Kolhapur Institute of Technology's

COLLEGE OF ENGINEERING (AUTONOMOUS),

Gokul Shirgaon, Kolhapur

KOLHAPUR INSTITUTE OF TECHNOLOGY'S
COLLEGE OF ENGINEERING
(AUTONOMOUS),
KOLHAPUR

Curriculum Structure

For

M.Tech.

Civil and Structural Engineering

Post Graduate Programme

Approved in Academic Council (Date: 06.02.2021)

Civil Department

9.02.2024

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INDEX

Teaching and Evaluation scheme for M.Tech. First Year Semester –I											
Sr. No	**Curriculum Component**	**Course Code**	**Course**	**Teaching Scheme**				**Evaluation Scheme**			
				L	**T**	**P**	**Credit**	**Component**	**Marks**		
									Max	**Min for Passing**	
1	PC	PCST 0101	Advanced Solid Mechanics	3	1	0	4	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
2	PC	PCST 0102	Advanced Structural Analysis	3	1	0	4	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
3	PC	PCST 0103	Advanced Concrete Structures Design	3	0	0	3	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
4	PE	PCST 01**	Professional Elective I*	3	1	0	4	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
5	PE	PCST 01**	Professional Elective II*	3	1	0	4	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
6		PCST 0161	Research Methodology (Audit Course)	2	0	0	0	ESE	100	40	
7	PC	PCST 0131	Advanced Concrete Structures Design Lab.	0	0	2	1	ISE	50	20	
								ESE OE	50	20	
8	PC	PCST 0132	Software Lab	0	0	4	2	ISE	50	20	
								ESE OE	50	20	
9	PW	PCST 0141	Seminar-I	0	0	2	1	ISE	100	40	
			Total	**17**	**4**	**8**	**23**	**Total Contact Hrs**			**29**

Teaching and Evaluation scheme for **M.Tech. First Year Semester –II**

Sr. No	Curriculum Component	Course Code	Course	Teaching Scheme				Evaluation Scheme			
				L	T	P	Credit	Component	Marks		
									Max	Min for Passing	
1	PC	PCST 0201	Structural Dynamics and Earthquake Engineering	3	1	0	4	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
2	PC	PCST 0202	Advanced Concrete Technology	3	1	0	4	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
3	PC	PCST 0203	Advanced Design of Steel Structures	3	1	0	4	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
4	PE	PCST 02**	Professional Elective III*	3	1	0	4	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
5	PE	PCST 02**	Professional Elective IV*	3	1	0	4	ISE-I	10		40
								ISE-II	10		
								MSE	30		
								ESE	50	20	
6		PCST 0261	Cost Management (Audit Course)	2	0	0	0	ESE	100	40	
7	PC	PCST 0231	Advanced Design of Steel Structures Lab.	0	0	4	2	ISE	50	20	
								ESE OE	50	20	
8	PW	PCST 0232	Mini Project	0	0	4	2	ISE	50	20	
								ESE OE	50	20	
9	PW	PCST 0241	Seminar-II	0	0	2	1	ISE	100	40	
			Total	**17**	**5**	**10**	**25**	**Total Contact Hrs**			**32**

Teaching and Evaluation scheme for **M.Tech. First Year Semester –III**

Sr. No	Curriculum Component	Course Code	Course	Teaching Scheme				Evaluation Scheme		
				L	T	P	Credit	Component	Marks	
									Max	Min for Passing
1	PW	PCST 0341	Internship	0	0	0	2	ISE-1	50	20
2	PW	PCST 0351	Dissertation Phase-I	0	0	5	2	ISE-I	50	60
							4	ISE-II	100	
3	PW	PCST 0352	Dissertation Phase-II	0	0		4	ESE (OE)	100	40
			Total	**0**	**0**	**5**	**12**	**Total Contact Hrs/Week/Student**		**5**

Important Note:

Internship should be completed after Semester-II and before End Semester Examination of Semester-III. Minimum duration of internship should not be less than 16 weeks.

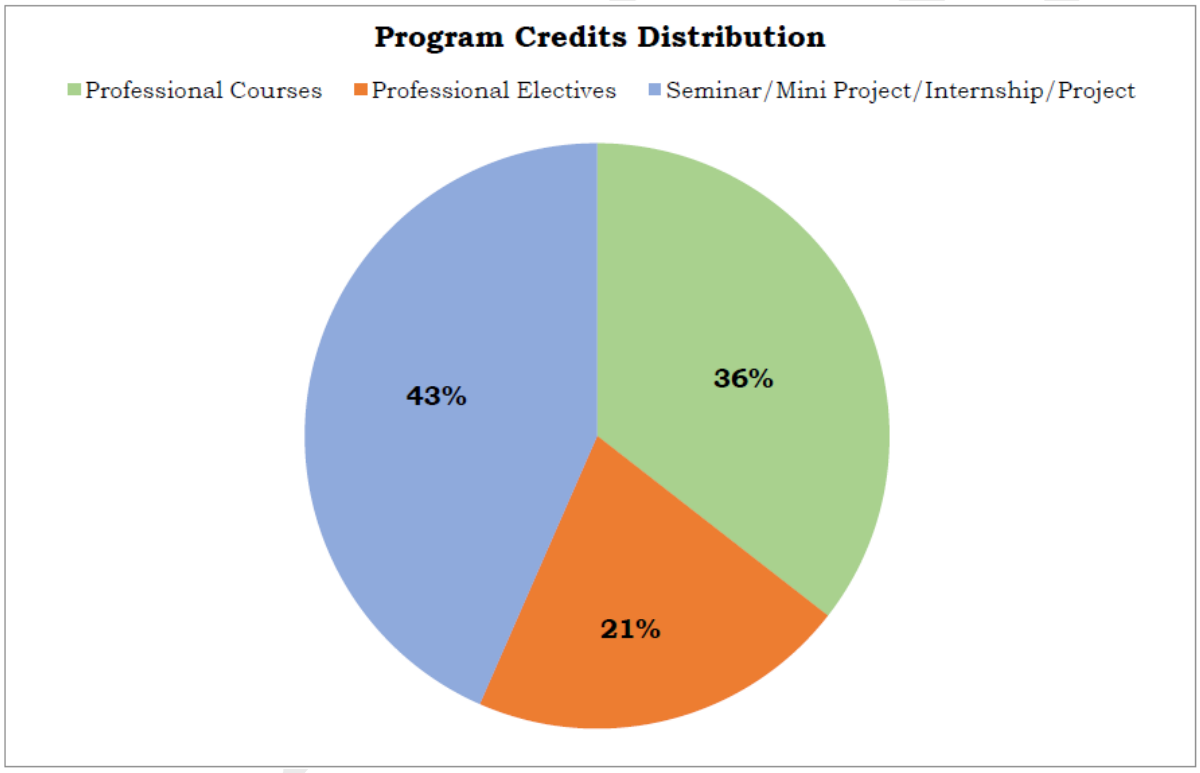
Teaching and Evaluation scheme for **M.Tech. First Year Semester –IV**

Sr. No	Curriculum Component	Course Code	Course	Teaching Scheme				Evaluation Scheme		
				L	T	P	Credit	Component	Marks	
									Max	Min for Passing
2	PW	PCST 0451	Dissertation Phase-III	0	0	6	4	ISE-I	100	80
							4	ISE-II	100	
3	PW	PCST 0452	Dissertation Phase-IV	0	0		8	ESE (OE)	200	80
			Total	**0**	**0**	**6**	**16**	**Total Contact Hrs/Week/Student**		**6**

LIST OF PROFESSIONAL ELECTIVES		
Semester - I		
Sr No	***Course Code***	**Professional Elective I**
1	PCST0121	Earth Retaining Structures And Soil Improvement
2	PCST0122	Advanced Construction Techniques
3	PCST0123	Repairs and Rehabilitation of Structures
Sr No	***Course Code***	**Professional Elective II**
1	PCST0126	Design of RCC Bridges
2	PCST0127	Theory of plates and Shells
3	PCST0128	Advanced Design of Foundation
Semester - II		
Sr No	***Course Code***	**Professional Elective III**
1	PCST0221	Project Planning and Scheduling
2	PCST0222	Advanced Numerical Methods
3	PCST0223	Digital Cartography, Remote Sensing And GNSS
Sr No	***Course Code***	**Professional Elective IV**
1	PCST0226	Advanced Prestressed Concrete
2	PCST0227	Tall Building Structures
3	PCST0228	Finite Element Method

Program Credits Distribution

Curriculum Component	Credits
Professional Courses	27
Professional Electives	16
Seminar/Mini Project/Internship/Project	33
Total	**76**



Title of the Course:	**Advanced Solid Mechanics**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0101**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Students must have successfully completed Mechanics of Materials or have equivalent knowledge.

Course Description:

In this course, the instructor will introduce the relationship between stress and strain in an elastic body, the two-dimensional theory of elasticity, applications to problems of rod-torsion and plate-bending, handling of anisotropic materials, approaches to elastic-plastic problems, the bending and torsion of elastic-plastic materials, and applications.

Course Learning Objectives:

The main objective of studying this course is to understand the theoretical concepts of material behaviour with particular emphasis on their elastic and plastic properties.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Achieve Knowledge of concepts of stress and strain.	2	Apply
CO2	Understand the principles of stress-strain behavior of continuum.	2	Understand
CO3	Achieve Knowledge of design and development of Axisymmetric problem-solving skills.	2	Apply
CO4	Describe the continuum in 2 and 3- dimensions & understand the concepts of plasticity.	3	Understand

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	-	-	-	-	1	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	1	-	1	-	1
CO3	-	1	-	-	-	2	-	-	-	1	-	1
CO4	2	-	-	-	1	-	-	1	-	-	-	1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Stress and strain Concept of stress at a point, stress tensor, stress on inclined plane, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, stress invariants. The state of strain at a point, strain displacement relations, strain compatibility condition and stress compatibility conditions.	**6 Hrs**
Unit 2: Stress-Strain Relationship Generalized Hooke's law for Isotropic, Orthotropic, Transversely Isotropic materials, plane stress, plane strain and axisymmetric problems, Problems in 2D Cartesian coordinate system, Airy's stress function, Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams.	**6 Hrs**
Unit 3: Polar Coordinate System Relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations, Stress-strain relationship, Strain displacement relationship for plane stress and plane strain conditions, Bending of curved bar, Stress concentration problems.	**8 Hrs**

Unit 4: Axisymmetric Problems Equilibrium equations, Strain displacement relations, Stress-strain relationship, Stress compatibility equations, Plane stress and Plane strain conditions. Cylinders subjected to internal and external pressure.	**6 Hrs**
Unit 5: Elementary problems of elasticity in three dimensions Stretching of a prismatic bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy, and propagation of waves in solid media, applications of finite difference equations in elasticity.	**6 Hrs**
Unit 6: Plastic behaviour and Failure theories Stress – strain diagram in simple tension, perfectly elastic, Rigid – Perfectly plastic, Linear work – hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials. Failure theories, yield conditions, stress – space representation of yield criteria through Westergaard stress space, Tresca and Von-Mises criteria of yielding.	**8 Hrs**

Recommended Textbooks:

1. Timoshenko & Goodier, "Theory of Elasticity", McGraw Hill.
2. Srinath L.S., Advanced Mechanics of Solids, 10th print, Tata McGraw Hill Publishing company, New Delhi, 1994.
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers.
4. Verma P.D.S, "Theory of Elasticity", Vikas Publishing Pvt. Ltd.
5. Chenn W.P and Hendry D.J, "Plasticity for Structural Engineers", Springer Verlag
6. Valliappan C, "Continuum Mechanics Fundamentals", Oxford IBH Publishing Co. Ltd.
7. Sadhu Singh, "Applied Stress Analysis", Khanna Publishers

References Books:

1. Hill, R. (1998). The mathematical theory of plasticity (Vol. 11). Oxford university press.
2. Chakrabarty, J. (2012). Theory of plasticity. Butterworth-Heinemann.
3. NPTEL Lecture Notes: IIT, Madras.
4. Theory of Elasticity, Sadhu Singh, Khanna Publishers
5. Advanced Mechanics of Solids, L. S. Sreenath, Tata McGraw-Hill Publications
6. Solid Mechanics, S M A Kazimi, Tata McGraw-Hill Publications
7. Mechanics of Materials, Swaroop Adarsh, New Age International Publishers
8. Theory of Elasticity, Timoshenko and Goodier, McGraw-Hill Publications
9. Applied Elasticity, Wang, Dover Publications

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. Achieve Knowledge of concepts of stress and strain.
2. Understand the principles of stress-strain behavior of continuum.
3. Achieve Knowledge of design and development of problem-solving skills.
4. Design and develop analytical skills.
5. Describe the continuum in 2 and 3- dimensions
6. Understand the concepts of plasticity.

