PG-Structural Engineering Syllabus

Year 2018-19

K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Curriculum Structure and Evaluation Scheme
To be implemented from **2018-19**
Rev: *CIVIL-Structural Engineering/Course Structure/RIT/01/2018-19*

Department : Civil Engineering
Class : F.Y. M. Tech. Structural Engineering **Semester:** I

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory (Marks) %			Practical (Marks) %	
		L	T	P	Credits	Scheme	Max	Min % for Passing		Max	Min % for Passing
SHP517	Numerical Methods for Structural Engineers	3	-	-	3	ISE	20	40	40	-	-
						UT1	15			-	-
						UT2	15			-	-
						ESE	50	40		-	-
CES1012	Advanced Structural Analysis	3	-	-	3	ISE	20	40	40	-	-
						UT1	15			-	-
						UT2	15			-	-
						ESE	50	40		-	-
CES1022	Advanced Solid Mechanics	3	-	-	3	ISE	20	40	40	-	-
						UT1	15			-	-
						UT2	15			-	-
						ESE	50	40		-	-
CES1032	Structural Dynamics and Earthquake Engineering	4	-	-	4	ISE	20	40	40	-	-
						UT1	15			-	-
						UT2	15			-	-
						ESE	50	40		-	-
PE-I	Program Elective - I	3	-	-	3	ISE	20	40	40	-	-
						UT1	15				
						UT2	15				
						ESE	50	40			
SHP551	Technical Communication	2	-	-	Audit Course	P/NP					-
CES1042	Structural Design lab I	-	-	4	2	ISE	-	-	-	50	50
						ESE	-	-	-	50	50
CES1052	Advanced Concrete Technology Lab.	-	-	2	1	ISE	-	-	-	100	50
CES1062	Mini Project I	-	-	2	1	ISE	-	-	-	100	50
Total		18	0	8	20						

Total Contact Hours/week : 26
Total Credits : 20
ISE = In Semester Exam, MSE (UT1+UT2) UT-I = Unit Test-I, UT-II = Unit Test-II ESE = End Semester Exam, P=Pass, NP=Not Pass

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Department : Civil Engineering
Class : F.Y. M. Tech. Structural Engineering **Semester:** II

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory (Marks) %			Practical (Marks) %	
		L	T	P	Credits	Scheme	Max	Min % for Passing		Max	Min % for Passing
CES2012	Finite Element Analysis in Structural Engineering	3	-	-	3	ISE	20	40	40	-	-
						UT1	15			-	-
						UT2	15			-	-
						ESE	50	40		-	-
PE-II	Program Elective - II	3	-	-	3	ISE	20	40	40	-	-
						UT1	15			-	-
						UT2	15			-	-
						ESE	50	40		-	-
PE-III	Program Elective - III	3	-	-	3	ISE	20	40	40	-	-
						UT1	15			-	-
						UT2	15			-	-
						ESE	50	40		-	-
PE-IV	Program Elective - IV	3	-	-	3	ISE	20	40	40	-	-
						UT1	15			-	-
						UT2	15			-	-
						ESE	50	40		-	-
CES2022	Research Methodology & Intellectual Property Rights (IPR)	1	1	-	2	ISE	50	40		40	-
						ESE	50	40			-
CES2032	Structural Design Lab II	-	-	4	2	ISE	-	-	-	50	50
						ESE	-	-	-	50	50
CES2042	Structural Dynamics and Earthquake Engineering Lab	-	-	2	1	ISE	-	-	-	50	50
						ESE	-	-	-	50	50
CES2052	Mini project II	-	-	4	2	ISE	-	-	-	100	50
	Internship *	-	-	-	-	-	-	-	-	-	-
Total		13	1	10	19						

Total Contact Hours/week : 24
Total Credits : 19
*** - Student have to complete internship of 4weeks after 2nd semester however evaluation of this will be carried out in 3rd semester.**

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Department : Civil Engineering
Class : S.Y. M. Tech. Structural Engineering **Semester:** III

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks) %		Practical (Marks) %	
							Max	Min % for Passing	Max	Min % for Passing
CES3012	Internship	-	-	2	Audit	ISE	-	-	P/NP	
CES3022	**Self-Learning:**MOOC / Certificate course	-	-	-	3	ESE*	-	-	100	50
CES3032	Dissertation Phase-I	-	-	08	04	ISE #	-	-	100	50
CES3042	Dissertation Phase-II	-	-	12	06	ISE	-	-	100	50
						ESE			100	50
Total		-	-	**22**	**13**					

Total Contact Hours/week : 22
Total Credits : 13

*** Note:**
1. If student completes the MOOC course such as NPTEL/SWAYAM etc. which has rigorous evaluation scheme. Student needs complete online/certification course approved by DPGC and produce certificate of online or certification course at the time of ESE. if student fails to produce this certificate, he or she will not be eligible to give ESE of Online/certification course.

2. If student completes certificate course such as C++/JAVA/PYTHON/VB, then supervisor has to conduct in semester evaluation and submit marks to COE.

