GURU GHASIDAS VISHWAVIDYALAYA
BILASPUR (C.G.)

(A Central University)

Koni, Bilaspur-495009, C.G (India)

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM (CBCS)

MASTER OF TECHNOLOGY
IN
STRUCTURAL ENGINEERING

COURSE STRUCTURE AND SYLLABI

M.Tech Regular Two Year Degree Program
(Effective from the Academic Year 2021-22)

DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF STUDIES IN ENGINEERING & TECHNOLOGY
GGV, BILASPUR, C.G. (INDIA)

DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF STUDIES IN ENGINEERING & TECHNOLOGY, GGV, BILASPUR, C.G. (INDIA)
SCHEME OF EXAMINATION
M.TECH. STRUCTURAL ENGINEERING
M.Tech. I-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CEPATT1	Advanced Structural Analysis	3	0	0	40	60	100	3
2.	CEPATT2	Advanced Solid Mechanics	3	0	0	40	60	100	3
3.	CEPATP1 CEPATP2 CEPATP3	Elective – I 1. Theory of Thin Plates and Shells 2. Theory and Applications of Cement Composites 3. Theory of Structural Stability	3	0	0	40	60	100	3
4.	CEPATP4 CEPATP5 CEPATP6 CEPATP7	Elective – II 1. Analytical and Numerical Methods for Structural Engg. 2. Structural Health Monitoring, Repairs and Rehabilitation of Structures 3. Structural Optimization 4. Advance Concrete Technology	3	0	0	40	60	100	3
5	CEPATP8 CEPATP9 CEPATP10 CEPATP11	Elective – III 1. Advanced Steel Design 2. Design of Formwork 3. Design of High-Rise Structures 4. Bridge Engineering	3	0	0	40	60	100	3
6.	CEPALT1	Advanced Concrete Lab	0	0	3	30	20	50	2
7.	IPPATC1	Research Methodology and IPR	2	0	0	-	50	50	2
Total			17	0	3	230	370	600	19

M.Tech. II-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CEPBTT1	FEM in Structural Engineering	3	0	0	40	60	100	3
2.	CEPBTT2	Structural Dynamics	3	0	0	40	60	100	3
3.	CEPBTP1 CEPBTP2 CEPBTP3 CEPBTP4	Elective – IV 1. Design of Advanced Concrete Structures 2. Advanced Design of Foundations 3. Soil Structure Interaction 4. Design of Industrial Structure	3	0	0	40	60	100	3
4.	CEPBTP5 CEPBTP6 CEPBTP7 CEPBTP8	Elective – V 1. Advanced Prestressed Concrete 2. Laminated Composite Plates 3. Fracture Mechanics of Concrete Structures 4. Design of Plates and Shells	3	0	0	40	60	100	3
5	MSPBTO1 IPPBTO2 IPPBTO3 CEPBTO4 MEPBTO5 CHPBTO6 ECPBTO7 MCPBTO8	Open Elective 1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects (Other than Civil Engg.) 5. Composite Materials 6. Waste to Energy 7. IoT 8. MOOCs	3	0	0	40	60	100	3
6.	CEPBLT1	Computer Applications Lab	0	0	3	30	20	50	2
7.	CEPBPT1	Mini Project	0	0	4	30	20	50	2
8.	ELPBTX1 PEPBTX2 CEPBTX3 LAPBTX4	Audit Course/Value Added Course 1. English for Research Paper Writing 2. Disaster Management 3. Constitution of India 4. Stress Management by Yoga	2	0	0	40	60	100	2
Total			17	0	08	300	400	700	21

Note: Under MOOCs the students have to opt any subject other than Civil Engineering from NPTEL/UGC SWAYAM

M.Tech. III-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CEPCPT1	Dissertation Stage–I	0	0	28	100	100	200	14
Total			0	0	28	100	100	200	14

M.Tech. IV-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CEPDPT1	Dissertation Stage–II	0	0	32	100	200	300	16
Total			0	0	32	100	200	300	16

Total Credits for the Program = 19 + 21 +14 +16 = 70

Civil Engineering Department

Programme Outcomes (POs)

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

PSO1	Graduates will be able to solve the problems related to structural engineering, geotechnical engineering, construction management, transportation engineering, irrigation engineering and environmental engineering by applying the knowledge of mathematical and physical sciences.
PSO2	Graduates will be able handle and apply the technology, modern engineering tools and equipment, software, remote sensing and GIS techniques to solve the problems in the field of civil engineering.
PSO3	Graduates are capable of working in groups by undergoing summer internship in the industry and in laboratories and carrying out minor and major project works.

M.Tech. Structural Engineering

Semester-I

Subject: **Advanced Structural Analysis** **Credits**

Type:	Core-I	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objective: The course is aimed

1. To impart knowledge on the analysis of structures by stiffness analysis.
2. To introduce the limitations of direct stiffness method.

Course outcomes: **At the end of the course, students will be able to**

1 Analyze the skeleton structures using stiffness analysis code.

2 Use direct stiffness method understanding its limitations

Syllabus Contents:

- Influence Coefficients: Physical Significance, Effects of Settlements, Temperature Change and Lack of Fit, Member Approach and Structure Approach.
- Stiffness Method applied to Frames: Local Coordinates and Global Coordinates.
- Stiffness Matrix Assembly of Structures: Stiffness Matrix in Global Coordinates, Boundary Conditions, Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces.
- Applications to Simple Problems: Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach.
- Boundary Value Problems (BVP): Approximate Solution of BVP by Variational formulation, Rayleigh-Ritz method, Weighted Residual techniques. Use of Modified Galerkin Method for One-Dimensional BVP,
- Linear Element: Shape Functions, Matrix formulation for solution of Poisson's Equation using Modified Galerkin method, solution of One Dimensional Equilibrium Problems.
- Formulation of Finite Difference Method (FDM) for BVP, analysis of simple problems using FDM

References:

- Matrix Analysis of Framed Structures, W. Weaver Jr and JM Gere. CBS Publishers & Distributors.
- The Finite Element Method, Lewis P. E. and WardJ. P., Addison-Wesley Publication Co.
- Computer Methods in Structural Analysis, MeekJ. L., E and FN, Span Publication.
- The Finite Element Method, Desai and Able, CBS Publication.
- A Text Book of Finite Element Analysis by P. Seshu, PHI Leaning Pvt Ltd.
- Concepts and Applications of Finite Element Analysis by RD Cook, DS Malkus, ME Plesha, John Wiley & Sons.
- Boundary and Finite Elements Theory and Problems by J. Raamachandram, Narosa Publishing House.

Course Outcomes and their mapping with Programme Outcomes: **Advanced Structural Analysis (CEPATT1)**

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3					2				3	2	1
CO2	3	2	3	2								3	2	3	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Advanced Solid Mechanics**	**Credits**			
Type:	Core-II	L	T	P	Total
Teaching Scheme:	Lectures: 3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the basic concepts and problems of elasticity and plasticity.

2 To Emphasize on numerical methods to solve continuum problems

Course outcomes: At the end of the course, students will be able to

1 Solve simple problems of elasticity and plasticity understanding the basic concepts.

2 Apply numerical methods to solve continuum problems

Syllabus Contents:

- Introduction to Elasticity: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.
- Strain and Stress Field: Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an arbitrary plane, differential equations of equilibrium, hydrostatic and deviatoric components.
- Equations of Elasticity: Equations of Equilibrium, Stress-Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co-axiality of the Principal Directions.
- Two-Dimensional Problems of Elasticity: Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.
- Torsion of Prismatic Bars: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.
- Plastic Deformation: 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.

References:

- Theory of Elasticity, Timoshenko S. and Goodier J. N., McGraw Hill,1961.
- Elasticity, Sadd M. H. Elsevier, 2005.
- Engineering Solid Mechanics, Ragab A. R., Bayoumi S.E., CRCPress, 1999.
- Computational Elasticity, Ameen M., Narosa,2005.
- Solid Mechanics, Kazimi S. M.A.,Tata McGraw Hill,1994.
- Advanced Mechanics of Solids, Srinath L.S.,Tata McGraw Hill,2000.