Title of the Course:	**Advanced Structural Analysis**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0102**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Solid Mechanics, Structural Analysis, Theory of Structures.

Course Description:

Advanced Structural Analysis forms a core subject which is taught to students of all non-circuit disciplines of engineering. The study of this course is aimed at developing a thorough understanding of the basic material behavior through principles of matrix methods & its applications to solve engineering problems.

Course Learning Objectives:

The objective of this course is enable the student to have a good grasp of all the fundamental issues in the advanced topics in structural analysis pertaining to the matrix method

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Analyze various beams by the matrix methods at different loading conditions.	3	Analyzing
CO2	Analyze various Plane truss problems by the matrix methods	3	Analyzing
CO3	Analyze Plane Frames by the matrix methods at different loading conditions	3	Analyzing
CO4	Apply plastic analysis for fixed beam, Continuous beam and plane frame to determine collapse load.	5	Applying

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	3	-	-	-	-	-	-	-	-	-	2
CO2	2	3	-	-	-	-	-	-	-	-	-	2
CO3	2	3	-	-	-	-	-	-	-	-	-	2
CO4	2	3	-	-	-	-	-	-	-	-	-	2

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Introduction to Matrix methods: Review of basic concepts. Matrix Methods of Analysis of Structures, Generalised Measurements - Degrees of freedom - Behaviour of structures - Review of analysis of indeterminate structures: Force methods and Displacement Methods. Matrix concepts and Matrix analysis of structures: matrix, vectors, displacement and force transformation matrices, Element and structure flexibility matrices; equivalent joint loads; stiffness and flexibility approaches.	**5 Hrs**
Unit 2: Matrix methods for beams: Analysis of beams, fixed and continuous beams by flexibility method. Analysis of beams, fixed and continuous beams by stiffness method	**8 Hrs**
Unit 3: Matrix methods for Plane truss problems: Analysis of 2-D trusses by flexibility method. Analysis of 2-D trusses by stiffness method.	**8 Hrs**
Unit 4: Matrix methods for Plane Frames: Analysis of 2-D frames by Flexibility matrix methods. Analysis of 2-D frames by Stiffness matrix methods.	**8 Hrs**

Unit 5: Transformation of co-ordinates: Local and Global co-ordinate systems-transformation of matrices from local to global coordinates of element stiffness matrix-direct stiffness method of analysis-assembly of global stiffness matrix from element stiffness matrices –static condensation-sub-structuring.	**8 Hrs**
Unit 6: Plastic Analysis: Concept, Assumptions, Shape factor for different cross section, Collapse load, Load factor, Plastic modulus of section, Plastic moment of resistance, Computation of collapse load for fixed beam, Continuous beam and plane frame subjected to various load cases.	**5 Hrs**

Recommended Textbooks:

1. Analysis of Inderminate structures – C.K Wang, McGraw Hill Co.
2. Matrix Analysis of framed Structures-W Weaver & Gere, Van Nostrand Reinhold Company
3. Matrix methods of Structural Analysis - G.S.Pandit, S.P.Gupta, TataMcGraw Hill book company
4. William Weaver, James M. Gere, "Matrix Analysis and Framed Structures", D. Van Nostrand Co., 1980.
5. 5.Advanced Structural Analysis – Ashok K.Jain, New Channel Brothers.
6. 6.Basic structural Analysis – C.S.Reddy , Tata Mc Graw Hill publishing company Ltd,New Delhi.

References Books:

1. Devdas Menon,"Advanced StructuralAnalysis", Narosa Publishing House, 2009.
2. Asslam Kassimali,"Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 199.

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. To prepare the students to have a basic knowledge in the matrix methods such as flexible matrix method and Stiffness matrix method.
2. To prepare the students to analyze the beams by matrix methods.
3. To prepare the students to analyze the Plane truss problems by matrix methods.
4. To prepare the students to analyze the Plane Frames by matrix methods.
5. To prepare the students to analyze the structures by matrix methods.
6. Able to apply plastic analysis for fixed beam, Continuous beam and plane frame to determine collapse load.

Title of the Course:	**Advanced Concrete Structures Design**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0103**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Elements of Civil Engineering & Mechanics, Strength of Materials, Theory of Structures, DCS-I.

Course Description:

Analysis and Design of Structural Elements

Course Learning Objectives:

1. Identify the provisions made in IS Codes
2. Understand behavior of the different RCC structures and structural elements.
3. Design the reinforced concrete Flat Slab, Deep Beam, Continuous beam, water tanks and retaining walls.
4. Analyze and Design of Slab by Using Yield Line Theory

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Identify the provisions made in IS-456-2000, IS-3370-1984 and IS-1346	3	Applying
CO2	Develop the concept of Yield Line Theory	3	Applying
CO3	Analysis of different RCC structural elements, Water Tanks , retaining walls and slabs by using Yield Line Theory	4	Analyzing
CO4	Design of different RCC structural elements, Water Tanks , retaining walls and slabs by using Yield Line Theory	6	Creating

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	1	1	-	-	-	1	-	-	1	2	-	-
CO2	-	2	-	-	-	-	-	-	2	2	-	-
CO3	2	2	2	2	2	2	-	-	2	2	-	-
CO4	2	2	3	2	2	2	-	-	2	2	-	2

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Flat Slab Classification, Behaviour of Flat slabs, Direct design and equivalent frame method-, IS Codal provisions.	**6 Hrs.**
Unit 2: Deep Beams Analysis of deep beams- Design as per IS 456-2000.	**6 Hrs.**
Unit 3: Water Tanks Design of water tank - Introduction to working stress method for water tank design, Design criteria, permissible stresses, design of water tank resting on ground using IS code method – (i) circular water tanks with flexible and rigid joint between wall and floor, (ii) rectangular water tanks.	**8 Hrs.**
Unit 4: Retaining Structures Analysis and Design of cantilever retaining walls and counter-fort retaining walls with horizontal and inclined surcharge.	**8 Hrs.**

Unit 5: Continuous Beams Limit state Design of two span continuous beams and three span continuous beams using IS coefficient, concept of moment redistribution	**8 Hrs.**
Unit 6: Yield Line Theory Yield line analysis of slabs- virtual work and equilibrium method of analysis simply supported rectangular slabs with corners held down-uniform and concentrated loads- design of simply supported rectangular and circular slabs.	**4 Hrs.**

Recommended Textbooks:

1. Reinforced Concrete Structural Elements- Purushothaman. P, Tata Mc Graw Hill
2. Design and Construction of Concrete Shell Roofs-G.S.Ramaswamy
3. Reinforced Concrete – Ashok K Jain, Nem Chand Bros. Roorkee
4. Plain and Reinforced Concrete – Jain & Jaikrishna, Vol. I & II, Nem Chand Bros. Roorkee
5. Reinforced Concrete Chimneys- Taylor C Pere,
6. Yield Line Analysis of Slabs- Jones L L, Thomas and Hudson
7. Design of deep girders, Concrete Association of India
8. Reinforced Concrete, Mallick & Gupta- Oxford & IBH

References Books:

1. IS 456-2000 - Plain And Reinforced Concrete - Code Of Practice
2. IS 3370- 2009- Part 1 - 4 Code of Practice for concrete structures for the storage of liquids

Unit wise Measurable Learning Outcomes:

After the completion of the course the student will be able to

1. Student will able to Analyze and Design of Flat Slab.
2. Student will able to design the Simply supported and Continuous Deep Beam.
3. Student will able to Analysis the Retaining Structure and also design the Retaining Structures.
4. Student will able to Design the Water Tanks.
5. Student will able to design the Continuous Beam.
6. Student will able to understand the behavior of Yield Line pattern in slab.

LIST OF PROFESSIONAL ELECTIVES		
Semester - I		
Sr No	***Course Code***	**Professional Elective I**
1	PCST0121	Earth Retaining Structures And Soil Improvement
2	PCST0122	Advanced Construction Techniques
3	PCST0123	Repairs and Rehabilitation of Structures
Sr No	***Course Code***	**Professional Elective II**
1	PCST0126	Design of RCC Bridges
2	PCST0127	Theory of plates and Shells
3	PCST0128	Design of Foundation

Title of the Course:	**Earth Retaining Structures And Soil Improvement**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0121**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Soil Mechanics or Geotechnical Engineering I, Geotechnical Engineering II, foundation engineering etc.

Course Description:

Use of Earth retaining structures is Crucial in civil engineering which are engineered to retain soil and rock. They are commonly used to accommodate changes in grade, provide increases in right-of-way and buttress the toe of slopes. Today we are using every available land for construction, some soil are problematic for construction of various civil engineering structures. Under such conditions, ground improvement techniques are the only option. Selection of ground improvement technique is also a very critical task. In most of the cases retaining structures and ground improvement is closely related with each other. This course addresses types, design and stability analysis of retaining structures and in addition to that ground improvement techniques along with principles, design issues and construction procedures.

Course Learning Objectives:

1. To determine the earth pressure on retaining structures.
2. To evaluate stability of Rigid and Flexible Retaining Structures
3. To explain the Underground construction with methods.
4. To analyze Ground improvement methods.
5. To analyze Ground modification methods.
6. To analyze the field methods of soil improvement.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Discuss classical theories of earth pressure and underground construction techniques.	2	Cognitive
CO2	Analyze the suitable ground improvement techniques for field problem.	4	Cognitive
CO3	Evaluate stability of rigid retaining and flexible retaining structures.	5	Cognitive

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	2	1	1	1	1	-	-	-	-	-	-
CO2	1	3	3	2	2	2	-	-	-	-	-	-
CO3	3	3	3	2	2	2	-	-	-	-	-	-

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Earth Pressure Concept, Area of application, Rankin's theory of earth pressure - soil type, surface inclination, loads on surface, soil layers, water level and Coulomb's theory, effects due to wall friction and wall inclination, graphical methods, earthquake effect.	**6 Hrs**
Unit 2: Rigid and Flexible Retaining Structures Types, material, empirical methods, stability analysis, cantilever sheet piles, anchored bulkheads - free earth method, fixed earth method, moment reduction factors and anchorage.	**8 Hrs**

Unit 3: Underground construction Braced Excavation - methods, pressure distribution, stability, seepage. Pipes, conduits, trenchless technology, tunnelling techniques.	**6 Hrs**
Unit 4: Ground improvement Concept, Need, Different types of problematic soils, Emerging trends, Methods. Mechanical stabilization-principles of compaction, behaviour of compacted soil, Shallow and deep compaction methods, compaction control.	**6 Hrs**
Unit 5: Ground modification Ground Improvement by drainage, dewatering methods. Preloading, Vertical drains- Design method, vacuum consolidation. Grouting-materials, Permeation grouting, compaction grouting, jet grouting, grouting under difficult conditions- case studies	**8 Hrs**
Unit 6: Field methods Soil nailing, rock anchoring, micro-piles, construction techniques. Modification by admixtures- cement, lime, bitumen, Emerging methods. Gabion wall and Reinforce earth wall- Elements, construction methods, external and internal stability.	**8 Hrs**

Recommended Textbooks:

1. Soil Mechanics and Foundation Engg. by V.N.S.Murthy
2. Soil Mechanics and Foundation Engg. By K.R.Arora
3. Soil Mechanics and Foundation Engg. by B.C. Punmia
4. Bowles J. E., Foundation Analysis and Designs, McGraw-Hill Book Co. 1995.
5. Nayak N. V., Foundation Design Manual, Dhanpat Rai Publishing Co., 2002.

References Books:

1. Clayton C. R. I., Woods R. I. and Milititsky J., Earth Pressure and Earth Retaining Structures, Third Edition, Taylor & Francis, 1995.
2. Terzaghi K. and Peck R. B., Soil Mechanics in Engineering Practice, Wiley and Sons, 1996.
3. Manfired R. Hausmann, Engineering Principles of Ground Modification, McGraw-Hill Pub, Co., 1990.

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. Determine the earth pressure on retaining structures.
2. Evaluate stability of Rigid and Flexible Retaining Structures
3. Explain the Underground construction with methods.
1. Analyze Ground improvement methods.
2. Analyze Ground modification methods.
3. Analyze the field methods of soil improvement.