 # Note:
Topic should be selected based on relevance to societal needs, value addition to existing facilities in the institute, industry need, problems of national importance, research and development in structural engineering. The student should complete the following:

- Comprehensive Literature survey based on papers published in standard journals.
- Gap Analysis
- Problem Identification
- Define dissertation objectives
- Complete Preliminary design with feasibility analysis
- Implementation and Validation of models
- Prepare report and give presentation

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Department : Civil Engineering
Class : S.Y. M. Tech. Structural Engineering **Semester:** IV

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	Credits	Scheme	Theory (Marks) %		Practical (Marks) %	
							Max	Min % for Passing	Max	Min % for Passing
CES4012	Dissertation Phase-III	-	-	10	06	ISE	-	-	100	50
CES4022	Dissertation Viva Voice	-	-	18	10	ISE	-	-	100	50
						ESE			100	50
Total		-	-	**28**	**16**					

Total Contact Hours/week : **28**
Total Credits : **16**

List of Program Elective- I

Sr. No.	Course Code	Course
1	**CES1072**	Advanced Design of Steel Structures
2	**CES1082**	Structural Health Monitoring
3	**CES1092**	Advanced Concrete Technology

List of Program Elective – II

Sr. No.	Course Code	Course
1	**CES2062**	Advanced Earthquake Engineering
2	**CES2072**	Theory and Application of Cement Composites
4	**CES2082**	Structural Optimization

List of Program Elective- III

Sr.No.	Course Code	Course
1	**CES2092**	Design of Bridges and Flyovers
2	**CES2102**	Design of Pre-stress Concrete Structures.
4	**CES2112**	Theory of Thin Plates and Shell

List of Program Elective – IV

Sr.No.	Course Code	Course
1	**CES2122**	Design of Advanced Concrete Structures
2	**CES2132**	Design of Industrial Structures
3	**CES2142**	Design of Formwork

SEMSTER - I

Class:- **F.Y. M. Tech. Structural Engineering**	Semester-**I**
Course Code: **CES1012**	Course Name: **Advanced Structural Analysis**

L	**T**	**P**	**Credits**
3	---	--	3

Course Description:
Advanced Structural analysis is offered as core course at the first semester of Civil Structural Engineering post graduate program. This course is focuses on basic concept and different analytical tools for understanding the behavior of especially of statically indeterminate structures. This course divided into four modules. The first module contains influence line diagram for cantilever, fixed, continuous beams, portal frames and arches. The Second module focuses on analysis beams curved in plan and Beam-Columns. The module three includes member oriented and structure oriented stiffness and flexibility matrix methods. Module four contains Boundary value problems
This course intends to build the competency in the students to identify indeterminate structures, and to analyze the structures like fixed beam, continuous beam, arches and portal frames. Also advanced topic such as beams curved in plan, beam-column analysis, matrix methods of analysis of structures and solution of boundary value problems

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1.Construct of ILD for reactions, S.F. and B.M. for indeterminate structures
2.Draw SFD, BMD and TMD for beams curved in plan for various loading and support condition
3.Analyze the beam-columns
4. Analyze the skeleton structures using stiffness analysis
5. Use direct stiffness method understanding its limitations

Prerequisite:
The course learns through prerequisite courses of Engineering Mathematics, Engineering Mechanics, Solid Mechanics and Theory of Structures should have a clear understanding of methods of analysis of structures.

Course Content		
Unit No	**Description**	**Hrs**
1.	**Influence Lines:** Physical Significance, Muller Breslau's Principle, Moment distribution method, ILD for propped cantilever, fixed beams , continuous beam, , portal frames and two hinged arches	**06**
2.	**Beams Curved in Plan:** Analysis of determinate and indeterminate beams curved in plan such as cantilever circular arch, semicircular beams fixed at two ends subjected to point load and udl, simply supported semicircular beams, circular ring beam.	**06**
3.	**Beam Columns:** Governing differential equation, geometric and material nonlinearity, analysis of beam- columns simply and fixed supported at ends with concentrated load, moment and uniformly distributed load, magnification factor	**06**
4.	**Member Oriented Stiffness Matrix:** Stiffness matrices for beam, truss, plane frame, pin and rigid jointed space frame element on member axis, transformation of matrices on structure axes, overall joint stiffness matrix and nodal vector, assembly rules, calculation of member end forces	**06**
5.	**Structure Oriented Stiffness Method:** Flexibility and stiffness matrices, analysis of continuous beams, trusses and plane frames by structure oriented approach	
6.	**Boundary Value Problems:** Approximate solution of boundary value problems, Modified Galerkin Method for one-dimensional BVP, Matrix formulation of the Modified Galerkin Method	**06**

References -

Text Books:

1. Vazirani and Ratwani,- Advanced Theory of Structures & Matrix method, Khanna Publisher, Delhi
2. C.S. Reddy,- Basic structural Analysis, Tata Mc Graw Hill, Delhi

Reference Books:

1. Timoshcnko and Gere, - Strength of Materials Vol II, East West Press Ltd.
2. Gere and Weaver, - Matrix Analysis of Framed Structures, CBS Publishing, Delhi.
3. Pandit & Gupta, Structural Analysis - A matrix approach, Tata Mc Graw Hill, Delhi
4. Negi and Jangid, -Structural Analysis, Tata McGraw Hill Pub.Co.Delhi
5. Thimoshenko,- Strength of Materials Vol. II, East-West Press ltd.
6. N. Krishnaraju and D.R. Gururaja,- Advanced Mechanics of Solids & Structures, Narosa Pub. House delhi,
7. C. K.Wang,- Indeterminate Structural Analysis
8. Lewis P. E. and Ward J. P., -The Finite Element Method, Addison-Wesley Pub.Co.
9. Meek J. L., E and FN, -Computer Methods in Structural Analysis, Span Pub.
10. Desai and Able, - The Finite Element Method, CBS Publication

Class: **First Year M.Tech. Structural Engineering**	Semester: **I**
Course Code: **CES1022**	Course Name: **Advanced Solid Mechanics**

L	T	P	Credits
3	---	--	3

Course Description:
This course is introduced at first semester of F Y M Tech Structural Engineering as core course. It consists of study of stress, strain and displacement of deformable bodies and relationship between them. Also, torsion of solid non-circular cross sections and thin tubes is included in this course. Plasticity, yield criteria and elasto-plastic loading for beams and thick cylinders are also studied in this course.