Course Outcomes and their mapping with Programme Outcomes: **Advanced Solid Mechanics (CEPATT2)**

COs	**POs**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					1						1		
CO2	3	3	1	1			1		1					2	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Theory of Thin Plates and Shells**	**Credits**			
Type:	Program Elective(I)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To learn the analysis of thin plates and shells.

2 To introduce the numerical techniques for analysis of complex problems in thin plates and shells.

Course outcomes: At the end of the course, students will be able to

1 Use analytical methods for the solution of thin plates.

2 Use analytical methods for the solution of shells

3 Apply the numerical techniques and tools for the complex problems in thin plates.

4 Apply the numerical techniques and tools for the complex problems in shells.

Syllabus Contents:

- Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.
- Static Analysis of Plates: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.
- Circular Plates: Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.
- Static Analysis of Shells: Membrane Theory of Shells - Cylindrical, Conical and Spherical Shells,
- Shells of Revolution: with Bending Resistance - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.
- Thermal Stresses in Plate/ Shell

References:

- Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill.
- Stresses in Plates and Shells, Ugural Ansel C., McGraw Hill.
- Thin Elastic Shells, Kraus H., John Wiley and Sons.
- Theory of Plates, Chandrashekhara K., Universities Press.
- Design and Construction of Concrete Shells, Ramaswamy G.S.

Course Outcomes and their mapping with Programme Outcomes: **Theory of Thin Plates and Shells (CEPATP1)**

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1							3	3	2
CO2	3	3	2	3	3	1							3	3	2
CO3	3	3	2	2	2								3	3	2
CO4	3	3	2	2	2								3	3	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Theory and Applications of Cement Composites**	**Credits**			
Type:	Program Elective(I)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the constitutive behaviour of composite materials and enable the student for its classification.

2 To emphasize the theories applicable to composite materials.

3 To impart the analysis and design of structural elements made of cement composites.

Course outcomes: At the end of the course, students will be able to

1 Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour.

2 Classify the materials as per orthotropic and anisotropic behaviour.

3 Estimate strain constants using theories applicable to composite materials.

4 Analyse and design structural elements made of cement composites.

Syllabus Contents:

- Introduction: Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.
- Mechanical Behaviour: Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.
- Cement Composites: Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.
- Mechanical Properties of Cement Composites: Behavior of Ferrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.
- Application of Cement Composites: FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.
- Analysis and Design of Cement Composite Structural Elements - Ferrocement, SIFCON and Fibre Reinforced Concrete.

References:

- Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998.
- Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
- New Concrete Materials, Swamy R.N., 1st Ed., Blackie, Academic and Professional, Chapman & Hall, 1983.

Course Outcomes and their mapping with Programme Outcomes: **Theory and Applications of Cement Composites (CEPATP2)**

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1						2		
CO2	3	3	2	1	1	1	1			1			1		
CO3	3	2	2	2	2	1	1		1	1	1	1	2	1	1
CO4	3	2	2	2	2	1	1		1	1	1	1	2	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Theory of Structural Stability**	**Credits**			
Type:	Program Elective(I)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To learn the concepts to evaluate stability of columns, frames, beams and plates

2 To emphasize the stability criteria for discrete and continuous systems

Course outcomes: At the end of the course, students will be able to

1 Determine stability of columns and frames

2 Determine stability of beams and plates

3 Use stability criteria and concepts for analysing discrete and continuous systems

Syllabus Contents:

- Criteria for Design of Structures: Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behaviour.
- Stability of Columns: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.
- Stability of Frames: Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.
- Stability of Beams: lateral torsion buckling.
- Stability of Plates: axial flexural buckling, shear flexural buckling, buckling under combined loads.
- Introduction to Inelastic Buckling and Dynamic Stability.

References:

- Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
- Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
- Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd.
- Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York

Course Outcomes and their mapping with Programme Outcomes: **Theory of Structural Stability (CEPATP3)**

COs	**POs**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1					1	3	2	
CO2	3	2	2	2	2	2	1					1	3	3	
CO3	3	3	2	2	2	2	1					2	2	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Analytical and Numerical Methods for Structural Engineering**	**Credits**			
Type:	Program Elective (II)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To impart the knowledge to formulate the mathematical model of the problem to solve civil engineering problems

2 To develop skills to solve the partial differential equations with closed form or numerical solution for the solution of structural problems.

3 To study the applications of mathematical tools and statistical methods for the solution of the problems related to structures.

Course outcomes: At the end of the course, students will be able to

1 Solve algebraic and Transcendental equations

2 Obtain numerical solution of ordinary and partial differential equations

3 Apply integration method/s for structural analysis,

4 Carry out interpolations and curve fitting,

5 Obtain solution of Eigen value problems for structural analysis

6 Apply iterative and transformation methods in structural engineering

Syllabus Contents:

- Fundamentals of Numerical Methods: Error Analysis, Polynomial Approximations and Interpolations, Curve Fitting; Interpolation and extrapolation.
- Solution of Nonlinear Algebraic and Transcendental Equations
- Elements of Matrix Algebra: Solution of Systems of Linear Equations, Eigen Value Problems.
- Numerical Differentiation & Integration: Solution of Ordinary and Partial Differential Equations.
- Finite Difference scheme: Implicit & Explicit scheme.
- Computer Algorithms: Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.

References:

- An Introduction to Numerical Analysis, Atkinson K.E., J. Wiley and Sons, 1989.
- Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
- Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

Course Outcomes and their mapping with Programme Outcomes: **Analytical and Numerical Methods for Structural Engg. (CEPATP4)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	2	1						2		
CO2	3	3	3	3	2	2	1	1					3	3	1
CO3	3	3	3	3	1	1	1						2	1	1
CO4	2	3	3	2	3	1	1						2	1	1
CO5	2	3	3	2	3	1	1						2	1	1
CO6	3	3	3	3	1	1	1						2	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Structural Health Monitoring, Repairing and Rehabilitation of Structures**	**Credits**			
Type:	Program Elective(II)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the aspects of structural health monitoring for structures.

2 To understand the conditional assessment & techniques for strengthening and retrofitting of structures.

Course outcomes: At the end of the course, students will be able to

1 Identify suitable Sensors & Instruments required in SHM for in-service performance of structures.

2 Implement suitable technique for structural condition assessment and assess the health of structures using different techniques of SHM.

3 Adopt an appropriate strengthening & retrofitting techniques to regain the structural strength.

Syllabus Contents:

- STRUCTURAL HEALTH MONITORING An Overview of Structural Health Monitoring, Structural Health Monitoring and Smart Materials, Structural Health Monitoring versus Non Destructive Evaluation, Overview of Application Potential of SHM, Notable Applications of SHM in Civil Engineering and instrumentation.
- REPAIRS AND REHABILITATION OF STRUCTURES Mechanisms of structural damages, cause of structural damages, assessment procedures of evaluating a damaged structure, strength assessment of damaged structure by destructive and non-destructive method. Engineered demolition techniques, repair and retrofitting methods, epoxy injection, shoring, and grouting, jetting, jacketing techniques.
- Corrosion protection techniques, corrosion inhibitors, corrosion resistant steels, coating to reinforcement, cathodic protection.
- Damages and structural failures (residential public and industrial), their repairs and rehabilitation. Maintenance, repair and rehabilitation of concrete pavements and bridges. Maintenance, repair and rehabilitation of liquid retaining structures. Case studies and their analysis.

References:

- Smart Materials and Structures, Gandhi and Thompson. Springer Science & Business Media, 31-May-1992 - Technology & Engineering.
- Concrete structure: Protection, Repair and Rehabilitation, Woodson R. .
- Bridge and Highway structure Rehabilitation and Repair, Khan M. A. McGraw-Hill Professional (1 April 2010).
- CPWD Handbook on Repair and Rehabilitation of RCC buildings.

Course Outcomes and their mapping with Programme Outcomes: **Structural Health Monitoring, Repairs and Rehabilitation of Structures (CEPATP5)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	3	1	1					1	3	2
CO2	3	3	1	3	2	3							2	3	2
CO3	3	3	1	3	2	3							2	3	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Structural Optimization**	**Credits**			
Type:	Program Elective (II)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To formulate structural optimization problems in the framework of calculus of variations as well as finite-variable optimization

2 To become familiar with principles of structural optimization and be able to solve them analytically when it is possible and computationally in most cases.