Title of the Course:	**Advanced Construction Techniques**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0122**	**3**	**1**	**-**	**4**

Course Pre-Requisite:

Students must have idea about new materials of construction and techniques

Course Description:

This course will help the students to understand different Advanced construction techniques

Course Learning Objectives:

Provides clear understanding idea about new materials of construction and techniques.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Descriptor
CO1	Identify & understand the Importance of sub structure and super structure construction	2	Compare
CO2	Determine the applicability of new construction materials.	1	Select
CO3	Understand the need of advanced construction Techniques.	3	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	-	2	-	-	-	-	-	-	-	-	-
CO2	3	2	3	2	3	-	-	-	-	-	-	-
CO3	3	3	2	3	3	-	-	-	-	-	-	-

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: SUB STRUCTURE CONSTRUCTION Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunnelling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting - shoring for deep cutting	**8 Hrs**
Unit 2: SUPER STRUCTURE CONSTRUCTION Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyor.	**6 Hrs**
Unit 3: COMPOSITE CONSTRUCTION: Composite v/s non composite action; composite steel-concrete construction. **FORMWORK: -** Material for formwork, special types of formwork, design of formwork	**6 Hrs**

Unit 4: **NEW MATERIAL** of construction such as geosynthetics, Epoxy resins, Adhesives, MDF, FRC, FRP, Polymer-based composites.	**8 Hrs**
Unit 5: a. **Rehabilitation of bridges:** Necessity and methods of strengthening, preservation of bridges. b. **Retaining structures** like diaphragm walls, advanced methods of their construction.	**6 Hrs**
Unit 6: a. Construction of concrete pavement by techniques like vaccum processing, revibrated concrete, Roller –compacted concrete. b. Use of techniques like slip form paving in pavement construction; using Wet-MIX macadam in Road. Advanced Techniques, vaccum dewatering in concrete slab construction, Reinforced earth construction, foundation strengthening	**6 Hrs**

Recommended Textbooks:

1. Handbook of Composite construction Engg--- G.M. Sabanis
2. Formwork design and construction---- Wynn
3. Water power Engineering—Dandekarsharma
4. Bridge Engineering--- Raina
5. Bridge engineering Punnuswamy
6. Concrete Technology--- M.S. Shetty S.Chand publication

References Books:

1. Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", Dhanpat Rai and Sons, 1997.
2. Varghese, P.C. "Building construction", Prentice Hall of India Pvt. Ltd, New Delhi, 2007.

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. Understand the importance of sub structure construction
2. Aware of super structure construction
3. Understand the importance of composite construction
4. Understand the provisions made in techniques for new material.
5. Understand the importance of rehabilitation of bridges
6. Understand the importance of construction of concrete pavement.

Title of the Course:	**Repairs and Rehabilitation of Structures**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0123**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Concrete Technology and Non-Destructive Testing

Course Description:

To make students to investigate the cause of deterioration of concrete structures and the strategize different repair and rehabilitation of structures. To evaluate the performance of the materials for repair

Course Learning Objectives:

1. To explain the importance of Repairs and Rehabilitation of Structures
2. To explain different technique of Repairs and Rehabilitation of Structures
3. To explain the strength and durability of concrete

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Classify maintenance and repair	II	Understand
CO2	Apply Special Concretes for Strength and durability of concrete	III	Apply
CO3	Compare techniques for repair and protection methods	IV	Compare
CO4	Develop methods of repair and rehabilitation	VI	Develop

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	-	-	-	2	-	-	-	-	-	1	-	-
CO2	-	-	-	2	-	2	-	-	2	-	-	-
CO3	-	-	1	2	-	2	-	-	2	1	-	-
CO4	-	-	2	2	-	2	-	-	2	-	-	-

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Maintenance and repair strategies Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.	**8 Hrs**
Unit 2: Strength and durability of concrete Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete - Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion - Effects of cover thickness	**6 Hrs**
Unit 3: Special Concretes Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.	**6 Hrs**

Unit 4: Techniques for repair and protection methods Non-destructive Testing Techniques, Epoxy injection, Shoring Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.	**8 Hrs**
Unit 5: Methods of Repair Shortcreting; Grouting; Epoxy-cement mortar injection; Crack ceiling Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – DEMOLITION TECHNIQUES – Engineered demolition methods – Case studies.	**6 Hrs**
Unit 6: Rehabilitation and Retrofitting of Concrete Structure: Repair rehabilitation & retrofitting of structures, damage assessment of concrete structures, Materials and methods for repairs and rehabilitation, modeling of repaired composite structure, structural analysis and design -Importance of re-analysis, execution of rehabilitation strategy, Case studies.	**6 Hrs**

Recommended Textbooks:

1. Sidney, M. Johnson "Deterioration, Maintenance and Repair of Structures"
2. Denison Campbell, Allen & Harold Roper, "Concrete Structures– Materials, Maintenance and Repair"- Longman Scientific and Technical
3. R.T.Allen and S.C. Edwards, "Repair of Concrete Structures"-Blakie and Sons
4. Raiker R.N., "Learning for failure from Deficiencies in Design, Construction and Service"- R&D Center (SDCPL)

References Books:

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK,
2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987
3. Dov Kominetzky.M.S., "Design and Construction Failures", Galgotia Publications Pvt. Ltd.,
4. Ravishankar.K., Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers,
5. Diagnosis and treatment of structures in distress by R.N.Raikar, Published by R&D Centre of Structural Designers & Consultants Pvt.Ltd., Mumbai,
6. Handbook on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi,
7. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande,

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. Understand the importance of Maintenance and repair strategies
2. Aware of Strength and durability of concrete
3. Understand the importance of Special Concretes
4. Understand the provisions made in techniques for repair and protection methods.
5. Understand the importance of Methods of Repair
6. Understand the importance of Rehabilitation and Retrofitting of Concrete Structure.

Title of the Course:	**Design of RCC Bridges**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0126**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Preliminary knowledge of Design of Concrete structures I & Design of Concrete structures II.

Course Description:

The worldwide design, development and construction of bridges represent the most challenging achievement in civil engineering. This course presents the structural design of concrete bridges and covers both superstructures and substructures. The analysis and design includes an overview of different short and medium span bridge types as well as long span bridges.

Course Learning Objectives:

1. To impart concepts and skills of Bridge Engineering
2. To introduce the fundamental concepts of analysis and design of different type of bridges.
3. To enable the students to understand the skills and concepts of bridge engineering

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	**Interpret** the Fundamentals of Bridge Engineering.	3	Applying
CO2	**Analyze** the different types of bridges with appropriate loads and methods.	4	Analyzing
CO3	**Design** the different types of bridges and its foundation using codal provisions.	5	Evaluating

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	2	-	-	-	-	-	-	-
CO3	-	-	3	-	2	-	-	-	-	-	-	2

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: General Basic bridge forms –beam, arch, suspension, various types of bridges, selection of type of Bridge and economic span length, super structure -philosophy, geometric alignment, drainage, road kurb, wall foundation, pile foundation, open well foundation.	**7 Hrs**
Unit 2: Design loads for bridges –dead load, vertical live load, IRC loading, wind load, longitudinal forces, centrifugal forces, buoyancy, water current forces, thermal forces, deformation and horizontal forces.	**8 Hrs**
Unit 3: Design of R. C. deck slab, beam and slab, T beam, Pigeaud's theory, Courbon's theory, balanced cantilever bridge, box culvert.	**8 Hrs**
Unit 4: Construction techniques -construction of sub structure footing, piles, cassions, construction of reinforced earth retaining wall and reinforced earth abutments, super structure erection method bridge deck construction,by cantilever method, Inspection maintenance and repair of bridges.	**7 Hrs**

Unit 5: Design of sub – structure - abutments, Piers, approach slab, Pile and Well foundation, Pneumatic caissons.	**8 Hrs**
Unit 6: Bearing and expansion joints forces on bearings Types of bearings, design of unreinforced elastometric bearings, expansion joints.	**7 Hrs**
Recommended Textbooks: 1. Dr. V.K. Raina, "Concrete Bridge Practice", Tata McGraw Hill, 2nd Edition, 1991. 2. Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Reinforced Concrete Structures – Vol II", Laxmi Publications,10th Edition,2014.	
References Books: 1. Dr. Johnsan Victor, "Essential of Bridge Engineering", Oxford& IBH Publishing Co., Pvt. Ltd.,6 th Edition,2007. 2. R. E. Rowe, "Concrete Bridge Design" John Wiley & Sons, 1963,C.R. Books Limited,1st Edition,1962. 3. Jagadesh T. R. & Jayram M.A., "Design of Bridge Structure", Prentice Hall of India Pvt. Ltd., 2nd Edition, 2009.	

Title of the Course:	**Theory of Plates and shells**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0127**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Theory of Elasticity, Structural Analysis

Course Description:

Historical development of modern shell roofs- Brick domes, Reinforced concrete shells, Folded plates for roofing. Types of shell roofs and design -Classification of shells, Structure analysis and design. Spherical domes and conical roofs- Analysis, design and detailing. Circular cylindrical shells- Classification, analysis and design, beam theory.

Course Learning Objectives:

1. To generate awareness about different types of plates and their solution strategy when subjected to different types of loads and boundary conditions.
2. To Generate awareness about different types (and behaviour) of shells and their solution strategy when subjected to different types of loads

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Develop equations for solution of structural response of plate bending problems by classical theories	VI	Creating
CO2	Evaluate Navier's and Levy's solutions for plate bending problems.	V	Evaluating
CO3	Examine shell action and simplified membrane and bending analysis for thin shells of single and double curvatures	IV	Analyzing

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	3	3	1	1	1	-	1	-	-	-	2
CO2	3	2	3	1	-	-	-	1	-	-	-	2
CO3	3	3	3	1	1	1	-	1	-	-	-	2

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Introduction to plate theory Thin and thick plates, small and large deflection theory of thin plate-assumptions, moment-curvature relations, stress resultants, governing differential equation for bending of rectangular plates, various boundary conditions	**6 Hrs**
Unit 2: Small Deflection Theory for Laterally Loaded Thin Rectangular Plates Navier's and Levy's solution for distributed and concentrated loads, use of numerical technique for the solution of plates, concept of influence surface, study of simply supported plate with continuous edge moments.	**9 Hrs**
Unit 3: Symmetrical Bending of Circular Plates Small deflections under axi-symmetric transverse loads, differential equations of equilibrium, different support conditions.	**6 Hrs**
Unit 4: Introduction to Shells Introduction to structural behavior of thin shells, membrane and	**5 Hrs**

bending actions. Mathematical representation of a shell surface, principal curvatures, Gauss curvature, Classification of shells	
Unit 5: Membrane Theories of Shell Membrane theories of thin shells stress resultants, application to cylindrical shells under symmetric loads and surfaces of revolution under axi-symmetric loads	**8 Hrs**
Unit 6: Cylindrical Shells Bending theory of open circular cylindrical shells with special emphasis on approximate theories of Finsterwalder and Shorer theories: Introduction to DKJ, Flugge and other exact theories: Different boundary conditions for single and multiple shells.	**8 Hrs**

Recommended Textbooks:

1. Timoshenko S.P. and Woinowsky-Krieger S., Theory of Plates and Shells, 2nd ed., McGraw-Hill, 1975.

References Books:

1. Bairagi N K, A text book of Plate Analysis, Khanna Publishers, New Delhi
2. J N Reddy, Theory and Analysis of Elastic Plates and Shells, CRC Press, 2007.
3. Rudolph Szilard, Theory and Analysis of Plates Prentice Hall, New Jercy
4. K Chandrashehara, Theory of Plates, University Press, Hyderabad, 2001.
5. Ramaswamy G.S., Design and Construction of Concrete Shell Roofs, CBS Publishers & Distributors, 1986.

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. Understand the small and large deflection plate theory for various boundary conditions
2. Derive the Navier's and Levy's solution for rectangular plates
3. Analyze Bending of Circular Plates
4. Introduce thin shells behavior under membrane and bending action
5. Derive the membrane theories for thin shells
6. Analyze bending behavior of cylindrical shells under various boundary conditions

Title of the Course:	**Advanced Design of Foundations**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0128**	**3**	**1**	**-**	**4**

Course Pre-Requisite:

Design of Concrete Structures, Geotechnical Engineering-II

Course Description:

This course makes students aware of analysis, design and detailing of various foundations – combined, raft, pile, well, pier and foundation for transmission tower. The syllabus content has direct application in the industry (consultancy offices).