Course Learning Outcomes
At the end of the course, students will be able to
1. Analyze bodies for stresses and strains.
2. Analyze prismatic bars and tubes subjected to torsion
3. Analyze beams and thick cylinders for elasto-plastic loading.

Prerequisite: This course requires the knowledge of basic mathematics and structural analysis.

Unit No	Description	Hrs
1.	**Stress** Basic concepts of continuum, concept of stress, equilibrium equations, stress on oblique plane, stress transformation, principal stresses, stress invariants, deviatoric stresses, maximum shear stress, octahedral stresses, plane stress.	06
2.	**Strain** Strain at a point, concept of strain, strain components, compatibility equations, strain transformation, principal strains, strain invariants, deviatoric strains, maximum shear strain, octahedral strains, plane strain	06
3.	**Stress-strain relations** Generalized Hooke's law, stress strain relationship for isotropic material, strain displacement and compatibility relations, Airy's stress function and its applications.	06
4.	**Torsion** Torsion of Prismatic Bars:Saint Venant's method, Prandtl's membrane analogy, torsion of elliptical, triangular and rectangular bar, torsion of thin tubes.	06

5.	**Plasticity** Strain Hardening, Idealized Stress- Strain curve, yield criteria, vonMises yield criterion, Tresca yield criterion, plastic stress-strain relations, principle of normality and plastic potential, isotropic hardening.	
6.	**Elasto-Plastic loading** Beams under elasto-plastic condition, collapse load, plastic hinge, elasto-plastic deflections of beams of rectangular cross sections, residual stresses, thick- walled cylinders.	**06**

References:

1. S.P. Timoshenko & J. N. Goodier, "Theory of Elasticity", Mc Graw Hill International Editions, 1988
2. Sadhu Singh, " Theory of Elasticity", Khanna Publishers, 2002
3. Sadhu Singh, " Theory of plasticity", Khanna Publishers, 2002
4. S. M. A. Kazimi, "Solid Mechanics, Tata McGraw Publishing Company Limited, 1990
4. L.S. Srinath, "Advanced Mechanics of Solids, McGraw Publishing Company Limited, 2003
5. Continuum Mechanics by Valiappan, Mc. Graw Hill
6. Arthur P. Boresi and Richard J. Schmidt, "Advanced Mechanics of Materials", Wiley, India, 2009

Class:- **First Year M. Tech Structural Engineering**	Semester-**I**
Course Code: **CES1032**	Course Name: **Structural Dynamics & Earthquake Engineering**

L	T	P	Credits
4	---	--	4

Course Description:
Structural Dynamics is offered as a core course at the first semester of Civil Structural Engineering postgraduate programme. This course focuses on vibrations types and their causes. Response for single and multiple degree of freedom system by fundamental theory. This course also throws light on response by numerical methods. This course also focuses on elements of seismology and static method for lateral load evaluation.
This course intends to build the competency in the students to evaluate responses developed due to vibrations caused by various means. This theoretical knowledge will help to student for studying behavior of structures under earthquake loading.

Course Learning Outcomes:
After successful completion of this course students will be able to:

1. Analyze and study of the response of single and multi-degree freedom systems by fundamental theory and equations of motion.
2. Analyze and study of the response of single and multi-degree freedom systems by numerical methods.
3. Develop mathematical solutions to predict system response subjected to dynamic loads.
4. Explain causes, measurements and sources of earthquakes.
5. Evaluate lateral loads developed on multi-storeyed structures by the Response Spectrum Analysis Method and Static Equivalent Method.

Prerequisite:
As a prerequisite to study this course, the students must possess the knowledge of D'Alembert's principle, differential equations and Integration by parts.

Course Content

Unit No	Description	Hrs
1.	**Introduction** Introduction to dynamic problems of Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, Types of vibrations, Principle of virtual displacement and energy, Single degree of freedom systems, Examples of Single	08

	degree of freedom systems in Engineering, Free vibration of damped and undamped systems. Mathematical modeling of dynamic system. Equivalent stiffness.	
2.	**Single Degree of Freedom Systems** Free and force vibration with and without damping, Response to harmonic loading, Response to general dynamic loading, Duhamel integral solution, Response to suddenly applied load and triangular pulse loading, Vibration isolation, transmissibility, Methods of damping measurements, Response of Single degree of freedom systems to arbitrary excitation, Principles of vibration measuring instruments.	**08**
3.	**Numerical Methods:** Numerical methods of frequency analysis, Rayleigh's method and matrix iteration methods, Stadola method, Newmarks method, Direct integration method.	**08**
4.	**Multiple Degree of Freedom System** Two and multiple degrees of freedom system, Determination of Natural Frequency and normal modes, Orthogonality of modal vectors, Shear building model without damping and with proportional damping,	**08**
5.	**Introduction Engineering seismology:** Earthquake phenomenon, cause of earthquakes-Faults- plate seismic tectonics-waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales- Energy released-Earthquake measuring instruments-seismograph accelerograph, Characteristics of strong ground motions - Seismic zones of India, Earthquake prediction.	**08**
6.	**Conceptual design** Introduction-Functional planning, continuous load path, overall form, simplicity and symmetry, elongated shapes, stiffness and strength, Horizontal and Vertical members, Twisting of buildings, Ductility, definition, ductility relationships, flexible buildings, framing systems, choice of construction materials, Introduction to earthquake resistant design: seismic design requirements, regular and irregular configurations, basic assumptions, design earthquake loads, basic load combinations, permissible stresses, seismic methods of analysis, factors in seismic analysis, Evaluation of equivalent lateral forces, response spectrum method and Time history method.	**08**