3 To learn the contemporary literature on structural optimization in general and topology optimization in particular.

Course Outcomes: At the end of the course, students will be able to

1 Use Variational principle for optimization

2 Apply optimization techniques to structural steel and concrete members.

3 Design using frequency constraint.

Syllabus Contents:

- Introduction: Simultaneous Failure Mode and Design, Classical External Problems.
- Calculus of Variation: Variational Principles with Constraints,
- Linear Programming, Integer Programming, Nonlinear Programming, Dynamic Programming,
- Geometric Programming and Stochastic Programming.
- Applications: Structural Steel and Concrete Members, Trusses and Frames.
- Design: Frequency Constraint, Design of Layouts.

References:

- Variational methods for Structural optimization, Cherkaev Andrej, Springer.
- Haftka, R. T. and Gurdal, Z., "Elements of Structural Optimization," Kluwer Academic Publishers, 1992.
- Bendsoe, M. P. and Sigmund, O., "Topology Optimization: Theory, Methods, and Applications," Springer, 2003.
- Haug, E. J., Choi, K. K., and Komkov, V., "Design Sensitivity Analysis of Structural Systems," Academic Press, 1986.
- NPTEL MOOC: https://nptel.ac.in/courses/112/108/112108201

Course Outcomes and their mapping with Programme Outcomes: **Structural Optimization (CEPATP6)**

Cos	**Pos**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	2	1						3	3	3
CO2	3	3	3	3	3	2	2					2	3	3	3
CO3	3	3	3	3	3	2	1						3	3	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Advance Concrete Technology**				**Credits**
Type:	Program Elective(II)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To make students understand concrete admixtures, non-destructive testing, semi-destructive testing, special concrete.

2 To familiarize students with structure of hydrated cement paste, types of cement, cement production quality control.

3 To make students learn transition zone in concrete, measurement of workability, properties of concrete, concrete mix design

4 To make students understand causes of concrete deterioration, permeability of concrete, durability of concrete, alkali aggregation reaction.

Course outcomes: At the end of the course, students will be able to

1 To understand concrete technology, admixtures, non-destructive testing, semi destructive testing, special concrete.

2 To be familiar with structure of hydrated cement paste, types of cement, cement production quality control.

3 To learn transition zone in concrete, measurement of workability, properties of concrete, rheological behaviour of concrete, economic concrete mix design

4 To be exposed to strength-porosity relationship, failure modes in concrete, elastic behaviour in concrete, ageing properties and long term behaviour

5 To better understand the causes of concrete deterioration, permeability of concrete, durability of concrete, alkali aggregation reaction.

Syllabus Contents:

Introduction to concrete – Mineral and chemical admixtures – Structure of hydrated cement paste – Calcium Aluminate Cement – Cement Production quality control - Transition zone in concrete – measurement of workability by quantitative empirical methods – concrete properties: setting and hardening.
Concrete Design mix for higher grades. Strength-Porosity relationship – Failure modes in concrete – plastic and thermal cracking – maturity concept to estimate curing duration - Elastic behavior in concrete- Creep, shrinkage and thermal properties of concrete.
Classification of causes of concrete deterioration – Permeability of concrete – durability concept: pore structure and transport process - Alkali-aggregate reactivity.
Non-Destructive testing methods - Semi-destructive testing methods. Concreting under special circumstances – Special materials in construction – Concreting machinery and equipment – Sustainability in concrete - Future trends in concrete technology

References:

- P. Kumar Metha and Paulo J. M. Monteiro., Concrete: Microstructure, Properties and Materials, Mc Graw Hill, Fourth Edition, 2014.
- John Newman and Ban Seng Choo, Advanced Concrete Technology Part 1 to 4, utterworth-
- Adam. M. Nevillie., Properties of Concrete, Wiley Publications, Fourth and Final Edition,1996.

- Properties of Concrete by A.M.Neville, ELBS publications Oct 1996.
- Concrete Technology by A.R. Santha kumar, Oxford University Press Oct 2006.
- Concrete Technology by M.S.Shetty, S.Chand& Co 2009.
- P. C. Aitcin, High Performance Concrete, E & FN SPON, 1998.
- Relevant IS Codes and BS Codes.

Course Outcomes and their mapping with Programme Outcomes: **Advance Concrete Technology (CEPATP7)**

COs	**Pos**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	1	1	1	-	-	-	3	3	2
CO2	3	2	2	3	1	1	1	1	-	-	-	-	3	2	1
CO3	3	3	2	3	2	2	1	1	1	-	-	-	2	3	2
CO4	3	3	2	2	2	2	1	1	1	-	-	-	3	3	2
CO5	3	3	2	2	2	2	1	1	1	-	-	-	3	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Advanced Steel Design**	**Credits**			
Type:	Program Elective(III)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To recognize limit states and failure modes in structural steel members and systems

2 To study the design specification and codes for steel structures, and understand their basis in mechanics, testing, and analysis.

3 To learn the design of steel and composite members and connections with an understanding of their limit states / failure modes and current design specifications / codes.

Course outcomes: At the end of the course, students will be able to

1 Design steel structures/ components by different design processes

2 Analyze and design beams and columns for stability and strength, and drift.

3 Design welded and bolted connections

Syllabus Contents:

- Properties of Steel: Mechanical Properties, Hysteresis, Ductility. Hot Rolled Sections: compactness and non-compactness, slenderness, residual stresses.
- Design of Steel Structures: Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift.
- Stability of Beams: Local Buckling of Compression Flange & Web, Lateral Torsional Buckling.
- Stability of Columns: Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis.
- Method of Designs: Allowable Stress Design, Plastic Design, Load and Resistance Factor Design.
- Strength Criteria: Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor, Effective Length, PM Interaction, Biaxial Bending, Joint Panel Zones.
- Drift Criteria: P Effect, Deformation Based Design;
- Connections: Welded, Bolted, Location Beam Column, Column Foundation, Splices.

References:

- Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
- Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
- The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., Heyman J., ELBS.
- Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.
- IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
- SP – 6 - Handbook of Structural Steel Detailing, BIS,1987

Course Outcomes and their mapping with Programme Outcomes: **Advanced Steel Design (CEPATP8)**

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1							1	3	2	1
CO2	3	3	2	1	1							1	3	2	1
CO3	3	3	2	1	1	1	1					1	3	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Design of Formwork**	**Credits**			
Type:	Program Elective(III)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the various form work materials.

2 To introduce the concepts of design of various form works.

3 To learn the failure case studies of form work.

Course outcomes: At the end of the course, students will be able to

1 Select proper formwork, accessories and material.

2 Design the form work for Beams, Slabs, columns, Walls and Foundations.

3 Design the form work for Special Structures.

4 Understand the working of flying formwork

5 Judge the formwork failures through case studies.

Syllabus Contents:

- Introduction: Requirements and Selection of Formwork.
- Formwork Materials- Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.
- Formwork Design: Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.
- Formwork Design for Special Structures: Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.
- Flying Formwork: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.
- Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction

References:

- Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.
- Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education, 2012.
- IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.

Course Outcomes and their mapping with Programme Outcomes: **Design of Formwork (CEPATP9)**

COs	**Pos**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		1					1				3		1
CO2	3	2	2	1					1		1	1	3	2	1

CO3	3	2	2	1	1				1		1	1	2	2	1
CO4	3	1			1				1	1			3		1
CO5	3	2	1		1				1	1	1	1	2		1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject: **Design of High Rise Structures** **Credits**

Type:	Program Elective (III)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To Introduce the design of Transmissions towers, masts.

2 To study the design of RC and/or Steel Chimneys.

3 To learn the analysis and design of tall buildings.

Course outcomes: At the end of the course, students will be able to

1 Analyze, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.

2 Analyze, design and detail the RC and Steel Chimney.

3 Analyze, design and detail the tall buildings subjected to different loading conditions using relevant codes.

Syllabus Contents:

- Design of transmission/ TV tower, Mast and trestles: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.
- Analysis and Design of RC and Steel Chimney, Foundation design for varied soil strata.
- Tall Buildings: Structural Concept, Configurations, various systems, Wind and Seismic loads.
- Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.
- Application of software in analysis and design.