Course Learning Objectives:

1. To make students aware of the importance of structural design of foundations in civil engineering problems.
2. To introduce the design of various types of foundations and retaining structures.
3. To impart estimation of forces on foundation for transmission tower.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Analyze Retaining Structures	4	Analyzing
CO2	Estimate forces on foundation	4	Analyzing
CO3	Design foundation and other substructures	6	Creating

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	1	-	1	-	1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Shallow Foundation Detailed designing of RCC trapezoidal combined footing, RCC strap footing, Analysis and design of Raft Foundation	**8 Hrs**
Unit 2: Pile Foundation Structural Design of RCC piles and pile caps for upto 4 piles group	**6 Hrs**
Unit 3: Retaining Wall Design of RCC cantilever type of retaining wall for a) With Horizontal backfill b) With Horizontal backfill and traffic load c) With Slopping backfill	**6 Hrs**
Unit 4: Bridge Substructure-1 Design of Pier, Design of Pier cap	**7 Hrs**
Unit 5: Bridge Substructure-2 Design of well cap, design of well steining, design of well curb, design of cutting edge, design of bottom plug	**7 Hrs**

Unit 6: Design of Special Foundations	**6 Hrs**
Introduction to Special foundations – Tunnel, underground water tanks, transmission line towers. Estimation of forces on special foundations, Design procedure for special foundations.	

Recommended Textbooks:

1. Limit State Design of Reinforced Concrete – Dr B C Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications P (Ltd).
2. Limit state theory and Design –Karve and Shah , Structures publications, Pune
3. Reinforced Concrete Design – Limit state - A.K. Jain, Nem Chand brothers Roorkee
4. Design of Bridges – N. Krishna Raju, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi
5. Analysis & Design of Substructures – Limit State Design – Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi

References Books:

1. J.E. Bowles, —Foundation Analysis and Design‖ Tata McGraw Hill Book Company
2. W. C. Teng, —Foundation Design‖ , Prentice Hall of India Pvt. Ltd., New Delhi
3. Poulos, H.G. and Davis, E.H. (1980). —Pile Foundation Analysis and Design‖ , John Wiley and Sons, New York

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. Design shallow footings.
2. Analyze pile caps & Design piles.
3. Analyze & Design cantilever retaining wall.
4. Design pier & pier cap for bridge substructure.
5. Design various components of well foundations.
6. Estimate various forces on foundation of high rise buildings.

Title of the Course:	**Research Methodology**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0161**	**2**	**-**	**-**	**-**

Course Pre-Requisite:

Seminar, Mini project, Major project

Course Description:

The course mainly deals with Research types and methods, different techniques of its design, analysis methods and results interpretation methods.

Course Learning Objectives:

1. To aware the students about the importance of research.
2. To make the students to study the types and stages of research along with different methods for data collection.
3. To expose the students to different techniques of data analysis.
4. To make the students to be able to interpret and present the results.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Identify and analyze the significance of different types of research and its various stages.	1	Identify
CO2	Extend knowledge to the different methods of data collection.	4	Extend
CO3	Relate different methods for analyzing data and interpreting the results.	4	Relate
CO4	Develop the proper way of reporting and presenting the outcome	6	Develop

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	1	-	-	-	-	-	-	1	-	-	-	-
CO2	-	-	3	-	-	2	-	-	2	-	-	-
CO3	-	3	-	-	2	-	2	-	-	-	-	-
CO4	-	-	3	2	-	-	-	-	-	-	-	2

Assessments : **Teacher Assessment:** This is audit course, hence it will not have ISE, MSE or ESE.	
Course Contents:	
Unit 1: Introduction to research methodology. stages of research process, Types of Research, research methods Vs methodology , Literature review , Problem definition, Research design for exploratory, descriptive and experimental research, Brief introduction to completely randomized design	**4 Hrs**
Unit 2: **Guidelines** for Selecting and Defining a Research Problem , research Design , Concepts related to Research Design, Basic Principles of Experimental Design	**4 Hrs**
Unit 3: **Sampling Design :** Sampling fundamentals, steps in Sampling Design ,Characteristics of a Good Sample Design ,Time Series Analysis , Interpolation and Extrapolation, Tools and techniques of data collection, Collection, recording, editing, coding and scaling of data. Types of sampling: probability and non-probability sampling. Sampling theory, sampling distribution and sample size determination Scale classification and types. Measurement of validity, reliability and practicality.	**6 Hrs**
Unit 4: **Statistical Inference :** Descriptive and inferential statistics ,Data analysis and interpretation , Parametric vs Non-parametric Tests , Hypothesis Testing Procedure testing of population mean, variance and proportion,–Z test – t test – F test - chi square test. Test for correlation and regression, standard error of the estimate. Testing goodness of fit.	**6 Hrs**
Unit 5: **Interpretation of Results:** importance and care for interpreting results. Techniques of Interpretation	**4 Hrs**

Unit 6: **Report Writing and Professional Ethics:** Layout of a Research Paper,- Guidelines for writing research papers and reports ,Writing different sections of a research paper, Methods of giving references and appendices: referencing styles. Use of computers and internet in research. Making Scientific Presentations in Conferences and Seminars , Professional Ethics in Research	**4 Hrs**

Recommended Textbooks:

1. C. R. Kothari, "Research Methodology, Methods and techniques", 2nd Edition, New Age International Publishers, New Delhi, 2004).
2. R. Panneer selvam, "Research Methodology", Prentice Hall of India, New Delhi, 2011.
3. Ranjit Kumar, "Research Methodology, A step by step approach", Pearson Publishers, New Delhi, 2005.
4. K. N. Krishna swami, Appa Iyer and M Mathirajan, "Management Research
5. Methodology", Pearson Education, Delhi, 2010
6. M N Borse, "Hand Book of Research Methodology", SreeNivas Publications, Jaipur, 2004
7. P K Majumdar ,"Research Methods in Social Science", Viva Books Pvt Ltd, New Delhi, 2005

References Books:

1. Scientists must Write - Robert Barrass (Available as pdf on internet)
2. Crafting Your Research Future –Charles X. Ling and Quiang Yang (Available as pdf on internet)
3. Research Methodology and Statistical Tools – P.Narayana Reddy and G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. Know different types of research.
2. Visualize, know and define the research problem.
3. Use the different techniques for sampling design.
4. Understand and use statistical methods for data analysis.
5. Interpret the results from analysis done.
6. Present the results from interpretation of findings.

Title of the Course:	**Advanced Concrete Structures Design Lab.**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0131**	**-**	**-**	**2**	**1**

Course Pre-Requisite:

Elements of Civil Engineering & Mechanics, Strength of Materials, Theory of Structures, DCS-I.

Course Description:

Analysis and Design of Structural Elements

Course Learning Objectives:

1. Identify the provisions made in IS Codes
2. Understand behavior of the different RCC structures and structural elements.
3. Design the reinforced concrete Flat Slab, Deep Beam, Continuous beam, water tanks and retaining walls.
4. Analyze and Design of Slab by Using Yield Line Theory

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Identify the provisions made in IS-456-2000, IS-3370-1984 and IS-1346	3	Applying
CO2	Develop the concept of Yield Line Theory	3	Applying
CO3	Analysis of different RCC structural elements, Water Tanks , retaining walls and slabs by using Yield Line Theory	4	Analyzing
CO4	Design of different RCC structural elements, Water Tanks , retaining walls and slabs by using Yield Line Theory	6	Creating

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	1	1	-	-	-	1	-	-	1	2	-	-
CO2	-	2	-	-	-	-	-	-	2	2	-	-
CO3	2	2	2	2	2	2	-	-	2	2	-	-
CO4	2	2	3	2	2	2	-	-	2	2	-	2

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation

Assessment	Marks
ISE	50
ESE OE	50

- ISE based on Assignment
- ESE: Assessment is based on 100% course content

Course Contents:

Assignment : (Min TWO Assignment on Each Unit)

Unit 1: Flat Slab

A. Design of Interior Panel

B. Design of External Panel

Unit 2: Deep Beams

Unit 3: Water Tanks

A. Circular water tanks with flexible and rigid joint between wall and floor

B. Rectangular water tanks.

Unit 4: Retaining Structures

A. Analysis and Design of cantilever retaining walls

B. Analysis and Design counter-fort retaining walls

Unit 5: Continuous Beams

Unit 6: Yield Line Theory

Recommended Textbooks:

1. Reinforced Concrete Structural Elements- Purushothaman. P, Tata Mc Graw Hill
2. Design and Construction of Concrete Shell Roofs-G.S.Ramaswamy
3. Reinforced Concrete – Ashok K Jain, Nem Chand Bros. Roorkee
4. Plain and Reinforced Concrete – Jain & Jaikrishna, Vol. I & II, Nem Chand Bros. Roorkee

5. Reinforced Concrete Chimneys- Taylor C Pere,
6. Yield Line Analysis of Slabs- Jones L L, Thomas and Hudson
7. Design of deep girders, Concrete Association of India
8. Reinforced Concrete, Mallick & Gupta- Oxford & IBH

References Books:

1. IS 456-2000 - Plain And Reinforced Concrete - Code Of Practice
2. IS 3370- 2009- Part 1 - 4 Code of Practice for concrete structures for the storage of liquids

Unit wise Measurable Learning Outcomes:

After the completion of the course the student will be able to

1. Student will able to Analyze and Design of Flat Slab.
2. Student will able to design the Simply supported and Continuous Deep Beam.
3. Student will able to Analysis the Retaining Structure and also design the Retaining Structures.
4. Student will able to Design the Water Tanks.
5. Student will able to design the Continuous Beam.
6. Student will able to understand the behavior of Yield Line pattern in slab.

Title of the Course:	**Software Lab**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0132**	**-**	**-**	**4**	**2**

Course Pre-Requisite:

Course Description:

This course will impart the importance of application of different software in professional practice & give students a hands on experience of the same.

Course Learning Objectives:

To apply the civil engineering software to structural engineering problems.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Analyze the structural elements using software designs	4	Analyzing
CO2	Design the structures fir the dynamic loads using software.	6	Creating

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	2	2	2	2	-	-	-	2	2	-	-
CO2	2	2	3	2	2	-	-	-	2	2	-	2

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE)

Assessment	Marks
ISE	50
ESE OE	50

- ISE based on Assignment
- ESE: Assessment is based on 100% course content

Course Contents:

The students will be required to carry out the design of at least G+8 storey's (max upto 32 m height) individually with different layout of the building in using any relevant software.

All the structural drawings (prepared using Auto Cad) and design report (prepared in MS Excel and word) should be submitted at the end of the semester. Students should develop the design sheets for various structural components in MS Excel.

Recommended Textbooks:

1. Computer Applications In Structural Engineering by David R. Jenkins, American Society of Civil Engineers
2. Computer aided design-Software and Analytical tools by C.S. Krishnamoorthy & S. Rajesh.
3. Computer aided design in reinforced concrete, V. L. Shah.

Experiment wise Measurable students Learning Outcomes:

After the completion of the course the student will be able to

1. Analyze and design multi-storeyed building

Title of the Course:	**Seminar-I**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0141**	**-**	**-**	**2**	**1**

Course Description:

This course is aimed at developing the skills like literature review, identification, analysis and presentation of issues in societal context in general and Civil and structural Engineering perspective in particular. This course shall provide an opportunity to the student to develop self-learning, critical thinking and communication skills.

Course Learning Objectives:

1. To develop the student to apply the knowledge gained to solve the complex engineering problem.
2. To develop the student for the Self-study and self-learning ability.
3. To motivate students to think about real life problems and ideas.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Analyze the complex engineering problem	4	Analysing
CO2	Study and prepare the solution for engineering problems.	5	Evaluating
CO3	Justify the relevance and importance of the seminar topic with current technology with proper presentation	4	Analysing

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	-	2	1	1	-	-	2	1	-	-	-
CO2	2	2	-	3	-	-	-	-	-	-	-	-
CO3	1	-	-	-	3	-	-	-	-	3	-	-

Assessments:

Teacher Assessment:

- ISE is based on performance of student in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). The course teacher shall use at least two assessment tools as mentioned above for ISE.

Assessment	Marks
ISE	50

Course Contents:

1. Seminar shall be delivered on one of the advanced topics chosen in control systems in consultation with the guide after compiling the information from the latest literature and other sources.
2. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student.
3. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both sides printed, preferably in IEEE format) should be submitted to the Department before delivering the seminar.
4. A PDF copy of the report in soft form must be submitted to the guide along with other details if any.