References -

Text Books:

1. Mechanical Vibrations, Grover,
2. Structural Dynamics and Introduction of Earthquake Engineering, Chopra A. K.
3. Structural Dynamics: Theory and Computation, 2nd Edition, Mario Paz, CBS Publisher ISBN: 9788123909783, 8123909780.
4. Earthquake Resistant Design of Structures, P. Agarwal & M. Shrikhande, Prentice Hall Publications.
5. Elements of earthquake Engineering, Jai Krisna, A. R. Chandrashekharan& B. Chandra, South Asian Publishers Private Limited.

Reference Books:

1. Structural Dynamics: Vibrations and Systems, MadhujitMukophadhyay, Publisher: ANE Books ISBN: 9788180520907, 8180520900 Edition: 01, 2008.
2. Dynamics of Structures, R,W. Clough and J.Penzien, McGraw – Hill Education, 2nd revised Edition, 1993, ISBN -10: 0071132414, ISBN -13: 978-0071132411.
3. Theory of Vibration with applications, Willaim Thomson, CRC Press; 4th edition, 1996, ISBN -10: 0748743804, ISBN -13: 978-0748743803.
4. I. S. 1893 2016, Criteria for Earthquake Resistant Design of Structures.

Class:- **First Year M.Tech. Structural Engineering**	Semester- **I**
Course Code: **CES1042**	Course Name: **Structural Design Lab - I**

L	T	P	Credits
-	-	4	2

Course Description:
Structural design lab – I is the core laboratory course offered in first semester of M. Tech. Structural Engineering program. This laboratory course is mainly focused on analysis and design of steel structures using standard software packages like STAAD- Pro, ETABS and SAP etc. Students are expected to design various steel structures and prepare drawing of the same.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1.Analyze and design of the steel structures such as truss, Towers, Steel Building Frame and Hoarding Board etc. using standard software packages.
2.Interpret the results of analysis and design obtained from the software.
3. Prepare drawings of detailing of structural elements.

Prerequisite:
As a prerequisite to this course student must know limit state design of steel structures

Course Content		
Experiment No	**Description**	**Lab Hrs**
1.	Analysis and design of truss	5
2.	Structural drawing of truss	4
3.	Analysis and design of transmission tower	5
4.	Analysis and design of steel building (Frame)	5
5.	Analysis and design of hoarding boards	5

References -
1. M. R. Shiyekar ,"Limit State Design in Structural Steel", , PHI Learning.
2. K. S. Sai Ram, "Design of Steel Structures", Pearson.
3. S. K. Duggal, "Design of Steel Structures", Tata Mc-Graw Hill publishing company Ltd., New Delhi
4. Dr. N. Subramanian, "Design of Steel Structures", Oxford University Press, New Delhi.
5. J.E.Lothers, "Design in Structural Steel Structures", Prentice Hall New Jersy

Class: **First Year M. Tech. Structural Engineering**	Semester- **I**
Course Code: **CES1052**	Course Name: **Advanced Concrete Technology Lab**

L	T	P	Credits
-	-	2	01

Course Description:
The Advanced Concrete Lab course focuses on the experimental study of properties of various concrete ingredients and concrete elements / structure in order to analyze the quality and durability aspects. The course deals mix design methods of some special concretes and study of their properties in fresh and hardened state. The course aims to carry out condition survey of any structure for assessing its quality status using various standard and advanced NDT tools / equipment.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. determine properties of ingredients and different types of concretes (ordinary & special) using standard procedures.
2. design ordinary and special concretes using existing and new methods of mix design.
3. perform various durability and non-destructive tests on concrete elements / structures using standard and advanced tools / equipment for assessing the quality.
4. examine the concrete elements / structures by carrying out condition survey and recommend appropriate methods / techniques for their repair / strengthening works.

Prerequisite:
Fundamental knowledge of basic ingredients of concrete and properties of ordinary concrete

Experiment No	Description
1.	Experimental verification of properties of ingredients of various types of concrete
2.	Design of concrete Mixes of Ordinary and Special Concretes – HSC, SCC,
3.	Tests to determine properties of special concrete in fresh and hardened state- a. Workability tests b. Compressive Strength
4.	Experimental study of behavior of concrete members under flexure /shear.

5.	Nondestructive Testing of concrete elements/structure using standard and advanced NDT equipment.
6.	Durability Tests on Concrete (minimum two tests) a. Carbonation Test b. Water Permeability Test c. Effect of elevated temperatures d. Effect of acids, sulphates and chlorides e. Rapid Chloride Penetration Test
7.	Condition survey of any structure for assessing its present condition to provide the quality status.