References:

- Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers, New Delhi, 2002.
- Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.
- Illustrated Design of Reinforced Concrete Buildings (GF+3storeyed), Shah V. L. & Karve S. R., Structures Publications, Pune, 2013.
- Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.
- Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991.
- High Rise Building Structures, Wolfgang Schueller, Wiley. 1971.
- Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi

Course Outcomes and their mapping with Programme Outcomes: **Design of High-Rise Structures (CEPATP10)**

COs	**Pos**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3								3	3	3
CO2	3	3	3	3	3								3	3	3
CO3	3	3	3	3	3								3	3	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Bridge Engineering**	**Credits**			
Type:	Program Elective(III)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To learn the components of bridges, classification of bridges, importance of bridges.

2 To understand the investigation for bridges, subsoil exploration, choice of bridge type.

3 To study the specification of road bridges, loads to be considered.

4 To familiarize students with various types of bridges such as slab-bridge, Tbeam bridge, pre-stressed concrete bridge, continuous bridge, arch bridge, box girder bridge decks.

5 To get exposure to evaluation of sub structures, type of foundations, importance of bearings, lessons from bridge failures.

Course outcomes: At the end of the course, students will be able to

1 To be familiar with the components of bridges, classification of bridges, importance of bridges.

2 To understand the investigation for bridges, subsoil exploration, choice of bridge type.

3 To understand the specification of road bridges, loads to be considered

4 To be familiar with various types of bridges such as slab-bridge, T-beam bridge, pre-stressed concrete bridge, continuous bridge, arch bridge, box girder bridge decks

5 To get exposed to evaluation of sub structures, type of foundations, importance of bearings, lessons from bridge failures.

Syllabus Contents:

- Components of Bridges – Classification – Importance of Bridges – Investigation for Bridges – Selection of Bridge site – Economical span – Location of piers and abutments – Subsoil exploration – Scour depth – Traffic projection – Choice of bridge type.
- Specification of road bridges – width of carriageway – loads to be considered - dead load – IRC standard live load – Impact effect. General design considerations –- Slab Bridge – Design of T-beam bridge – Prestressed concrete bridge – continuous bridge – Arch Bridge – Box girder bridge decks.
- Evaluation of sub structures – Pier and abutments caps – Design of pier – Abutments – Type of foundations.
- Importance of Bearings – Bearings for slab bridges – Bearings for girder bridges – Electrometric bearing – Joints – Expansion joints. Construction and Maintenance of bridges – Lessons from bridge failures.

References:

- V. K. Raina, Concrete Bridges Practice – Analysis, Design and Economics, Shroff Publications
- Ponnuswamy, S., Bridge Engineering, Tata McGraw – Hill, New Delhi, 1997
- N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, New Delhi, 2006
- Jagadeesh. T. R. and Jayaram. M. A., Design of Bridge Structures, Prentice Hall of India Pvt. Ltd., 2004
- Victor, D. J., Essentials of Bridge Engineering, Oxford and IBH Publishers Co., New Delhi, 1980

Course Outcomes and their mapping with Programme Outcomes: **Bridge Engineering (CEPATP11)**

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1						2	2	
CO2	3	2	2	2	2	2	2						1	1	
CO3	3	2	2	2	2	2	2						1	1	
CO4	3	3	3	2	2	1	1						2	2	
CO5	3	2	2	2	2	2	2						1	1	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Advance Concrete Lab**	**Credits**			
Type:	Core Lab(I)	L	T	P	Total
Teaching Scheme:	Lectures:2hours/week	0	0	4	2

Course Objectives: The course is aimed

1 To learn the design of high grade concrete and study the parameters affecting its performance.

2 To conduct Non Destructive Tests on existing concrete structures.

3 To understand behavior of structural/ elements.

Course outcomes: At the end of the Lab, students will be able to

1 Design high grade concrete and study the parameters affecting its performance.

2 Conduct Non Destructive Tests on existing concrete structures.

3 Apply engineering principles to understand behavior of structural/ elements.

List of Experiments/Assignments:

- 1. Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
- 2. Effect of cyclic loading on steel.
- 3. Non-Destructive testing of existing concrete members.
- 4. Behavior of Beams under flexure, Shear and Torsion.

References:

- Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
- Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

Course Outcomes and their mapping with Programme Outcomes: **Advanced Concrete Lab (CEPALT1)**

COs	**Pos**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1						3	2	
CO2	2	2	2	1	3	2	2						2	2	
CO3	3	3	3	2	2	2	1						3	2	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Research Methodology and IPR**	**Credits**			
Type:	MLR	L	T	P	Total
Teaching Scheme:	Lectures: 2 hours/week	2	0	0	2

Course Objectives: The course is aimed

1 Understand research problem formulation.

2 Analyze research related information

3 Follow research ethics

4 Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property

5 Right to be promoted among students in general & engineering in particular.

Course outcomes: At the end of the course, students will be able to

1 Student will be able to understand research problem and its formulation.

2 They will be able to analyze research related information.

3 Students will understand the research ethics. Students will able to understand the basics of IPR.

Syllabus Contents:

Module 1

Introduction and Design of research: Meaning, objectives and significance of research, types and parameters of research, research process, identification and definition of the research problem, definition of construct and variables, pure and applied research design, exploratory and descriptive design methodology, qualitative vs. quantitative research methodology, field studies, field experiments vs. laboratory experiments, research design in social and physical sciences.

Module 2

Data and Methods of Data Collection: Survey, assessment and analysis: data collection, primary and secondary sources of data, Collection of primary data through questionnaire and schedules. Collection of secondary data, processing and analysis of data. Sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling and multistage sampling. Pilot survey, scaling techniques, validity & reliability.

Module 3

Data Analysis: Procedure for testing of hypothesis, the null hypothesis, determining levels of significance, type i and ii errors, grouped data distribution, measures of central tendency, measures of spread/dispersion, normal distribution, analysis of variance: one way, two way, chi square test and its application, students 'T' distribution, non-parametric statistical techniques, binomial test. Correlation and regression analysis – discriminate analysis –

factor analysis – cluster analysis, measures of relationship

Module 4

Research report preparation and presentation: Review of literature: historical survey and its necessity, layout of research plan, meaning, techniques and precautions of interpretation, types of report: technical report, popular report, report writing – layout of research report, mechanics of writing a research report. Writing bibliography and references.

Module 5

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

References:

1. Research in education, By J W Best and J V Kahn, Pearson/ Allyn and Bacon.

2. Research Methodology – Methods and Techniques, C K Kothari, New Age International.

3. Design and Analysis of Experiments, D C Montgomery, Wiley.

4. Applied Statistics & Probability for Engineers, D C Montgomery & G C Runger, Wiley.

5. Management Research Methodology: Integration of Principles, Methods and Techniques, K N Krishnaswamy, A I Sivakumar and M Mathiranjan, Pearson Education.

Course Outcomes and their mapping with Programme Outcomes: **Research Methodology and IPR (IPPATC1)**

COs	**Pos**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	3	2	1	2	3	1	1	2	2	1	3	2	2
CO2		3	3	3	1	3	3	1	2	2	2	2	1	2	2
CO3		2	1	2	2	2	3	2	1	2	3	2	3	2	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Semester-II

Subject:	**Finite Element Method in Structural Engg.**	**Credits**			
Type:	Core (III)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course objective: **The course is aimed**

1. To introduce the Finite Element Method for structural analysis.
2. To practice the Finite Element Program/ Software
3. To study the solutions for continuum problems using finite element analysis.