The topic for the Seminar shall be related to Civil Engineering areas such as

Transportation Engineering ,Environmental Engineering, Hydraulic structures , Town Planning, Advanced Construction Engineering, Disaster Management, Urban planning, Construction management Technique etc.

Title of the Course:	**Structural Dynamics & Earthquake Engineering**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0201**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Structural Mechanics, Earthquake Engineering

Course Description:

This course contains study of dynamics of structures – particularly multi-degree freedom systems, continuous systems and study of loading effects due to earthquake, wind and blast loading.

Course Learning Objectives:

1. To make students aware of Single degree freedom systems & multi-degree freedom systems used in structural dynamics.
2. To explain vibration analysis methods
3. To introduce students the continuous systems in vibration analysis
4. To make students accustomed to the lateral load effects on a structure.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Solve different vibrating systems to find response by using fundamental laws of vibrations.	3	Cognitive
CO2	Apply functional role of ductility in earthquake resistant design of structures.	3	Applying
CO3	Evaluate lateral loads on multi-storyed buildings due to earthquake using static and dynamic method	4	Analyzing

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	-	-	2	-	2
CO3	3	-	-	-	3	-	-	2	-	-	-	2

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Single degree of freedom systems Differential equation of motion - D' Alembert's principle - Free vibration and forced vibration response - damped and undamped - evaluation of damping constants - vibration of machine foundation - vibration isolation- vibration measuring instruments. Response to general loading - pulse excitation - Duhamel Integral - Numerical methods - Newmark method.	**7 Hrs**
Unit 2: Multi-degree of freedom Systems Two and three degree systems, solution of eigen value problem, Stodola method, orthogonality conditions, Modal superposition method., Frequency, mode shapes, modal participation factor.	**7 Hrs**
Unit 3: Continuous Systems Vibration analysis of continuous systems - simply supported beams - Effect of shear and rotary inertia - Timoshenko beam - Effect of axial loads.	**6 Hrs**
Unit 4: Earthquake resistant design philosophy Planning aspects, Load path, Stiffness and strength distribution, Lateral load resisting structural systems.	**5 Hrs**

Earthquake resistant design philosophy, Behavior of RC building, Role of ductility Ductile detailing of all structural members and joints as per IS 13920, Design of Shear Wall.	
Unit 5: Static method of seismic force estimation Code based procedure for determination of design lateral loads: static and dynamic analysis procedure. Equivalent static method.	**7 Hrs**
Unit 6: Dynamic method of seismic force estimation Response spectrum method for calculation of seismic forces on a multi-storeyed building.	**8 Hrs**

Recommended Textbooks:

1. A.K. Chopra "Dynamics of Structures Theory and Application to Earthquake Engineering" Pearson Education, 2001.
2. M. Mukhopadhyay, "Structural dynamics", Ane Books India.
3. Anderson R.A, "Fundamentals of vibration", Amerind Publishing Co., 1972.
4. Jagmohan L. Humar, "Dynamics of Structures", Prentice Hall, 1990.
5. Pankaj Agarwal & Manish Shrikhande, "Earthquake Resistant Design of Structures", PHI 2014.
6. S. K. Duggal, "Earthquake Resistance Design of Structure", Oxford Uni. Press

References Books:

1. Mario Paz, and William Leigh, "Structural Dynamics", CBS, Publishers, 1987.
2. Roy R Craig, Jr., "Structural Dynamics", John Wiley & Sons, 1981.
3. R. W. Clough and J Penzien,"Dynamics of Structures", McGraw-Hill, Inc.
4. J. W. Smith, "Vibration of Structures. Application in Civil Engineering Design", Chapman and Hall, 1988.
5. Gary Hart and Kevin Wong, "Structural Dynamics for Structural Engineers", John Wiley And Sons, 2000

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. Formulate equation of motion of a single degree freedom system.
2. Identify mode shapes and modal participation factors of a multi degree freedom system.
3. Carry out vibration analysis of continuous system.
4. Appreciate role of ductility in earthquake resistant design of structures.
5. Estimate design forces on a multi-storey building due to earthquake using static method.
6. Estimate design forces on a multi-storey building due to earthquake using dynamic method.

Title of the Course:	**Advanced Concrete Technology**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0202**	**3**	**1**	**-**	**4**

Course Pre-Requisite:

Basic Civil Engineering, Concrete Technology

Course Description:

This course contains study of advances in concrete technology.

Course Learning Objectives:

1. Students should understand weakness of plain concrete, and understand the latest development in trend in concrete composites
2. To understand advanced applications of composite materials.
3. To understand manufacturing and properties of concrete composites

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Classify plain concrete, and latest development in trend in concrete composites	II	Understand
CO2	Develop applications of composite materials.	III	Apply
CO3	Explain manufacturing and properties of concrete composites such as fibre reinforced concrete, ferrocement, silica fume concrete and polymer concrete	V	Evaluate

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	1	2	-	-	-	-	-	-
CO2	-	-	2	-	1	2	2	-	-	-	2	-
CO3	-	-	2	-	1	2	2	-	-	-	2	-

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Fiber reinforced composites: Introduction to Fiber Reinforced Concrete, types of fibers, properties of fibers. Properties of constituent materials. Mix proportion, mixing, casting methods.	**8 Hrs**
Unit 2: Ferro cement - Introduction, materials used, mechanical properties, construction techniques, design in direct tension, applications, merits as structural materials.	**6 Hrs**
Unit 3: Polymer Concrete : Introduction, Classification, properties of constituent materials, polymer impregnated concrete, polymer concrete, application	**6 Hrs**
Unit 4: Silica fume concrete Introduction, physical and chemical properties of silica fume, reaction mechanism of silica fume, properties of silica fume concrete in fresh state.	**6 Hrs**

Unit 5: Light Weight concrete- Introduction, Classification, Properties, Strength and Durability. High density concrete-Radiation, Shielding ability of concrete, Materials for high density concrete Placement methods,	**8 Hrs**
Unit 6: Ferrocement materials, Ferrocement constructions, applications, merits as structural materials. Silica Fume Concrete - Introduction, physical and chemical properties of silica Hume, properties of silica fume concrete in fresh state, mechanical properties and durability of silica fume concrete	**6 Hrs**

Recommended Textbooks:

1. Concrete Technology & Design by R N. Swamy,Surrey University Press.
2. Special Structural Concretes by Rafal Siddiquc,Galgotia pub. Pvt.ltd.
3. Fiber Reinforced Cement Composites by P. N. Balaguru, S. P. Shah, Mc-Graw Hill
4. Fiber Cement and Fiber Concrete by D.J Hannant, John Wiley and Sons.
5. Fracture Mechanics and Structural Concrete by Bhusan L. Karihal.

Title of the Course:	**Advanced Design of Steel Structures**	**L**	**T**	**P**	**Credit**
Course Code:	**PCVL0203**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Advanced Solid Mechanics, Advanced Structural Analysis

Course Description:

In this course students will exposed to practical structures like Hoardings, Castellated Beams, and Tower.Student will learn to design structures using light gauge steel and cold formed steel sections. He will also learn the fire resistance structures.

Course Learning Objectives:

1. Understand the background to the design provisions for hot-rolled andcold-formed steel structures, including the main differences betweenthem.
2. Design of structures like Hoarding, Towers, Light gauge steel.
3. Design concept of structures using cold formed steel.
4. Design structural sections for adequate fire resistance.

Course Outcomes:

COs	After the completion of the course the student will beable to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Proficiency in **applying** the provisions for design of Steel Structures	3	Applying
CO2	**Design** the Steel Structures like Hoardings, Castellated Beams, Towers	6	Creating
CO3	**Design** the structures using cold-formed steel& light gauge steel	6	Creating
CO4	**Design** structural sections for adequate fire resistance	6	Creating

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	2	--	--	--	--	--	--	--	--	--
CO2	2	2	2	2	--	--	--	--	--	--	--	--
CO3	2	2	2	2	--	--	--	--	--	--	--	--
CO4	2	2	2	2	--	--	--	--	--	--	--	--

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Hoarding Structures: Analysis and design of hoarding structures under dead, liveand wind load conditions as per code provisions by limit state method, introduction tofatigue failure.	**8Hrs**
Unit 2: Castellated beams: Concept, fabrication of the castellated beam from rolled steelsection, design of castellated beam for bending and shear as per code provisions by limitstate method.Design of laterally restrained castellatedbeams for given sectional properties.	**7 Hrs**
Unit 3: Microwave & Transmission Towers: Introduction, structural configuration, bracing systems,analysis and design as per code provisions.	**7 Hrs**
Unit 4: Cold formed steel sections: Techniques and properties, Advantages, Typical profiles, Stiffenedand unstiffened elements, Local buckling effects, effective sectionproperties, IS 801& 811 code provisions- numerical examples,beam design, column design.	**7 Hrs**

Unit 5: Light gauge steel structures: Local buckling of thin sections, Post packing of thin elements,Light gauge steel columns and compression members, Form factor for columns and compressionmembers, Stiffened compression elements, Multiple stiffened compression elements, Unstiffenedcompression elements effective length of light gauge steel compression members, Basic designstress, Allowable design stress, Light gauge steel beams, Laterally supported light gauge steelbeams web crippling. Allowable design stress in beams, Beams subjected to combined axial endbending stress, connections.	**7 Hrs**
Unit 6: Fire resistance: Fire resistance level, Period of Structural Adequacy, Properties ofsteel with temperature, Limiting Steel temperature, Protected andunprotected members, Methods of fire protection, Fire resistanceratings- Numerical Examples.	**6 Hrs**

Recommended Textbooks:

1. Design of Steel Structures, by Dr. N. Subramanian, Oxford University Press, NewDelhi.
2. Limit State Design of Steel Structures: S.K. Duggal, Tata Mc-Graw Hill IndiaPublishing House
3. Design of Steel Structures: K.S. Sairam, Pearson.
4. Design of steel structure by Limit State Method as per IS: 800- 2007: Bhavikatti S. S.,
   IKInternational Publishing House, New Delhi
5. Design of Steel Structures: B. C. Punmia, A. K. Jain and Arun Kumar Jain, Laxmi Publication.
6. Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
7. Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
8. The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R.,
   HeymanJ., ELBS.
9. Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.

References Books:

1. IS: 800 – 2007, IS: 875 (All five parts),IS 1641, 1642,1643, IS: 801-2001,IS: 808, IS:811, IS: 816, SP6 (1) & SP 6 (6).
2. LRFD Steel Design: William T. Segui, PWS Publishing.
3. LRFD Steel Designusing advanced analysis(Vol. 13),Chen, W. F., & Kim, S. E. (1997),CRC press.
4. Design of Steel Structures: Edwin H. Gaylord, Charles N. Gaylord James,

Stallmeyer, Mc-Graw-Hill.
5. Design of Steel Structures: Mac. Ginely T.
6. Design of Steel Structures: Dayaratnam, Wheeler Publications, New Delhi.
7. Design of Steel Structures: Kazimi S. M. and Jindal R. S., Prentice Hall India.
8. Steel Structure: Controlling Behaviour through Design, Englekirk, WILEY.
9. Srinath. L.S., Advanced Mechanics of Solids, Tata McGraw-Hill Publishing Co ltd., New Delhi
10. INSDAG Teaching Resource Chapter 11 to 20: www.steel-insdag.org

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to Design of;

1. Hoarding Structures
2. Castellated Beams
3. Towers
4. Structures using Cold Formed Steel Sections
5. Structures using Light Gauge Steel Sections
6. Fire resistant structures

Note:

1. Use of IS: 800-2007, IS: 875 (All parts) and steel table is permitted for theoryexaminations.
2. The Design shall be as per IS: 800 – 2007 by limit state method.

LIST OF PROFESSIONAL ELECTIVES		
Semester - II		
Sr No	***Course Code***	**Professional Elective III**
1	PCST0221	Project Planning and Scheduling
2	PCST0222	Advanced Numerical Methods
3	PCST0223	Digital Cartography, Remote Sensing And GNSS
Sr No	***Course Code***	**Professional Elective IV**
1	PCST0226	Advanced Prestressed Concrete
2	PCST0227	Tall Building Structures
3	PCST0228	Finite Element Method

Title of the Course:	**Project Planning and Scheduling**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0221**	**3**	**1**	**-**	**4**

Course Pre-Requisite:

Industrial Management & Economics

Course Description:

Construction Project & Management forms a core subject which is taught to students of all non-circuit disciplines of engineering. The study of this subject is aimed at developing a thorough understanding of the Construction Project & Management applications to solve engineering problems.