References -

Reference Books:

1) Design of Concrete Mixes by Krishna Raju
2) Concrete Microstructure, Properties and Material by P. Kumar Mehta &Paulo J. M. Monteiro
3) Concrete Technology by M.S. Shetty (S. Chand)
4) Properties of Concrete by A. M. Neville
5) Concrete Technology by A.R. Santhakumar

Class: **First Year M. Tech. Structural Engineering**	Semester- **I**
Course Code: **CES1062**	Course Name: **Mini Project I**

L	T	P	Credits
-	-	2	01

Laboratory Work (Mini Project):
Mini project shall be delivered on one of the advanced topics chosen in consultation with the supervisor, based on dissertation work/ societal problem / special structure. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing single side printed, preferably in TRM format) should be submitted to the Department Post Graduate Committee (DPGC) before delivering the seminar. A copy of the report in soft form must be submitted to the supervisor, along with other details, if any. Minimum 03 presentations should be delivered by the students.

Course Outcomes:
After successful completion of the course, students will be able to,

1. Identify research problem
2. Prepare and present statement of Purpose
3. Perform analysis work.
4. Communicate with outside agencies.
5. Write report and Present the work carried out.
6. Develop self-learning ability.

Class: **First Year M. Tech. Structural Engineering**	Semester-**I**
Course Code: **CES1072**	Course Name: **Advanced Design of Steel Structures (PE I)**

L	T	P	Credits
3	---	--	3

Course Description: This course is introduced at the first semester of F Y M Tech Structural Engineering as program elective. It consists of design of steel structures, components, design of plate girders, beam-columns, portal frames, cold formed light gauge steel sections, composite sections and bolted and welded connections.
This course intends to build confidence in students to design elements steel structures and their connections.

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

1. Design plate girder, beam columns, portal frames, cold formed light gauge steel sections, composite sections.
2. Design welded and bolted connection.

Prerequisite: This course requires the knowledge of structural analysis and design of basic structural elements of steel structures.

Course Content

Unit No	Description	Hrs
1.	**Plate girder** Introduction, plate buckling, web buckling in shear, tension field action, design of plate girder,	**06**
2.	**Design of beam-columns** Introduction, general behavior of beam-columns, P-Δ effects, elastic lateral-torsional buckling of beam columns, interaction between beam-column and structure, design of beam columns, beam-columns subjected to tension and bending, crane columns.	**06**
3.	**Design of portal frames** Introduction, plastic analysis of rectangular portal frames, plastic analysis of gable portal frames, design of portal frames.	**06**
4.	**Cold formed light gauge steel sections** Introduction, behavior of light gauge sections, design of axially loaded compression members, design of beams. deflection calculation.	**06**

5.	**Composite beams:** Introduction, elastic behavior, shear connectors, ultimate load behavior of composite beam, serviceability limit state.	**06**
6.	**Connections** Bolted connections, behavior of bolted connections, design strength, block shear failure, truss joint connections, design of seat connection, web angle connection, eccentrically loaded connections, beam splices, column splices, welded connections, design of welds for truss members, angle seat connections, web angles and end plate connections, moment resistant connections, beam and column splices, tubular connections.	**06**

Reference Books:

1. N. Subramanian, "Design of Steel Structures", Oxford University Press, New Delhi 2008
2. K. S. Sai Ram, "Design of Steel Structures", Pearson, 2012
3. M. R. Shiyekar ,"Limit State Design in Structural Steel", , PHI Learning Private Limited, 2010
4. S. K. Duggal, "Design of Steel Structures", Mc-Graw Hill Education (India) Private Limited, 2009.
5. Dayaratnam, "Design of Steel Structures", Wheeler Publishing, New Delhi.
6. IS:800-2007, General Construction in Steel- Code of Practice
7. IS:811-1987
8. IS:4923-1997
9. IS:11384-1985

Class: **First Year M. Tech Structural Engineering**	Semester-**I**
Course Code: **CES1082**	Course Name: **Structural Health Monitoring**

L	T	P	Credits
3	---	--	3

Course Description:
Structural Health Monitoring is offered as an Elective course at the first semester of Civil Structural Engineering postgraduate programme. This course focuses on various facts of Health monitoring of existing damaged structures. Various materials used in carrying out rehabilitation works forms the important aspect of this course. The course throws light on effects of various weathering agencies on serviceability and durability of the structures. It also includes preventive measures on various aspects and provides the information on inspection, assessment procedure for evaluating a damaged structure, causes of deterioration and testing techniques. The course covers the basic principles and methods for strengthening the existing structures.
This course intends to build the competency in the students to diagnose the causes of damaged concrete structures and analyze for rehabilitating them with suitable repair techniques or methods.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Carry out non-destructive testing of various elements of the structure for streng evaluation of existing structures.
2. Demonstrate various techniques for strengthening the existing structures.
3. Explain the assessment procedure for evaluating a damaged structure.

Prerequisite:
As a prerequisite to study this course, the students must possess the knowledge of concrete technology as a whole, the basic chemistry of the concrete and various mechanisms involved in the concrete.

