using software.

IPS ACADEMY

Institute of Engineering and Science, Indore (M.P.)

A UGC Autonomous Institute,

Affiliated to Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, (M.P.)

Masters of Technology (M.Tech.) Civil Engineering

Specialization: Structural Engineering

Semester IV [Second Year]

Fourth Semester (Autonomy) CE

S.No.	Course Code	Course Title	Maximum Marks Allotted					Total Marks	Hrs./Week			Total Credits
			Theory			Practical						
			End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	SBC – MTSE401	Dissertation Part - II	-	-	-	300	200	500	0	0	32	**16**
		Total	-	-	-	300	200	500	0	0	32	**16**

SBC-MTSE401	Dissertation Part - II	0L:0T:32P (Hrs)	16 Credits

Course Objective: To impart knowledge on

1. Developing analytical skills of the students to address any specific structural related problems.
2. Select suitable experimental method or simulation models to solve structural engineering problems.
3. Execution of the project using suitable techniques.

Project work Guidelines:

1. This is the continuation of the Phase I project
2. Students will be evaluated by the review committee and suggestions will be offered by members.
3. Three reviews will be conducted.
4. Thesis finding should be published in International/National journals.
5. Students should submit a project report as per the format prescribed by the college.

Course Outcome:

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

CO1. Identify the problem by analysing the gap through literature survey.

CO2. Conduct the experimental or Simulation work to solve structural engineering problems.

CO3. Validate the experimental results or simulation results.