Course outcomes: **At the end of the course, students will be able to**

1 Use Finite Element Method for structural analysis.

2 Execute the Finite Element Program/ Software

3 Solve continuum problems using finite element analysis.

Syllabus Contents:

- Basic principles of structural mechanics: Equations of equilibrium, Strain displacement relations, stress strain relations, plane stress and plane strain problems, Boundary conditions.
- Basics of finite element method: Different steps involved in finite element method (FEM), different approaches of FEM, Direct method, Variational Principle and Weighted residual method, advantages and disadvantages of FEM.
- Element Properties: Displacement models, interpolation functions, Stiffness matrices, One dimensional bar element, two dimensional truss elements, three dimensional truss elements, two dimensional beam elements, three dimensional beam elements, analysis of framed structures using truss and beam elements with numerical examples. Development of FEM Programming for analysis of structures in MATLAB environment.
- Application to Solid Mechanics: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.
- Hamiltons Principle, Lagrange's equation for dynamic problems. Vibration analysis of structures using FEM.
- Computer Implementation of FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.

References:

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

Course Outcomes and their mapping with Programme Outcomes: **FEM in Structural Engineering (CEPBTT1)**

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		2							2	3		2
CO2	2	2	2		3							3	3		1
CO3	3	1	1		2							1	3		3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Structural Dynamics**	**Credits**			
Type:	Core(IV)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the analysis of dynamics response of single degree freedom system using fundamental Theory and equation of motion.

2 To analyze and study the dynamics response of Multi degree freedom system using fundamental theory and equation of motion.

3 To study the use of the available software for dynamic analysis.

Course outcomes: At the end of the course, students will be able to

1 Analyze and study dynamics response of single degree freedom system using fundamental Theory and equation of motion.

2 Analyze and study dynamics response of Multi degree freedom system using fundamental theory and equation of motion.

3 Use the available software for dynamic analysis.

Syllabus Contents:

- Introduction: Objectives, Importance of Vibration Analysis, Nature of Exciting Forces, Mathematical Modeling of Dynamic Systems.
- Single Degree of Freedom System: Free andF orced Vibration with and without Damping, Response to Harmonic Loading, Response to General Dynamic Loading using Duhamel's Integral, Fourier Analysis for Periodic Loading, State Space Solution for Response.
- Numerical Solution to Response using Newmark Method and Wilson Method, Numerical Solution for State Space Response using Direct Integration.
- Multiple Degree of Freedom System (Lumped parameter): Two Degree of Freedom System, Multiple Degree of Freedom System, Inverse Iteration Method for Determination of Natural Frequencies and Mode Shapes, Dynamic Response by Modal Superposition Method, Direct Integration of Equation of Motion.
- Multiple Degree of Freedom System (Distributed Mass and Load): Single Span Beams, Free and Forced Vibration, Generalized Single Degree of Freedom System.
- Special Topics in Structural Dynamics(Concepts only): Dynamic Effects of Wind Loading, Moving Loads, Vibrations caused by Traffic, Blasting and Pile Driving, Foundations for Industrial Machinery, Base Isolation.

References:

- Dynamics of Structures, Clough R. W. and Penzien J., Mc Graw Hill.
- Structural Dynamics and Introduction to Earthquake Engineering, Chopra A. K.
- Vibration of Structures - Application in Civil Engineering Design, Smith J. W., Chapman and Hall.
- Dynamics of Structures, Humar J. L., Prentice Hall.
- Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication.
- Dynamics of Structures, Hart and Wong.

Course Outcomes and their mapping with Programme Outcomes: **Structural Dynamics (CEPBTT2)**

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1					1	1	3	2	1
CO2	3	3	2	1	1	1					1	1	3	2	1
CO3	3	3	2	1	3	1					1	1	2	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject: **Design of Advanced Concrete Structures** **Credits**

Type:	Program Elective (IV)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course objective: **The course is aimed**

1 To study the analysis of the special structures by understanding their behavior.

2 To learn the design and prepare detail structural drawings for execution citing relevant IS codes.

Course outcomes: **At the end of the course, students will be able to**

1 Analyze the special structures by understanding their behaviour.

2 Design and prepare detail structural drawings for execution citing relevant IS codes.

Syllabus Contents:

- Deflection of reinforced concrete beams: Short-term and long-term deflection, calculation of deflection by IS 456. Estimation of crack width in reinforced concrete members: Factor affecting crack width, calculation of crack width.Behavior and design of slender columns.
- Design of RC walls-ordinary and shear walls. Strut and tie method of analysis for corbels and deep beams. Design of corbels and Deep-beams. Design of grid floors as per IS 456.
- Design of flat slabs according to IS method. Yield line theory and Hillerborg's strip method of design of slabs.
- Inelastic behavior of concrete beams, moment –rotation curve, moment redistribution in continuous beams, Baker's method of plastic design.
- Concept of Ductility, Detailing for ductility – Design of beams, columns for ductility. Introduction to Fire resistance of buildings

References:

- Gambhir ML, "Design of Reinforced Concrete Structures", Prentice Hall of India, 2012.
- Purushothaman P, "Reinforced Concrete Structural Elements: Behaviour Analysis and Design", Tata McGraw Hill, 1986.
- Pillai U and Menon D,"Reinforced Concrete Design", Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2007.
- Varghese PC, "Advanced Reinforced Concrete Design", Prentice Hall of India, 2005.
- Bhavikatti SS, " Advanced RCC Design (RCC Volume-II)", New Age International Publisheres, 2018.
- Raju NK, Advanced Reinforced Concrete Design", CBS Publishers.
- Park R and Paulay T, "Reinforced Concrete Structure", John Willey & Sons, 1995.
- Hsu TTC and Mo YL, "Unified Theory of Concrete Structures", John Willey & Sons, 2010.

Course Outcomes and their mapping with Programme Outcomes: **Design of Advanced Concrete Structures (CEPBTP1)**

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3					2			3	3	2	1
CO2	3	2	3	2					2			3	2	3	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Advanced Design of Foundations**	**Credits**			
Type:	Program Elective(IV)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To learn the suitability of soil strata for different projects.

2 To study the designs of shallow foundations deciding the bearing capacity of soil.

3 To introduce the Analysis and design of pile foundation, well foundations.

Syllabus Contents:

- Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.
- Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.
- Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.
- Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods.
- Tunnels and Arching in Soils, Pressure Computations around Tunnels. Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.
- Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction

References:

- Design of foundation system, N.P. Kurian, Narosa Publishing House
- Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
- Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

Course outcomes: At the end of the course, students will be able to

1 Decide the suitability of soil strata for different projects.

2 Design shallow foundations deciding the bearing capacity of soil.

3 Analyze and design the pile foundation

4 Understand analysis methods for well foundation.

Course Outcomes and their mapping with Programme Outcomes: **Advanced Design of Foundations (CEPBTP2)**

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3		3			3	3	3	3	3	3	2
CO2		3	3		3	3	2	2	3	3	3		3	2	1
CO3		3	3		2	3			3	3			3	2	1
CO4	3	3	3	2	3	3	2	3	3	2	3		3	2	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Soil Structure Interaction**	**Credits**			
Type:	Program Elective(IV)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the soil structure interaction and the computer programs for interaction problems

2 To learn the analysis of different types of frame structure and evaluate the action of group piles considering stress-strain characteristics of soils.

Course outcomes: At the end of the course, students will be able to

1 Understand soil structure interaction concept and complexities involved to evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics

2 Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.

3 Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics.

4 Evaluate action of group of piles considering stress-strain characteristics of real soils.

Syllabus Contents:

- Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.
- Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.
- Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.
- Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems,
- Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts, Etc.
- Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.
- Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

References:

- Analytical and Computer Methods in Foundation, Bowels J.E., McGraw Hill Book Co., New York, 1974.
- Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.
- Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers.
- Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17, Elsevier Scientific Publishing Company.
- Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company.
- Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.
- Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

Course Outcomes and their mapping with Programme Outcomes: **Soil Structure Interaction (CEPBTP3)**

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1								3	2	1
CO2	3	2	1										3	2	1
CO3	3	2	1	1									3	2	1
CO4	2	2	1										2	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Design of Industrial Structures**	**Credits**			
Type:	Program Elective(IV)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the designs of Steel Gantry Girders, Steel Portal and Gable Frames

2 To study the designs of Steel Bunkers and Silos, Chimneys and Water Tanks.

Course outcomes: At the end of the course, students will be able to

1 Design Steel Gantry Girders.

2 Design Steel Portal, Gable Frames.

3 Design Steel Bunkers and Silos.

4 Design Chimneys and Water Tanks.

Syllabus Contents:

- Steel Gantry Girders: Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.
- Portal Frames: Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures, Lightweight Structures
- Steel Bunkers and Silos: Design of square bunker, Jansen's and Airy's theories, IS Code provisions, Design of side plates, Stiffeners, Hooper, Longitudinal beams Design of cylindrical silo, Side plates, Ring girder, stiffeners.
- Chimneys: Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.
- Water Tanks: Design of rectangular riveted steel water tank, Tee covers, Plates, Stays, Longitudinal and transverse beams, Design of staging, Base plates,, Foundation and anchor bolts.
- Design of pressed steel water tank: Design of stays, Joints, Design of hemispherical bottom water tank, side plates, Bottom plates, joints, Ring girder, Design of staging and foundation.