Course Content

Unit No	Description	Hrs
1.	**Structural audit:** Definition and objective of Condition survey, stages of condition survey (Preliminary, Planning, Inspection and Testing stages) Possible defects in concrete structures, quality control of concrete structures	06

	Definition and need, Quality control applications in concrete structures, NDT as an option for Non-Destructive Evaluation (NDE) of Concrete structures, case studies of a few NDT procedures on concrete structures.	
2.	**Non Destructive Testing of Structures:** Introduction to NDT - Situations and contexts, where NDT is needed, classification of NDT procedures, visual Inspection, half-Cell electrical potential methods, Schmidt Rebound Hammer Test, resistivity measurement, electromagnetic methods, radiographic Testing, ultrasonic testing, InfraRed thermography, ground penetrating radar, radio isotope gauges, other methods.	**06**
3.	**Rehabilitation and Retrofitting of Concrete Structure** : Definitions: Maintenance, repair and rehabilitation, importance of Maintenance, Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration, testing techniques.	**06**
4.	**Materials and Methods for Repairs and Rehabilitation:** Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning.	**06**
5.	**Introduction to Structural Health Monitoring (SHM) :** Definition & motivation for SHM, SHM - a way for smart materials and structures, analog between the nervous system of a man and a structure with SHM	
6.	**Application of SHM in Civil Engineering**: Introduction to capacitive methods, capacitive probe for cover concrete, SHM of a bridge, applications for external post tensioned cables, monitoring historical buildings.	**06**

References -

Text Books:

1. **R. T. Allen and S. C. Edwards**, "Repair of concrete structures", Blakie and Sons, UK, 1987.
2. **Denison Campbell, Allen and Harold Roper**, "Concrete structures", Materials, Maintenance and Repair, Longman Scientific and technical UK, 1991.
3. **SP25-84**, "Hand book on causes and prevention of cracks on buildings", Indian standards.
4. **M. S. Shetty, "**Concrete Technology- Theory and Practice**"**, S. Chand and Company, New Delhi, 1992.

Reference Books:

1. Hand book on "Repair and Rehabilitation of RCC Buildings", Published by Director General, CPWD, Govt. of India, 2002.
2. **Johnson. S.M., "**Deterioration, maintenance and repair of structures", McGraw-Hill book company, New York, 1965.
3. Daniel Balageas, Claus - Peter FritzenamI Alfredo Guemes, Structural Health Monitoring, Published by ISTE Ltd., U.K. 2006.

Class: **First Year M. Tech. Structural Engineering**	Semester-**I**
Course Code: **CES1092**	Course Name: **Advanced Concrete Technology**

L	**T**	**P**	**Credits**
3	-	--	3

Course Description:
The Advanced Concrete Technology course focuses on properties of newly developed concrete ingredients such as supplementary cementitious materials, artificial sand, chemical and mineral admixtures etc. The quality control and durability aspects of the concrete are also considered in the course content. The course throws light on various types of special concretes, mix design methods, manufacturing processes, properties in fresh and hardened state. The course aims to give updated information in the field of concrete technology involving modern trends and techniques.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. illustrate the micro-structural aspects associated with concrete/concrete ingredients and their effect on concrete quality, strength and durability properties.
2. design special concretes using existing and new methods of mix design.
3. explain various types of special concretes, their properties and methods of manufacturing and placing.
4. discuss various special processes and new techniques involved in various concreting jobs.
5. analyze qualities of fresh and hardened concrete / concrete elements using appropriate destructive or non destructive testing methods for evaluating quality.
6. identify and discuss various mechanisms affecting durability of concrete / concrete structures /elements.

Prerequisite:
Fundamental knowledge of basic properties of concrete ingredients is required.

Course Content		
Unit No	**Description**	**Hrs**
1.	**Micro-structural aspects of cement and concrete** Ingredients of concrete, phases in concrete, microstructure of cement paste, microstructure of concrete, microstructure investigation methods, basic properties of concrete, mineral and chemical admixtures, effect of admixtures on concrete properties.	06
2.	**Methods of Concrete mix design** Mix design: Review of methods and philosophies of IS, BS and ACI methods, mix design for special purposes, acceptance criteria for compressive strength of concrete. Design of high strength and high performance concrete, design of self compacting concrete. Rheological behavior of fresh concrete, properties of fresh and hardened concrete.	06
3.	**Special Concretes** - light weight concrete, foamed concrete, sulphur concrete and sulphur infiltrated concrete, high strength concrete, high performance concrete, self compacting concrete, pervious concrete, polymer concrete, fibre-reinforced concrete, refractory concrete, high density and radiation-shielding concrete, geopolymer concrete.	06
4.	**Special processes and technology for particular types of structure** Sprayed concrete, underwater concrete, grouts, grouting and grouted concrete, mass concrete, slip form construction, pumped concrete, concrete for liquid retaining structures, vacuum process, concrete coatings and surface treatments.	06
5.	**Test methods** Analysis of fresh concrete, Accelerated testing methods, Tests on hardened concrete, Core cutting and testing, partially destructive testing, advanced non-destructive testing methods of concrete structures: ground penetration radar, probe penetration, break off maturity method, stress wave propagation method, electrical/magnetic methods, nuclear methods and infrared thermographs.	06
6.	**Durability of concrete and concrete construction** Durability concept, permeability of concrete, reinforcement corrosion, fire resistance, frost damage, sulphate attack, alkali silica reaction, delayed	06

	ettringite formation, methods of providing durable concrete, short-term tests to assess long-term behavior.	

References -

Reference Books:

1) Design of Concrete Mixes by Krishna Raju
2) Concrete Microstructure, Properties and Material by P. Kumar Mehta &Paulo J. M. Monteiro
3) Concrete Technology by M.S. Shetty (S. Chand)
4) Properties of Concrete by A. M. Neville
5) Concrete Technology by A.R. Santhakumar

Class: **First Year M. Tech Structural Engineering**	Semester-**I**
Course Code: **SHP517**	Course Name: **Numerical Methods for Structural Engineers**

L	**T**	**P**	**Credits**
3	-	--	3

Course Description:
Numerical Methods for Structural Engineers is a core subject introduced at Semester I of first year M. Tech. Civil Structural Engineering. This course intends to build the competency in the students to apply the knowledge of mathematics to the solution of engineering problems and to analyze it.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Estimate the error.
2. Apply the relevant numerical method for interpolating the polynomial
3. Develop the equation to be fitted and fit the curve for given data
4. Estimate numerically the solution of given algebraic equation.
5. Use the relevant method for solving the simultaneous linear equations and compute the Eigen values.
6. Construct the fuzzy set for given linguistic variable and apply fuzzy logic.