Course Learning Objectives:

1. To explain the important of Project Management and Project Planning.
2. To explain the Safety Engineering.
3. To explain the Mechanical v/s manual construction

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Understand the importance of Project Management tools.	II	Understand
CO2	Develop Plan and Schedule the Project by using CPM, PERT and MSP.	VI	Develop
CO3	Importance of Material Management	V	Importance
CO4	Apply Safety and Risk Management in Construction and work study	III	Applying

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	1	-	-	-	-	-	-	2	2	2	2
CO2	-	2	1	2	1	-	-	-	2	2	2	-
CO3	-	-	-	1	-	-	-	-	2	2	2	-
CO4	-	1	-	1	-	2	1	-	2	2	1	-

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: a) Project Management – Objectives, Agencies, Phases; Work Breakdown Structure. b) Project Planning - Bar Chart, Mile Stone Chart, CPM c) Development of CPM Network – Time Estimates, Floats, Critical Path. d) Network Updating	**8 Hrs.**
Unit 2: a) PERT - Concept of Probability, Normal and Beta Distribution, Time Estimates, Slack, Probability of Project Completion b) Precedence Network: Concept only. c) Introduction to Management Software- MSP.	**8 Hrs.**
Unit 3 : a) Safety Engineering – Importance of Safety, Classification of Accidents, Causes of Accidents, Safety Policy, Safety Organization, Safety Plan, Safety Training, Various Safety Equipment used on site.	**4 Hrs.**

b) Risk Management –Definition, Types, Risk Identification Process, Sources of Risk, Risk Classification, Risk Mitigation-Risk Reduction, Risk Acceptance, Risk Avoidance.	
Unit 4: Material Management Objectives, Need for Inventory Control, EOQ Analysis, ABC analysis, Safety Stock, Purchase Procedure, Stores Record	**8 Hrs.**
Unit 5: Work Study: a) Definition, Objectives, basic procedure, method study and work measurement, Work study applications in Civil Engineering. b) Method study – Definition, Objective, Procedure for selecting the work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams. c) Work measurement – Time and motion studies, Concept of standard time and various allowances, time study, equipment performance rating. Activity sampling, time-lapse.	**6 Hrs.**
Unit 6: Site mobilization – demobilization aspects, various Resources management based on funds availability, coordinating, communicating & reporting Techniques, Training for Construction Managers, Engineers , Supervisors	**4 Hrs.**
Recommended Textbooks: 1. Project Planning and Control with PERT and CPM – Dr. B. C. Punmia and K. K. Khandelwal. 2. PERT and CPM: Principles and Applications – L. S. Srinath 3. Construction Project Management – K. K. Chitkara 4. Construction Engineering and Management – S. Seetharaman. 5. Construction planning equipment and methods—R.L. Peurifoy 6. Heavy Construction – Planning ,Equipment, Methods—Jagman Singh	
References Books: 1. Construction Project Management – Kumar Neeraj Jha . 2. Construction Safety Manual Published by National Safety Commission of India.	

Unit wise Measurable Learning Outcomes:

After the completion of the course the student will be able to

1. Understand the importance of Project Management.
2. Aware of PERT.
3. Understand the importance of Safety Engineering and Risk Management.
4. Understand the provisions made in Mechanical v/s manual construction.
5. Understand the importance of Work Study.
6. Understand the importance of Site mobilization – demobilization aspects.

Title of the Course:	**Advanced Numerical method**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0222**	**3**	**1**	**-**	**4**

Course Pre-Requisite:

Mathematics- I, II and III of UG program in Civil Engineering

Course Description:

Course is designed to solve complex structural analysis problems by mathematical methods and techniques

Course Learning Objectives:

To impart knowledge about various methods of analysing linear equations and understand the different mathematical techniques.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Understand various computational methods available to solve practical problems.	I	Understand
CO2	Select from alternative methods the one method that is most appropriate for a specific problem	II	Analyze
CO3	Develop an ability to solve numerically many types of problems such as Roots of equations, Systems of linear simultaneous equations, Numerical Differentiation and integration, Eigen value problems etc., applied in structural engineering.	III	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	2	-	3	-	-	-	-	-	-	2
CO2	3	2	2	-	3	-	-	-	-	-	-	2
CO3	3	2	3	-	3	-	-	-	-	-	-	2

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Solution of Linear and Non-linear equations: -Linear system of equations:- Gaussian Elimination, Cholesky's method and Cholesky's Decomposition method-Numerical examples. Nonlinear system of equations: - Newton-Raphson's method for single and multiples variables, Limitations. Modified-Newton Raphson's methods-Numerical examples Solution Techniques for Eigen Value Problems: -Eigen value problems in structural engineering, Solution by characteristics polynomial Numerical examples.	**8 Hrs**
Unit 2: Numerical Integration: -Trapezoidal and Simpson's Rule for Areas, Trapezoidal Rule for Volumes- Related problems. Newmark's Method: -Equivalent Loads, Newmark's Procedure, Application of Newmark's method for the, slope and deflection of beams (Simply supported, Cantilever and Over hanging) having uniform and varying flexural rigidity with different loading cases (Concentrated, Uniformly distributed and uniformly varying). Slope and deflection of propped cantilevers and fixed beams having uniform flexural rigidity with uniformly distributed loads.	**8 Hrs**

Unit 3: Finite Difference Technique for Ordinary Differential Equations and its Applications in Structural Engineering:-Forward, Backward and central difference. Initial and boundary value problems. Application of finite difference method for statically determinate beam problems: - Calculation of bending moment and deflection of beams (simply supported and cantilever) having uniform and varying flexural rigidity subjected to loads (concentrated, uniformly distributed, uniformly varying and parabolic).	**7 Hrs**
Unit 4: Application of finite difference method for statically indeterminate beam problems: - Calculation of bending moment and deflection of beams (propped cantilevers, fixed and two span continuous) having uniform and varying flexural rigidity subjected to loads (concentrated and uniformly distributed).	**4 Hrs**
Unit 5: Application of finite difference method for buckling of columns: - Calculation of buckling load of columns (ends hinged, one end hinged and other fixed) with uniform and non-uniform flexural rigidity. Application of finite difference method for vibration of beams: - Calculation of natural frequency of beams (simply supported, propped cantilever and fixed) of uniform flexural rigidity subjected to concentrated load and uniformly distributed loads.	**4 Hrs**
Unit 6: Finite Difference Technique for Partial Differential Equations and its Applications in Structural Engineering: - Application of finite difference technique for partial differential equation for membrane problems: - Derivation of module, Calculation of slope and deflection of laterally loaded square, triangular, L and T shaped membrane. Application of finite difference technique for partial differential equation for bending of laterally loaded thin plates:- Derivation of module, Calculation of deflection of laterally loaded square, and rectangular plates with fixed and simply supported boundaries subjected to uniformly distributed and varying loads	**9 Hrs**

Recommended References:

1. Rajasekaran S., "Numerical Methods in Science and Engineering-A practical approach", S. Chand Publishing; 2nd Edition 2003 edition
2. Grewal B.S., "Numerical Methods in Engineering and Science", Khanna Publishers.
3. Krishna Raju N., and Muthu K.U, "Numerical Methods for Engineering Problems", Macmillan India Limited.

4. Bathe K.J., "Finite Element Proceedings in Engineering Analysis" Prentice Hall Inc.
5. James M.L, Smith G.M. and Wolford J.C., "Applied Numerical Methods for Digital Computation", Harper and Row Publishers.
6. Wang P.C., "Numerical and Matrix Methods in Structural Mechanics", John Wiley 53 & Sons.
7. Meghre A.S. and Deshmukh S.K., "Matrix Methods of Structural Analysis (Theory, Examples and Programs), Charotar Publishing House.
8. James B. Scarborough, "Numerical Mathematical Analysis",
9. Radha Kanta Sarkar, "Numerical Methods for Science and Engineering" Eswar Press,

Title of the Course:	**Digital Cartography, Remote Sensing And GNSS**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0223**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Knowledge of fundamentals of Science, physics and basic mathematical ability - trigonometry. Good geographical clarity of places. Surveying and levelling basics. Knowledge of coordinate geometry and rectangular coordinate.

Course Description:

Cartography is the science of mapping from age old times which has advanced by digital technology. Remote Sensing and GNSS are the study of science and technology in resonance with the domain of Geography, Surveying and satellites using space technology . It deals with technology that develops and uses surveying, aerial survey, satellite remote sensing infrastructure to address the problems of Geography, cartography, geosciences and other related branches of science and engineering.

Course Learning Objectives:

1. Acquire knowledge of fundamentals of basic surveying and map projections .
2. Learn the importance of aerial Surveying and satellite remote sensing.
3. Use GNSS concepts knowledge for absolute positioning mapping .

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's	
		level	Descriptor
CO1	Outline the history of aerial photography and Remote sensing	II	Understanding
CO2	Demonstrate and Apply Remote sensing satellite and their sensors	III	Apply
CO3	Compare and use Aerial Survey, remote sensing and GPS data	IV	Analyzing
CO4	Prepare technical papers, take part in seminars and workshops of Cartography, Remote sensing and GNSS for webinar/guest lectures of scientist in the field	V	Evaluate

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	-	-	-	-	-	-	2	-	-	
CO2	2	2	2	2	1	2	3	-	2	-	-	-
CO3	3	1	1	2	-	-	-	-	1	-	1	-
CO4	-	1	2	2	3	1	1	-	1	1	1	-

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Cartography The Earth: its shape and size; Datum and co-ordinate systems; Geographical and projected co-ordinate system and grid system; Choice and classification of map projections. Basics of Computer Cartography: Cartographic Data: Point, line and polygonal data.	**8 Hrs**
Unit 2 : Aerial Surveying and UAVs Overview and background, Aerial Surveying terms and types, flight planning history of UAVs c. classifications of UAVs ,UAV working principle and components platforms on-board flight control payloads Regulators' and regulations	**7 Hrs**

Unit 3: Remote Sensing: Definition and scope, History and development of remote sensing technology; Electromagnetic radiation (EMR) and electromagnetic spectrum; EMR interaction with atmosphere and earth surface; Atmospheric window.	**7 Hrs**
Unit 4: Remote sensing satellites: Types and their characteristics; Types of Sensors; Orbital and sensor characteristics of major earth resource satellites. Indian remote sensing satellite programme	**6 Hrs**
Unit 5: Global Navigational satellite System : Introduction to GNSS; Types of GNSS; GNSS satellite; Differential GPS; Sources of GNSS errors; Application of GNSS in surveying, mapping and navigation.	**7 Hrs**
Unit 6: NPTEL and ISRO-IIRS eLearning through outreach programs with online lectures on digital cartography, Remote Sensing, aerial photography, GNSS and GIS	**7 Hrs.**

Recommended Textbooks:

1. Jensen, J.R. (2006): Remote Sensing of the Environment: An Earth Resource Perspective (2nd Ed.), Prentice Hall, New Jersey
2. Lillesand, T.M., Kiefer, R.W., and Chipman, J.W. (2007): Remote Sensing and Image Interpretation (6th Ed.). Wiley, New Jersey
3. Reddy, M.A. (2008): Textbook of Remote Sensing and Geographical Information System (3rd Ed.), BS Publications, Hyderabad,

References Books:

1. Nair, N. B. (1996): Encyclopaedia of Surveying, Mapping and Remote Sensing. Rawat Publications., Jaipur and New Delhi.
2. Bernhardensen, Tor. 1999. Geographic Information Systems: An Introduction. Toronto: John Wiley & Sons, Inc
3. Monmonier, M.S. (1982): Computer Assisted Cartography: Principles and Prospects, Prentice Hall, New Jersey.
4. Cromley, R.G.(1992): Digital Cartography, Prentice-Hall, New Jersey.

Websites:

1. Indian institute of remote sensing,(IIRS),
2. National Remote Sensing Centre (NRSC), India: http://www.nrsc.gov.in
3. National Aeronautics and Space Administration (NASA), USA: http://www.nasa.gov

4. United States Geological Survey (USGS), USA: http://www.usgs.gov
5. International Society for Photogrammetry and Remote Sensing (ISPRS): http://www.isprs.org
6. Bhuvan: http://www.bhuvan.nrsc.gov.in
7. Wikimapia: http://www.wikimapia.org

Unit wise Measurable Learning Outcomes:

1. Conduct digital mapping in the field of cartography
2. Demonstrate advanced knowledge of aerial Surveying and satellite remote sensing.
3. Apply aerial mapping using present day UAVs withing govt rules and regulations
4. Evaluate different techniques for their pros and cons and explain the same in seminars, conferences workshops and paper presentation's.