References:

- Subramanian. N, "Design of Steel Structures: Theory and Practice", Oxford university Press, U.S.A, Third Edition, 2011.
- Duggal.S.K, "Design of Steel Structures", McGraw Hill New Delhi, 2010.
- Dayaratnam. P, "Design of Steel Structures," Chand. S, Limited, New Delhi. 2008.
- John. E, Lothers, "Structural Design in Steel", Prentice Hall, 1999.
- Neal. B.G, "Plastic Method of Structural Analysis", Taylor & Francis, Third Edition, 1985.
- Edwin .H, Gaylord, Charles .N, Gaylord, James .E, Stallmeyer, "Steel Structures", McGraw Hill, New Delhi, 1980.
- Ramchandra, "Design of Steel Structures", Vol I & II Standard Book House, Delhi, 1975.
- Arya.S and Ajmani. J.L, "Design of Steel Structures", Nem Chand & Bros, Roorkee.

Course Outcomes and their mapping with Programme Outcomes: **Design of Industrial Structure (CEPBTP4)**

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2		2						2	3	2	3
CO2	3	3	3	2		2						2	3	2	3
CO3	3	3	3	2		2						2	3	2	3
CO4	3	3	3	2		2						2	3	2	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject: **Advanced Prestressed Concrete** **Credits**

Type:	Program Elective(V)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the understanding of properties and behavior of Prestressing material.

2 To learn the analysis and design of Prestressed structure and superstructure.

Course outcomes: At the end of the course, students will be able to

1 Demonstrate the overall understanding of properties and behavior of Prestressing material.

2 Analyse/design the prestressed structure and prestressed concrete superstructure.

Syllabus Contents:

Need for prestressing; Materials used; Pretensioning and Post-tensioning methods; Systems of prestressing, Behaviour of prestressed concrete beams; Loss of prestress; bursting forces in anchorage zone; Design methods; Partial prestressing; Analysis and design of continuous beams. Need of composite construction; Design methods for composite beams, slabs, columns and box -girders; Prestressed concrete water tanks, Prestressed concrete superstructures. Statically determinate PSC beams: design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.

References:

- Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
- Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
- Limited State Design of Prestressed Concrete, Guyan Y., Applied Science Publishers, 1972.
- IS: 1343- Code of Practice for Prestressed Concrete
- IRC: 112

Course Outcomes and their mapping with Programme Outcomes: **Advanced Prestressed Concrete (CEPBTP5)**

COs	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1					1	3	2	1
CO2	3	3	2	1	1	1	1					1	3	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject: **Analysis of Laminated Composite Plates**

		Credits			
		L	T	P	Total
Type:	Program Elective(V)				
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the analysis of rectangular composite plates using the analytical methods.

2 To understand the analysis of the composite plates using advanced finite element method.

3 To learn the computer programs for the analysis of composite plates.

Course outcomes: At the end of the course, students will be able to

1 Analyse the rectangular composite plates using the analytical methods.

2 Analyse the composite plates using advanced finite element method.

3 Develop the computer programs for the analysis of composite plates.

Syllabus Contents:

- Introduction: Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending of Rectangular Laminated Plates using CLPT.
- Governing Equations. Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply Supported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary Conditions, Analytical Solutions for Bending of Rectangular Laminated Plates Using FSDT.
- Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT.
- Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses.
- Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT. Finite Element Model, C0 Element Formulation, Post Computation of Stresses.
- Analysis of Rectangular Composite Plates using Analytical Methods

References:

- Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press

Course Outcomes and their mapping with Programme Outcomes: **Laminated Composite Plates (CEPBTP6)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1						2	1	
CO2	3	3	2	2	2	1	1						2	1	
CO3	3	2	3	3	3	1	1						2	1	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Fracture Mechanics of Concrete Structures**	**Credits**			
Type:	Program Elective(V)	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the Identification and the classification of cracking of concrete structures based on fracture mechanics.

2 To study the Implementation of stress intensity factor for notched members

3 To introduce the application of fracture mechanics models to high strength concrete and FRC structures.

Course outcomes: At the end of the course, students will be able to

1 Identify and classify cracking of concrete structures based on fracture mechanics.

2 Implement stress intensity factor for notched members

3 Apply fracture mechanics models to high strength concrete and FRC structures.

4 Compute J-integral for various sections understanding the concepts of LEFM.

Syllabus Contents:

Review of theory of elasticity: Body and surface forces, strain and strain tensors, equilibrium equation, compatibility condition, plane stress, plane strain, Airy stress function, polar coordinate system.

Basic modes of fracture, an atomic view of fracture, stress concentration effect of flaws, Griffith theory of brittle fracture, Irwin's modifications for elastic-plastic materials, dimensional analysis of fracture mechanics.

Theories of linear elastic fracture mechanics, stress intensity factors, Fracture toughness, Energy release rate, Critical Energy release rate, Crack mouth opening displacement, R-Curve and J integral.

Tensile Behavior of Concrete, Strain localization effect, Fracture process zone, Nonlinear behavior of concrete, softening function of concrete, Fracture energy.

Definition and brief introduction of fracture parameters of various nonlinear concrete fracture models: cohesive crack model (CCM) or fictitious crack model (FCM), crack band model (CBM), two parameter fracture model (TPFM), size effect model (SEM), effective crack model (ECM), double-K fracture model (DKFM) and double-G fracture model (DGFM).

References:

- David Broek, Elementary Engineering Fracture Mechanics, Sijthoff and Noordhaff, Alphen Aan Den Rijn, The Netherlands, 2001.
- Analysis of Concrete Structure by Fracture Mechanics, Ed L. Elfgren and S.P. Shah, Proc of Rilem Workshop, Chapman and Hall, London, 2001.
- Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New
- Delhi, India, 2009. K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007.
- Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, Wiley, India, 5th Edition, 2014.
- Anderson, : Fracture Mechanics: Fundamentals and Applications, CRC press, 3rd Ed., 2005
- Kumar S, Barai SV (2011) Concrete Fracture Models and Applications. ISBN 9783642167638 (Hard Cover), Springer.

Course Outcomes and their mapping with Programme Outcomes: **Fracture Mechanics of Concrete Structures (CEPBTP7)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	-	-	-	-	3	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	2	2	1
CO3	3	3	3	3	2	1	-	-	-	-	-	-	3	2	2
CO4	3	2	2	2	1	1	-	-	-	-	-	-	2	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject: **Design of Plates and Shells**

Type:	Program Elective(V)	L	T	P	Credits Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the analysis and design of prismatic folded plate systems.

2 To study the analysis and design of shells using approximate solutions

3 To learn the analysis and design of cylindrical shells and doubly curved shells

Course outcomes: At the end of the course, students will be able to

1 Analyze and design prismatic folded plate systems.

2 Analyze and design shells using approximate solutions

3 Analyze and Design Cylindrical Shells

4 Design Doubly Curved Shells using Approximate Solutions.

Syllabus Contents:

- Prismatic folded Plate Systems
- Shell Equations
- Approximate Solutions
- Analysis and Design of Cylindrical Shells
- Approximate Design methods for Doubly Curved Shells..