Title of the Course:	**Advanced Prestressed Concrete**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0226**	**3**	**1**	**0**	**4**

Course Pre-Requisite:

Design of Concrete Structures

Course Description:

This course demonstrates advanced reinforced concrete design method that is prestressed concrete. The course covers conceptual knowledge, analysis and design of prestressed systems. Prestressed concrete structure is a specialized stream of structural design & usually economical for long span structures. The application of this course can be found in design of long span beams, bridges, stadiums, large slabs etc.

Course Learning Objectives:

1. To impart advanced concrete design method
2. To introduce the basic principles of prestressed concrete and tensioning systems.
3. To make aware of losses of prestress
4. To explain analysis, design of prestressed concrete members like beams and slabs.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Analyze prestressed sections	4	Cognitive
CO2	Estimate losses of prestress	5	Cognitive
CO3	Anlayze for flexural strength	4	Cognitive
CO4	Design prestressed sections for beams and floor slabs	6	Cognitive

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	1	2	-	-	-	-	-	-	-	-	-	-
CO2	1	3	-	2	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	1	-	-	-	-	1	-	1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Analysis of prestress Basic assumptions, Concept of analysis of prestress sections, Different cable profiles, Analysis of rectangular, symmetrical and unsymmetrical I sections. Prestress line or thrust line.	**6 Hrs**
Unit 2: Losses of Prestress Nature of losses of prestress, Loss due to elastic deformation of concrete, Loss due to shrinkage of concrete, Loss due to creep of concrete, Loss due to relaxation of stress in steel, Loss of stress due to friction, Loss due to anchorage slip, Total losses allowed for design.	**6 Hrs**
Unit 3: Flexural strength of prestressesd concrete section. Types of flexural failure, strain compatibility method, simplified code procedures, comparative analysis of code procedures	**8 Hrs**
Unit 4: Limit state Design of prestressed concrete members Philosophy of limit state design, criteria for limit states, Design of rectangular section for flexure, Design of rectangular section for the limit state of collapse in flexure	**6 Hrs**

Unit 5: Design of pre tensioned and post tensioned I sections for flexural members Dimensioning of flexural members, Estimation of self wt of the beam, Design of I section pretentioned beam, design of I section post tensioned beam.	**8 Hrs**
Unit 6: Prestressed Concrete Slab Types of prestressed concrete floor slabs, design of prestressed concrete one way slab, design of prestressed concrete two way slab.	**6 Hrs**

Recommended Textbooks:

1. Fundamental of Prestressed Concrete - Sinha & Roy, S. Chand & Co. New Delhi
2. Prestressed Concrete – N Krishna Raju, Tata McGraw-Hill Publication Company ltd., New Delhi
3. Prestressed Concrete Structures - Dayaratnam P.
4. IS 1343: Code of Practice for Prestressed Concrete by Bureau of Indian Standards.

References Books:

1. Prestressed Concrete - T.Y. Lin, John Willey & sons Newyark
2. Prestressed Concrete - Guyon Y., Vol. I & II, John Wiley and Sons, New York.

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

1. Analyze different prestressed sections – rectangular, symmetrical & unsymmetrical I sections
2. Estimate losses of prestress
3. Analyze for flexural strength
4. Design rectangular prestressed sections for flexure
5. Design I section of prestressed concrete for flexure
6. Design prestressed concrete slabs

Title of the Course:	**Tall Building Structures**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0227**	**3**	**1**	**-**	**4**

Course Pre-Requisite:

Design and analysis of RCC and steel structures

Course Description:

The course aims at the development of ability for design of high-rise buildings. It offers the student with an opportunity to gain real life design experience, and to develop the ability to identify and solve civil engineering problems in a feasible and creative way, and to apply design procedures, codes of practice and computer software to design conventional steel and concrete high-rise buildings.

Course Learning Objectives:

- The students are expected to understand fundamental concept, principles and various forms of tall buildings.
- The students are expected to analyse braced frames, shear wall and core structures for different forces as per Indian standards.
- The students are expected to analyse the tall buildings for its stability under various modes.
- The students are expected to analyse the tall buildings under dynamic loading conditions.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Understand fundamental concept, principles and various forms of tall buildings	III	Understand
CO2	Analyse braced frames, shear wall and core structures of tall buildings for different forces as per Indian standards	IV	Analyse
CO3	Analyse the tall buildings under dynamic loading conditions.	IV	Analyse

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	-	-	1	-	-	-	-	-	-	-	-
CO2	-	3	-	-	3	-	-	2	-	-	-	2
CO3	-	-	3	-	-	-	-	3	-	2	-	2

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: INTRODUCTION TO TALL BUILDINGS, DESIGN CRITERIA AND LOADING Tall buildings – Design process, philosophy, scope and content Design criteria – Design philosophy, strength and stability, stiffness, human comfort, creep and temperature effects, fire Loading – Gravity, wind, earthquake and combine loading	**8 Hrs**
Unit 2: MODELING FOR ANALYSIS Introduction of Structural forms – Braced, rigid, infill, shear wall, wall frame, core structure forms Modeling for analysis – approaches, assumptions, high rise behavior,	**6 Hrs**

modeling for approximate and accurate analysis	
Unit 3: BRACED FRAMES, SHEAR WALL Braced frames – types, behavior, methods of analysis Shear wall – behavior, analysis of proportionate and non-proportionate wall, stress analysis of shear wall	**6 Hrs**
Unit 4: CORE STRUCTURES Concept of warping behavior Thin wall subjected to torsion – sectorial coordinate, shear center Theory of restrained warping of uniform cores – governing differential equation, uniformly distributed torque, warping stresses	**8 Hrs**
Unit 5: STABILITY OF HIGH RISE BUILDING Overall buckling analysis – Approximate and analytical method, Second order effects of gravity loading – P-delta effect, iterative P-delta analysis, direct P-delta analysis Stiffness of members in stability calculations	**6 Hrs**
Unit 6: DYNAMIC ANALYSIS Dynamic response to wind load – Sensitivity of structures, dynamic response, along wind and cross wind response Dynamic response to earthquake load – response to ground acceleration, spectrum analysis, structural damping ratio Human response to building motion	**6 Hrs**

Recommended Textbooks:

1. Bryan Smith, Alex Coull, "Tall Building Structures, Analysis and Design", Wiley, 2013
2. Taranath B.S., "Structural Analysis and Design of Tall Buildings", CRC Press, 2011.

References Books:

1. Beedle.L.S., "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1986.
2. Holmes, "Wind Loading of Structures, Third Edition, Spon Press, London, 2017
3. Schuller W. G, "High rise building structures"- John Wiley,1977.
4. Smith B.S and Coull A, "Tall Building Structures - Analysis and Design", John Wiley and Sons, Inc., 2011.
5. O.P. Jain and Jaikrishna., Plain and Reinforced Concrete Structures – Vol II, Nemchand and Bros Roorkee

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

- The students will understand fundamental concept, design philosophy of high rise structure
- The students will learn different structural frames of tall buildings and modelling of analysis for high rise buildings
- The students will learn in details the concepts and analysis of braced frames and shear wall for tall buildings
- The students will learn in details the analysis of core structures for tall buildings
- The students will learn the stability analysis of tall buildings
- The students will learn the dynamic analysis of tall buildings under wind and earthquake

Title of the Course:	**Finite Element Method**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0228**	**3**	**1**	**-**	**4**

Course Pre-Requisite:

Acquaintance with the basic concepts of theory of structures.

Course Description:

The objective of the course is to make the students aware about the basic concepts of Finite Element Technique, the world wide accepted numerical tool for the solution of different classes of problems in solid mechanics.
Different application areas will be introduced and illustrated after introducing the basic aspects of the method. However, major emphasis will be laid on the solution of Civil Engineering problems.
The curriculum intends to cover the analysis methodologies for 1-D, 2-D and 3-D problems with the advantages and disadvantages clearly highlighted. It is expected that once the students are familiar to the course, they will be in a position to develop computer codes for any physical problem using Finite Element technique.

Course Learning Objectives:

1. To impart knowledge of finite element method for 1-D, 2-D,3-D elements.
2. To discuss finite element method in structural engineering.
3. To illustrate applications of FEM for plates, shells and structural dynamics.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	**Implement** finite element methodology for solving 1-D, 2-D, 3-D problems.	III	Applying
CO2	**Analyze**nodal degrees of freedom and stress resultants.	III	Applying
CO3	**Discuss** finite element model for solution of various fieldProblems.	V	Evaluating

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	1	-	-	-	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	-	-	-

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE I	10
MSE	30
ISE II	10
ESE	50

- ISE I and ISE II are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit 1: Basics of F.E.M. Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions. Natural Coordinates, Various types of elements, Concepts of Numerical Integration and its implementation.	**9 Hrs**
Unit 2: Analysis of Structures Modelling and solving of beamsand attempting to co-relate with exact analytical solutions.	**6 Hrs**
Unit 3: Applications of FEM Modelling and solving of trusses and plane frames by using linear elements.	**5 Hrs**
Unit 4: FEM for Two and Three Dimensional Solids Pascal's triangle, convergence requirements and compatibility conditions,shape functions, boundary conditions, element aspect ratio, applications to a continuum.	**8 Hrs**

Unit 5: Specialised Elements and their application Isoperimetric Elements, Plate and Shell Elements Formation of stiffness matrix for plate bending elements oftriangular and quadrilateral shapes, cylindrical thin shell elements.	**6 Hrs**
Unit 6: Finite Element Applications to Structural Dynamics Finite Element Applications to Structural Dynamics Formulation, Hamilton's principle, element mass matrices, evaluation of Eigen values and eigenvectors.	**6 Hrs**

Recommended Textbooks:

1. O. C. Zienkiewicz and Y. K. Cheung, The Finite Element Method in Structural andSoild Mechanics, McGraw Hill, London
2. S. S. Rao, Finite Element Analysis, Elsevier Butterworth-Heinemann
3. W. Weaver Jr. and J. M. Gere, Matrix Analysis of Framed Structure, CBS Publishers &Distributors, New Delhi, India
4. Reddy J. N., An Introduction to the Finite Element Method, McGraw Hill, 3rd edition, NewYork, 2006.
5. Cook Robert D., Malkus David S., Plesha Michael E., and Witt Robert J., Concepts andApplications of Finite Element Analysis, 2003.

References Books:

1. Bathe Klaus-Jurgen, Finite Element Procedures in Engineering Analysis,1982.
2. Chandrupatla T. R. and Belegundu A. D., Introduction to Finite Element in Engineering,Prentice.
3. Erik G. Thompson, Introduction to the Finite Element Method: Theory, Programming and Applications, John Wiley
4. H. C. Martin and G. F. Carey, Introduction to Finite Element Analysis - Theory and Application, NewYork, McGraw-Hill
5. Irving H. Shames, Clive L. Dym, Energy and Finite Element Methods in Structural Mechanics; New Age International
6. K. J. Bathe, Finite Element Procedures, Prentice-Hall of India, New Delhi, India
7. M. Mukhopadhyay, Matrix, Finite Element, Computer and Structural Analysis, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.

Unit wise Measurable Learning Outcomes:

After completion of the course the student will be able to

- The student shall be able to interpret the capabilities of Finite element method
- The student shall be able to visualize the merits of Finite element method
- The student shall be able to apply the finite element method for basic

professional problems • The student shall be able to extend the FEM application to complicated problems • The student shall be able to optimize his FEM modelling utilities for improved solutions • The student shall be able to apply the techniques in the field of dynamics

Title of the Course:	**Cost Management (Audit Course)**	**L**	**T**	**P**	**Credit**
Course Code:	**PCVL0261**	**2**	**-**	**-**	**-**

Assessments :

Teacher Assessment: NOT APPLICABLE

Course Contents:

Unit 1: Engineering Economics: Introduction, Importance, Time value of Money, Mathematics of Interest – present worth, future sum, uniform series factors.	**5 Hrs.**
Unit 2: Economic Comparisons: Equivalent Annual Cost Method, Present Worth Method, Future Worth Method, Capitalized Cost Method, Net Present Value.	**8 Hrs.**
Unit 3 : Economic Comparisons: a). Rate of Return Method, Pat-Back Method, Benefit Cost Ratio b). Break Even Analysis	**5 Hrs.**
Unit 4: Resource Management: Material Management – Objectives, Functions Inventory Control – Necessity, Techniques such as ABC, EOQ, Safety Stocks.	**5 Hrs.**
Unit 5: Retirement and Replacement: Introduction, Factors for Replacement, Cost of Owning and Operation a Construction Equipment.	**5 Hrs.**
Unit 6: Quality Control: Concept of quality and quality control, statistical methods variable and attributes, Control Charts (X & R, P and C Chart), Acceptance Sampling, Sampling Plans	**5 Hrs.**

Recommended Textbooks:

1. Quantitative Techniques in Management – Vol. I, L.C.Zhamb
2. Material Management – Gopal Krishnan, Sdueshan
3. Executive Decisions & Operation Research by Miller and Stars, Prentice Hall of India, Publisher.
4. Principles of Construction Management by Roy Pilcher.
5. Project Cost Control in Construction by Roy Pilcher.
6. Projects by Prasanna Chandra
7. Management and Engineering Economics by G.A.Taylor.
8. Engineering Economics – Layland Blank and Torquin.

9. Engineering Economics by Pannerselvam
10. Industrial Engineering and Production management by Martand Telsang

References Books:

1. John L.Ashford, " The Management of Quality in Construction ", E & F.N Spon, New York, 1989.
2. Juran Frank, J.M. and Gryna, F.M. " Quality planning and Analysis ", Tata McGraw Hill, 1982.
3. James, J.O Brian, " Construction Inspection Handbook - Quality Assurance and Quality Control ", Van Nostrand, New York, 1989.
4. Relevant Acts

Title of the Course:	**Advanced Design of Steel Structures Lab.**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0231**	**-**	**-**	**4**	**2**

Course Pre-Requisite:

Advanced Design of Steel Structures

Course Description:

In this course students is exposed to practical structures. He will design the structures using standard software.

Course Learning Objectives:

Design of steel structures like hoarding, towers, chimney, castellated beams, gantry girder, single storey trussed roof steel building, Pre-engineered building and multi-storey building.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Design of steel structures.	6	Creating

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	2	3		2				3	3	1	2

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation

Assessment	Marks
ISE	50
ESE OE	50

- ISE based on course content
- ESE: Assessment is based on 100% course content

Course Contents:

List of Designs:

A minimum of 6 of the following problems are to be solved using application software like STAAD PRO, ANSYS, SAP, MATLAB etc.

1. Design of one storey trussed roof steel building
2. Design of one storey gable frame (Pre-engineered) building.
3. Design of steel multi-story pin-jointed building with braces.
4. Design of a transmission tower.
5. Design of a microwave tower.
6. Design of a steel chimney.
7. Design of a hoarding structure.
8. Design of a castellated beams.
9. Design of a gantry girder.

Recommended Textbooks:

1. Design of Steel Structures, by Dr. N. Subramanian, Oxford University Press, NewDelhi.
2. Limit State Design of Steel Structures: S.K. Duggal, Tata Mc-Graw Hill IndiaPublishing House
3. Design of Steel Structures: K.S. Sairam, Pearson.
4. Design of steel structure by Limit State Method as per IS: 800- 2007: Bhavikatti S. S.,
   IKInternational Publishing House, New Delhi
5. Design of Steel Structures: B. C. Punmia, A. K. Jain and Arun Kumar Jain, Laxmi Publication.
6. Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
7. Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
8. The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R.,
   HeymanJ., ELBS.
9. Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.

References Books:

1. IS: 800 – 2007, IS: 875 (All five parts),IS 1641, 1642,1643, IS: 801-2001, IS: 808, IS:811,
   IS: 816, SP6 (1) & SP 6 (6).
2. LRFD Steel Design: William T. Segui, PWS Publishing.
3. LRFD Steel Designusing advanced analysis(Vol. 13),Chen, W. F., &

Kim, S. E. (1997),CRC press.
4. Design of Steel Structures: Edwin H. Gaylord, Charles N. Gaylord James, Stallmeyer, Mc-Graw-Hill.
5. Design of Steel Structures: Mac. Ginely T.
6. Design of Steel Structures: Dayaratnam, Wheeler Publications, New Delhi.
7. Design of Steel Structures: Kazimi S. M. and Jindal R. S., Prentice Hall India.
8. Steel Structure: Controlling Behaviour through Design, Englekirk, WILEY.
9. Srinath. L.S., Advanced Mechanics of Solids, Tata McGraw-Hill Publishing Co ltd., New Delhi
10. INSDAG Teaching Resource Chapter 11 to 20: www.steel-insdag.org

Experiment wise Measurable students Learning Outcomes:

After the completion of the course the student will be able to design the steel structures using standard software.

Title of the Course:	**Mini Project**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0232**	**-**	**-**	**4**	**2**

Course Pre-Requisite:

Course Description:

Course Learning Objectives:

1. Acquire knowledge to conduct research.
2. Develop experimental setup to solve problem, do testing and validation of the results.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	**Formulate** a real world problem and develop its requirements.		Create
CO2	**Develop** a design solution for a set of requirements.		Apply
CO3	**Test and validate** the conformance of the problem.		Evaluating
CO4	**Express** technical ideas, strategies and methodologies in written & oral form.		Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	1	-	-	-	-	-	-	-	-	-	-

Assessments :

Teacher Assessment:

Assessment	Marks
ISE	50
ESE OE	50

ISE for Mini Project is based on the efforts by the student for formulating problem, developing design solution, testing and validation of the solution and presentation.

Course Contents:

Students are expected to carry out independent research work on the given topic. It is expected that the student shall do formulation of the small research problem, development/fabrication of experimental set-up (if any/required) and testing, and analysis of results thus obtained. The students are required to submit the report.

Title of the Course:	**Seminar - II**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0241**	**-**	**-**	**2**	**1**

Course Description:

This course is aimed at developing the skills like literature review, identification, analysis and presentation of issues in societal context in general and Civil and structural Engineering perspective in particular. This course shall provide an opportunity to the student to develop self-learning, critical thinking and communication skills.

Course Learning Objectives:

1. To develop the student to apply the knowledge gained to solve the complex engineering problem.
2. To develop the student for the Self-study and self-learning ability.
3. To motivate students to think about real life problems and ideas.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Analyze the complex engineering problem	4	Analysing
CO2	Study and prepare the solution for engineering problems.	5	Evaluating
CO3	Justify the relevance and importance of the seminar topic with current technology with proper presentation	4	Analysing

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	-	2	1	1	-	-	2	1	-	-	-
CO2	2	2	-	3	-	-	-	-	-	-	-	-
CO3	1	-	-	-	3	-	-	-	-	3	-	-

Assessments:

Teacher Assessment:

• ISE is based on performance of student in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). The course teacher shall use at least two assessment tools as mentioned above for ISE.

Assessment	Marks
ISE	50

Course Contents:

1. Seminar shall be delivered on one of the advanced topics chosen in control systems in consultation with the guide after compiling the information from the latest literature and other sources.
2. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student.
3. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both sides printed, preferably in IEEE format) should be submitted to the Department before delivering the seminar.
4. A PDF copy of the report in soft form must be submitted to the guide along with other details if any.

The topic for the Seminar shall be related to Structural Engineering areas such as

Structural Engineering, Concrete Technology, Geotechnical Engineering, Foundation Engineering Infrastructural Engineering, Earthquake engineering, Bridge Engineering, Earthquake Engineering etc.

Title of the Course:	**Field Training**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0341**	**-**	**-**	**-**	**2**

Course Pre-Requisite:

Course Description:

Course Learning Objectives:

1. To provide an opportunity for student to work in collaborative and multidisciplinary environment.
2. To expose the students to real life Civil/Structural engineering problems encountered in industry/society.

Course Outcomes:

COs	After the completion of the course the student will be able to	**Bloom's Cognitive**	
		level	Descriptor
CO1	Understand the function of Civil/Structural Organizations	2	Understand
CO2	Identify the requirements of Civil/Structural Organizations for performance improvement	3	Apply
CO3	Take part in group work for efficient operation.	4	Analyze

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	2	-									
CO2		2	-									
CO3	2		-									

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE)

Assessment	**Marks**
ISE	100

ISE is based on extent of objectives defined; work done at the organization, outcome of training, and quality of report. Departmental Evaluation Committee shall carry out the evaluation

Course Contents:
The objective of this training is to expose the students to industry environment and practices. Students will be sent to leading Environmental Engineering organizations/Research laboratories/Design Consultancy organizations to undergo a rigorous training for a minimum period of one month during summer term/vacation.
Important Note: Internship should be completed after Semester-II and before End Semester Examination of Semester-III. Minimum duration of internship should not be less than 16 weeks.

Title of the Course:	**Dissertation Work**	**L**	**T**	**P**	**Credit**
Course Code:	**PCST0351, PCST0352,**	**-**	**-**	**5**	**26**
	PCST0451, PCST0452	**-**	**-**	**6**	

Course Pre-Requisite:

Course Description:

Course Learning Objectives:

1. Acquire knowledge to solve real world problems of societal concerns.
2. Impart flexibility to the student to have increased control over his/ her learning.
3. Teachers would serve as mentor/facilitator of inquiry and reflection rather than as an instructor.
4. Enhance student's learning through increased interaction with peers and colleagues.

Course Outcomes:

COs	After the completion of the course the student will be able to	**Bloom's Cognitive**	
		level	Descriptor
Phase I & II			
CO1	Conceive and divide a project into suitable phases to hypothesize the end objectives of the project.	4,5	Analyze Evaluate
CO2	Express the abstract of a project (Written/Oral) in a professional, well-structured style using suitable section headings in good English.	2	Understand
Phase III & IV			
CO3	Reevaluate initial hypotheses/synopsis considering literature evidence and collaborative discussion with the goal of making considered judgments.	5	Evaluate
CO4	Analyse, Experiment and judge the progress of achieving the set objectives of the project	4,5	Analyze Evaluate
CO5	Develop the capacity to observe judiciously and propose and defend opinions and ideas with tact and conviction.	5	Evaluate

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Credits	Marks
Dissertation Phase I ISE I	2	50
Dissertation Phase I ISE II	4	100
Dissertation Phase II ESE (OE)	4	100
Dissertation Phase III ISE I	4	100
Dissertation Phase III ISE II	4	100
Dissertation Phase IV ESE (OE)	8	200

- **ISE for dissertation phase I** is based on the efforts by the student for synopsis preparation. It shall be evaluated using the parameters extent of literature review, scope defined, objectives, and fundamental concepts, quality of presentation, and interaction during presentation, effort/work done, quality of report and interaction with guide.

- **ISE for dissertation phase II** is based on the progress made during the semester for the objectives defined in the synopsis and the report submitted by the students. It shall be evaluated through progress seminar(s) at the end of the semester. The parameters for evaluation include extent of work done, results and discussion/publication efforts, quality of presentation, quality of report, interaction during presentation and interaction with guide. ISE shall be conducted by Departmental Post-Graduate Committee (DPGC).

- **ESE for dissertation phase II** shall be conducted at the end of semester by a duly constituted examination panel composed of Chairman, internal examiner (guide) and external examiner.

- **ISE for dissertation phase III** is based on the work done by the student during fourth semester. It shall be evaluated using the parameters extent of work done after phase II, quality of presentation, interaction during presentation, and interaction with guide. **ISE for dissertation phase IV** is based on the work done during the semester and the report submitted by the students. It shall be evaluated through progress seminar(s) at the end of the semester. The parameters for evaluation include extent of work done, results and discussion/publication efforts, quality of presentation, quality of report, interaction during presentation and interaction with guide. ISE shall be conducted by Departmental Post-Graduate Committee (DPGC).

- **ESE for dissertation phase IV** shall be conducted at the end of semester by a duly constituted examination panel composed of Chairman, internal examiner (guide) and external examiner.

Course Contents:

The third semester is completely devoted to dissertation work which is defined based on the interest of the students to specialize in a particular area. Students are expected to carry out independent research work on the chosen topic. In this semester it is expected that the student has carried out substantial research work including exhaustive literature survey, formulation of the research problem, development/fabrication of experimental set-up (if any/required) and testing, and analysis of initial results thus obtained. In fourth semester, the students continue their dissertation work. It is expected that the student has completed most of the experimental/computation works and analyzed the results so obtained as proposed in the synopsis. The work should be completed in all respects in this semester. The students are required to submit the dissertation work in the form of report as per the institute rule.