References:

- Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata Mc Graw Hill Edition, 2010.
- Design and Construction of Concrete Shell Roofs,RamaswamyG.S.,1st Edition,2005.
- Design of Reinforced Concrete Shells & Folded Plate,Varghese P.C.,1st Edition ,PHI.
- Design of Plate and Shell Structures,Jawad Maan H.,Springer Science.

Course Outcomes and their mapping with Programme Outcomes: **Design of Plates and Shells (CEPBTP8)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2								3	3	3
CO2	3	3	3	2	2								3	3	3
CO3	3	3	3	2	2								3	3	3
CO4	3	3	3	2	2								3	3	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Business Analytics**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the aspects and importance of data analytics

2 To study the ability of think critically in making decisions based on data and deep analytics.

3 To learn the technical skills in predicative and prescriptive modeling to support business decision-making and to demonstrate the ability to translate data into clear, actionable insights

Course outcomes: At the end of the course, students will be able to

1 Students will demonstrate knowledge of data analytics 1

2 Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.

3 Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

4 Students will demonstrate the ability to translate data into clear, actionable insights.

Syllabus Contents:

- Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.
- Unit 2: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.
- Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.
- Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.
- Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.
- Unit 6: Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

Subject:	**Industrial Safety**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the Safety Measures and the plans for Engineering maintenance.

2 To learn the determination of the wear & Corrosion and apply methods for their prevention.

3 To introduce the method for Tracing the Fault and equipment, and preventive maintenance.

Course outcomes: At the end of the course, students will be able to

1 Apply the knowledge of Safety Measures

2 Plan for Engineering maintenance.

3 Determine the wear & Corrosion and apply methods for their prevention.

4 Trace the Fault of machine tools and equipment

5 Plan and implement the periodic and preventive maintenance for machines/equipment.

Syllabus Contents:

- Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting.
- Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.
- Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.
- Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.
- Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
- Maintenance Engineering, H. P. Garg, S. Chand and Company.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Outcomes and their mapping with Programme Outcomes: **Industrial Safety (IPPBTO2)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3	2	1
CO2	2	1	1										2	1	1
CO3	3	2	1	1	1								2	2	1
CO4	3	2	1										3	2	1
CO5	3	2	1										3	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Operations Research**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures: 3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the dynamic programming for the solutions of discreet and continuous variables.

2 To learn the applications of non-linear programming

3 To introduce applications of the methods to carry out sensitivity analysis and implementation of real world problem simulations.

Course outcomes: At the end of the course, students will be able to

1 Apply the dynamic programming to solve problems of discreet and continuous variables.

2 Apply the concept of non-linear programming

3 Carry out sensitivity analysis

4 Model the real world problem and simulate it.

Syllabus Contents:

- Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models
- Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming
- Non-linear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT
- Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.
- Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

- H.A. Taha, Operations Research, An Introduction, PHI, 2008
- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Libermann Operations Research: McGraw Hill Pub. 2009
- Pannerselvam, Operations Research: Prentice Hall of India 2010
- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes and their mapping with Programme Outcomes: **Operations Research (IPPBTO3)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		2	1							2	3	3	
CO2	2	3		2	1							2	3	3	
CO3	2	3		2	1							2	3	3	
CO4	2	3	3	2	1							2	3	3	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Cost Management of Engineering Projects**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To learn the cost concepts in the cost management process.

2 To study the application of project cost control methods and determine costing and carryout the analysis of pricings for profitability.

3 To implement the application of PERT/CPM for cost management

Course outcomes: At the end of the course, students will be able to

1 Discuss the cost concepts in the cost management process.

2 Able to handle the projects by the application of project cost control methods.

3 Determine all types of costing and carryout the analysis of pricings for profitability.

4 Apply the PERT/CPM for cost management.

Syllabus Contents:

- Introduction and Overview of the Strategic Cost Management Process
- Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.
- Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process
- Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.
- Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

- Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
- Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Outcomes and their mapping with Programme Outcomes: **Cost Management of Engineering Projects (Other than Civil Engg.) (CEPBTO4)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					2	3		2			3	2		2	1
CO2	1		1		2	3	1	2			3	1		2	1
CO3	2	2		1	2	2					3	1		2	1
CO4	2	1	3		3	1		2			3	3		2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Composite Materials**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the implementation of the composite materials for the required performance and adopt the composite materials as reinforcements

2 To study the methods of manufacturing of metal matrix composites

3 To study the strength of laminates

Course outcomes: At the end of the course, students will be able to

1 Explain and also implement the composite materials for the required performance based on the characteristics.

2 Adopt the composite materials as reinforcements.

3 Implement the methods of manufacturing of metal matrix composites

4 Adopt the methods of manufacturing of polymer matrix composites

5 Evaluate the strength of laminates.

Syllabus Contents:

- INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.
- REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.
- Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.
- Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.
- Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations

References:

- Material Science and Technology – Vol 13 – Composites by R. W. Cahn – VCH, West Germany.
- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Bala subramaniam, John Wiley & Sons, NY, Indian edition, 2007.
- Hand Book of Composite Materials-ed-Lubin.
- Composite Materials – K.K.Chawla.
- Composite Materials Science and Applications – Deborah D.L. Chung.
- Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course Outcomes and their mapping with Programme Outcomes: **Composite Materials (MEPBTO5)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1		1	1						2		
CO2	3	3	2	1	1	1	1						1		
CO3	3	2	2	2	2	1	1		1	1	1	1	2	1	1
CO4	3	2	2	2		1	1		1	1	1	1	2	1	1
CO5	3	2	2	2		1	1		1	1	1	1	2	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Waste to Energy**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures:3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To learn the Classifications of the waste for fuel and identify the devices for conversion of waste to energy.

2 To study and Implement the Biomass Pyrolysis and evaluate the methods of Biomass Gasification and implement their applications.

3 To study the designs, construction and operation the Biomass Combustion devices

Course outcomes: At the end of the course, students will be able to

1 Classify the waste for fuel and identify the devices for conversion of waste to energy.

2 Implement the Biomass Pyrolysis

3 Evaluate the methods of Biomass Gasification and implement their applications.

4 To design, construct and operation the Biomass Combustion devices.

5 Classify biomass, apply the bio energy systems design and construction.

Syllabus Contents:

- Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors
- Biomass Pyrolysis: Pyrolysis – Types, slow, fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
- Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.
- Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.
- Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

- Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes and their mapping with Programme Outcomes: **Waste to Energy (CHPBTO6)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	0	-	1	1	-	-	-	-	-	1	-	-
CO2	3	2	2	1	-	1	1	-	-	-	-	-	3	-	-
CO3	3	2	2	1	-	1	1	-	-	-	-	-	3	-	-
CO4	3	2	2	1	-	1	1	-		-	-	-	3	-	-

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Internet of Things**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures:3hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the concepts of Internet of Things.

2 To study the analysis of the basic protocols in wireless sensor network.

3 To learn the design of IoT applications in different domain and be able to analyze their performance and security.

Course outcomes: At the end of the course, students will be able to

1 Understand the concepts of Internet of Things.

2 Analyze basic protocols in wireless sensor network.

3 Design IoT applications in different domain and be able to analyze their performance

4 Elaborate the need for Data Analytics and Security in IoT

Syllabus Contents:

Introduction to Internet of Things

- Review of computer communication concepts (OSI layers, components, packet communication, Networks, TCP-IP, subnetting, IPV4 addressing and challenges). IPV6 addressing. IoT architecture reference layer. Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open source hardware, Examples of IoT infrastructure.
- **IoT and M2M**
  Software defined networks, network function virtualization, difference between SDN and NFV for IoT, Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER
- **IOT protocols and Communication Technologies**
  MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP,XMPP and gateway protocols, IoT Communication Pattern, IoT Protocol Architecture, Selection of Wireless technologies (6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA, Lifi, Widi).
- **Data and Analytics for IoT**
  An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of IOT Security, Common Challenges in IOT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.
- **IoT Physical Devices and Endpoints**: Introduction to Arduino and Raspberry Pi-Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.
- **IoT Physical Servers and Cloud Offerings**: Introduction to Cloud Storage models and communication APIs WebServer: Web server for IoT, Cloud for IoT, Python web application

framework Designing a RESTful web API.

- **IoT application and its Variants: Case studies:** IoT for smart cities, smart grid, health care, agriculture, smart meters.M2M, Web of things, Cellular IoT, Industrial IoT, Industry 4.0,IoT standards.

References:

- "Internet of Things - A Hands-on Approach", Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
- "Internet of Things", Srinivasa K G, CENGAGE Leaning India, 2017.
- " IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
- "Getting Started with Raspberry Pi", Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.
- "From Machine to Machine to Internet of Things", Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, Elsevier Publications, 2014.

Subject:	**Computer Applications Lab**	**Credits**			
Type:	Core Lab I(II)	L	T	P	Total
Teaching Scheme:	Lectures:2hours/week	0	0	3	2

Course Objectives: The course is aimed

1 To introduce the practical development of computer programs for the analysis of structural elements based on FEM

2 To introduce the use of software for the design of multi-storey building

Course outcomes: At the end of the course, students will be able to

1 Develop the computer programs for analysis of structural elements based on FEM

2 Use the design software for the design of multi-storey buildings

Syllabus Contents:

To develop the MATLAB applications for Finite Element Method on structural analysis

- Static and Dynamic Analysis of Beam, rigid frame and truss, 3-D Analysis of simple building
- Analysis, Design and Detail complete Multi-Storey Framed Buildings using STAAD Pro/ETABs.

Course Outcomes and their mapping with Programme Outcomes: **Computer Applications Lab (CEPBLT1)**

Cos	**Pos**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	1	1						2		
CO2	3	3	3	2	3	2	2			1			2	2	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Mini Project**	**Credits**			
Type:	Core	L	T	P	Total
Teaching Scheme:	Practice 4hours//week (Contact:2hours/week)	0	0	4	2

Course Objectives: The Mini Project is aimed

1 To Identify structural engineering problems reviewing available literature.

2 To Study different techniques used to analyze complex structural systems.

3 Work on the solutions given and present solution by using his/her technique applying Engineering principles.

Course outcomes: At the end of the course, students will be able to

1 Identify methods for structural engineering problems reviewing available literature.

2 Adopt different techniques used to analyze complex structural systems.

3 Propose solutions, or give solutions or present a solution by using his/her technique applying Engineering principles.

Syllabus Content:

- Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.
- Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Subject:	**English For Research Paper Writing**	**Credits**			
Type:	Audit/Value Added Course	L	T	P	Total
Teaching Scheme:	Lectures:2hours/week	2	0	0	2

Course Objectives: The course is aimed

1 To study, how to improve writing skills and level of readability.

2 To Learn about what to write in each section and the skills needed when writing a Title

3 To learn writing a good quality of paper at the very first-time submission

Course outcomes: At the end of the course, students will be able to

1 Student will be able to improve your writing skills and level of readability.

2 Student will learn about what to write in each section

3 Student will understand the skills needed when writing a Title

Syllabus Contents:

- Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
- Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.
- Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.
- Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.
- Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

References:

- Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
- Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

- Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
- Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Outcomes and their mapping with Programme Outcomes: **English For Research Paper Writing (ELPBTX1)**

Cos	**Pos**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	3	2	1	2	3	1	1	2	2	1	3	2	2
CO2	-	3	3	3	1	3	3	1	1	2	2	2	2	2	2
CO3	-	2	1	2	1	2	3	2	1	2	3	2	3	2	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Disaster Management**	**Credits**			
Type:	Audit/Value Added Course	L	T	P	Total
Teaching Scheme:	Lectures:2hours/week	2	0	0	2

Course Objectives: The course is aimed

1 To attempt the understanding of key concepts in disaster risk reduction and humanitarian response
2 To study the disaster risk reduction and humanitarian response policy and practice from multiple perspectives
3 To study the standards of humanitarian response and practical relevance in specific types of disasters and conflict situations

Course outcomes: At the end of the course, students will be able to

1 Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response
2 Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives
3 Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations and understand the strengths and weaknesses of disaster management approaches

Syllabus Contents:

- Introduction Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
- Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.
- Disaster Prone Areas in India, Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with special reference to Tsunami; Post-Disaster Diseases and Epidemics.
- Disaster Preparedness and Management: Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other agencies, Media Reports: Governmental and Community Preparedness.
- Risk Assessment: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.
- Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

References:

- Disaster Management in India: Perspectives, issues and strategies, Nishith R., Singh A. K, New Royal book Company.
- Disaster Mitigation Experiences and Reflections", Sahni, Pardeep Et. al. (Eds.), Prentice Hall of India, New Delhi.
- Disaster Administration and Management Text and Case Studies, Goel S. L., Deep & amp; Deep Publication Pvt. Ltd., New Delhi.

Course Outcomes and their mapping with Programme Outcomes: **Disaster Management (CEPBTX3)**

Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	3								2	2	1
CO2	3	2	1	2	2								3	3	2
CO3	3	2	1	2	3								2	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Subject:	**Constitution of India**	**Credits**			
Type:	Audit/Value Added Course	L	T	P	Total
Teaching Scheme:	Lectures:2hours/week	2	0	0	2

Course Objectives: The course is aimed

1 To bring awareness of the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

2 To know the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

3 To remind the circumstances surrounding the foundation of the Congress Socialist Party and the eventual failure of the proposal of direct elections.

Course outcomes: At the end of the course, students will be able to

1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

2 Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

3 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

4 Discuss the passage of the Hindu Code Bill of 1956. 4

Syllabus Contents:

- History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working). Philosophy of the Indian Constitution: Preamble, Salient Features
- Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.
- Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, appointment and Transfer of Judges, Qualifications, Powers and Functions.
- Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.
- Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

References:

- The Constitution of India, 1950 (Bare Act), Government Publication.
- Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Subject:	**Stress Management by Yoga**	**Credits**			
Type:	Audit/Value Added Course	L	T	P	Total
Teaching Scheme:	Lectures:2hours/week	2	0	0	2

Course Objectives: The course is aimed

1 To introduce the practices for developing a healthy mind in a healthy body.

2 To practice the methods for improving human efficiency at work

Course outcomes: At the end of the course, students will be able to

1 Develop healthy mind in a healthy body thus improving social health also.

2 Improve efficiency

Syllabus Contents:

- Definitions of Eight parts of yog. (Ashtanga).
- Yam and Niyam, Do`s and Don't's in life, i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.
- Asan and Pranayam, i) Various yog poses and their benefits for mind & body, ii) Regularization of breathing techniques and its effects-Types of pranayam.

References:

- 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
- "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

Semester-III

Subject:	**Dissertation I**	**Credits**			
Type:	Core	L	T	P	Total
Teaching Scheme:	Practice hours: 28hours/week (contact-3hours/week)	0	0	28	14

Course Objectives: The course is aimed

1 To inculcate the reviewing available research literature for Identifying the complex Civil Engineering problems.

2 To practice the applications of appropriate techniques to analyze complex Civil Engineering problems.

3 To adopt the engineering and management principles through efficient handling of the projects

Course outcomes: At the end of the course, students will be able to

1 Identify complex Civil Engineering problems reviewing available literature.

2 Identify appropriate techniques to analyze complex Civil Engineering problems.

3 Apply engineering and management principles through efficient handling of project

Syllabus Contents:

- Dissertation-I will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution.
- Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem. and End Sem. will be monitored by the departmental committee.

Semester-IV

Subject:	**Dissertation-II**	**Credits**			
Type:	Core	L	T	P	Total
Teaching Scheme:	Practice hours: 32 hours/week (contact-3 hours/week)	0	0	32	16

Course Objectives: The dissertation is aimed

1 To introduce the problem solving skills related to the complex Civil Engineering problems by applying appropriate techniques and tools.

2 To necessitate the exhibition of good communication skill to the engineering community and society.

3 To crop out and demonstrate the promotion of professional ethics and work culture.

Course outcomes: At the end of the Dissertation, students will be able to

1 Solve complex Civil Engineering problems by applying appropriate techniques and tools.

2 Exhibit good communication skill to the engineering community and society.

3 Demonstrate professional ethics and work culture. 3

Syllabus Contents:

- Dissertation – II will be extension of the work on the topic identified in Dissertation – I.
- Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.