Prerequisite:
Undergraduate Engineering Mathematics

Unit No.	Details of Content	Hrs.
1.	**Unit-IError Analysis and Estimation:** Error and their analysis, A general error formula, Error in numerical computations, Error in series approximation.	6
2.	**Unit-II Interpolations:** Introduction, Finite differences, Relation between operators, Differences of a polynomial, Factorial notation, Missing term technique, Lagrange's interpolation formula, Newton's Divided difference formula.	6

3.	**Unit-III Curve Fitting:** Method of least squares, Fitting a straight line, Fitting of an exponential curve $y = ae^{bx}$, Fitting of the curve $y = ax^b$, Fitting of the curve $y = ab^x$, Fitting of the curve of the type $xy = b + ax$, Fitting of the curve $y = ax + bx^2$.	6
4.	**Unit-IV Solution of Nonlinear Algebraic and Transcendental Equations** Muller's Method, Horner's Method, Multiple roots, Lin Bairtow's Method, Graeffe's Squaring Method.	6
5.	**Unit-VElements of Matrix Algebra**: Gaussian Elimination method, Gauss Jordan method, LU- decomposition from Gaussian Elimination method, Solution of Tridiagonal Systems, Eigen Value problems.	6
6	**Unit-VI Fuzzy Logic Theory and Applications:** Classical logic theory, Logical functions of the Two Valued logic, Boolean algebra. Multi valued logic, Fuzzy logic and approximate reasoning, Fuzzy relations, Applications of fuzzy logic for product quality evaluation, Decision making for investment.	6

Reference Books:

1. An Introduction to Numerical Analysis, Atkinson K. E., J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
3. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.
4. Fuzzy Mathematics, M. S Bapat, ShivajiUnivesrsity, Kolhapur, 2015.
5. Introduction to Fuzzy Systems, Guanrong Chen, Trung Tat Pham, Chapman and Hall/ CRC Taylor and Francis Group.

Class:- **First Year M. Tech. Structural Engineering**	Semester-**I**
Course Code : **SHP551**	Course Name: **Technical Communication**

L	T	P	Credits
2	---	--	**Audit Course**

Course Description:
This is the core course offered in first semester of M. Tech. Structural Engineering to enhance corporate communication of students.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Acquire skills required for good oral and written communication
2. Demonstrateimproved writing and reading skills
3. Ensure the good quality of oral and written communication

Course Content

Unit No	Description	Hrs
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	06
2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism,	06
3.	Sections of a Paper, Abstracts, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	06
4.	4 key skills needed when writing a Title, key skills needed when writing an Abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature,	06
5.	Key skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, useful phrases, how to ensure good quality of the paper at the time of submission	06
6.	Resume Writing, e-Mails, Interview skills , Dos and Don'ts while Answering, FAQs, GROUP DISCUSSION: Structured and Unstructured GD, Opening and Closure, Showing Agreement and Disagreement	06

References -

Text Books:

1. Goldbort R ,Writing for Science, Yale University Press (available on Google Books), 2006
2. Day R , How to Write and Publish a Scientific Paper, Cambridge University Press, 2006
3. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book, 1998 .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
5. John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
6. Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
7. Jeff Butterfield, Soft Skills for Everyone, Cengage Learning India Private Limited, 2010

SEMSTER - II

Class:- **First Year M. Tech Structural Engineering**	Semester-II	L	T	P	Credits
Course Code: **CES2012**	Course Name: **Finite Element Analysis in Structural Engineering**	**3**	**-**	**--**	**3**

Course Outcomes:
At the end of the course, students will be able to
1. Use Finite Element Method for structural analysis.
2. Execute the Finite Element Program/ Software.
3. Solve continuum problems using finite element analysis.

Course Content

Unit No	Description	Hrs
1.	**Introduction:** Principle of minimum potential energy, finite element procedure. discretization, nodes, element incidence, displacement model, application to springs, bars with constant and variable cross sections subjected to axial forces, nodal equilibrium equations, assembly of global stiffness	06
2.	**2D problems:** Development of element stiffness matrix and nodal load vector for truss, beam and plane frame elements, transformation of matrices, relevant structural engineering applications	06
3.	**3D problems:** Pascal's triangle, Convergence requirements and compatibility conditions, element aspect ratio, half band width, development of element stiffness matrix and nodal load vector for tetrahedron, hexahedral elements	06
4.	**Application to Solid Mechanics:** Plane Stress, CST element, plane strain rectangular element, Shape function, Natural coordinate systems, Isoparametric formulation, 1D & 2D isoparametric elements, axi-symmetric elements	06
5.	**Plate and Shell Elements:** Formation of stiffness matrix for plate bending elements of triangular and quadrilateral shapes, types of shells elements, formation of stiffness matrix for cylindrical thin shell element	06
6.	**Computer Implementation:** FEM procedure, Pre-processing, solution, post-processing, use of commercial FEA software, Result interpretation	06

Reference Books:

1. O.C. Zienkiewicz& R.L. Taylor, The Finite Element Method Vol. I & II, Tata McGraw Hill
2. J.N. Reddy, An introduction to the Finite Element Method, Tata McGraw Hill Pub.
3. R. D. Cook, Concept and Application of Finite Element Analysis, John Wiley & sons
4. Hutton D.V., Fundamentals of Finite Element Analysis, Tata McGraw Hill Pub.
5. C. S. Desai & J. F. Abel, Introduction to the Finite Element Method, CBS Pub.
6. C. S .Krishnamoorthy, Programming in the Finite Element Method, Tata McGraw Hill
7. T. R. Chandrupatla and Belegundu, Introduction to the Finite Element in Engineering-Prentice Hall of India, pvt.ltd
8. Bathe K.J., Finite Element Procedures, PHI learning pvt.ltd
9. Y.M. Desai, T.I Eldho, Finite Element Method with application in Engineering, Pearson, Delhi
10. Seshu P., Finite Element Analysis, Prentice-Hall of India
11. Buchanan G.R., Finite Element Analysis, McGraw Hill Publications, New York

Class:- **First Year M. Tech. Structural Engineering**	Semester-**II**
Course Code : **CES2022**	Course Name: **Research Methodology & Intellectual Property Rights (IPR)**

L	T	P	Credits
1	1	--	2

Course Description:
Research Methodology and Intellectual Property Rights (IPR) is offered as a core course in second semester of structural engineering PG program.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Formulate a research problem.
2. Analyze research related information
3. Prepare and present research proposal/paper by following research ethics
4. Make effective use of computers and computing tools to search information, analyze information and prepare report.
5. Describe nature and processes involved in development of intellectual property rights

Course Content

Unit No	Description	Hrs
1.	Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.	06
2.	Effective literature studies approaches, Plagiarism, Research ethics, Approaches of investigation of solutions for research problem, data collection, Data analysis with software, interpretation, Necessary instrumentations	06
3.	Effective technical writing, how to write technical report and paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	06

4.	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT.	**06**
5.	Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.	**06**
6.	New Developments in IPR: Administration of Patent System, New developments in IPR; IPR of Biological Systems, Computer Software etc., Traditional knowledge Case Studies, IPR and IITs.	**06**

References -

Text Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", Juta & Co Ltd
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", Juta Academic
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners", SAGE Publication
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", Wolters Kluwar,2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Class:- **First Year M.Tech. Structural Engineering**	Semester-II
Course Code: **CES2032**	Course Name: **Structural Design Lab - II**

L	T	P	Credits
-	-	4	2

Course Description:
Structural design lab – II is the core laboratory course offered in second semester of M. Tech. Structural Engineering program. This laboratory course is mainly focused on analysis and design of concrete structures using standard software packages like STAAD- Pro, ETABS and SAP etc. Students are expected to design various steel structures and prepare drawing of the same.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1.Analyze and design of the RCC structures such as building, retaining wall, flat slab and foundations using standard software packages.
2.Interpret the results of analysis and design obtained from the software.
3. Prepare drawings of detailing of structural elements.

Prerequisite:
As a prerequisite to this course student must know limit state design of steel structures

Course Content		
Experiment No	**Description**	**Lab Hrs**
1.	Analysis and design RCC building	8
2.	Structural drawing of RCC building	8
3.	Analysis and design of RCC retaining wall	8
4.	Analysis and design of flat slab	8
5.	Analysis and design of water tank	8
6.	Analysis and design of foundation	8

References -
1. Sinha and Roy - Fundamentals of Reinforced Concrete, 3rd Edition, S. Chand and Company Ltd, New Delhi
2. A. K. Jain - Reinforced Concrete Design
3. Karve and Shah - Limit State Theory and Design, Structures Publications, Pune
4. P. C. Varghese - Limit State Design of Reinforced Concrete, 2nd Edition, Prentice Hall of India, New Delhi
5. IS: 456-2000
6. IS:3370- 1 to 4- Code of Practice for concrete structures for the storage of liquids.

Class:- **First Year M.Tech. Structural Engineering**	Semester- **II**
Course Code: **CES2042**	Course Name: **Structural Dynamics and Earthquake Engineering Lab**

L	T	P	Credits
-	-	2	1

Course Description:
Model testing laboratory is a core lab in the 2nd semester. This lab focuses on study of behavior of single and multi-storied structures under dynamic loads. The responses are measured with help of measuring instruments. This laboratory develops skills among the students such as leadership, life long learning skills and applications of fundamentals of vibrations for calculation of responses.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1.Interpret the response of structures due dynamic loading.
2. Prepare the models.
3. Conduct model testing for static and dynamic loading.
4. Conduct model testing for free and forced vibrations.

Prerequisite:
As a prerequisite to this course student should apply theory of fundamentals of vibrations for single and multiple degrees of freedom systems.

Course Content

Experiment No	Description	Lab Hrs
1.	Dynamics of a three storied building frame subjected to harmonics base motion.	4
2.	Dynamics of a vibration absorber.	4
3.	Dynamics of one-span and two-span beams.	4
4.	Earthquake induced waves in rectangular water tanks.	4
5.	Dynamics of a one-storied building frame with planar asymmetry subjected to harmonic base motions.	4
6.	Vibration isolation of a secondary system.	4

References -
1. Structural Dynamics: Vibrations and Systems, MadhujitMukophadhyay, Publisher: ANE Books ISBN: 9788180520907, 8180520900 Edition: 01, 2008.
2. Structural Dynamics and Introduction of Earthquake Engineering, Chopra A. K.
3. Structural Dynamics: Theory and Computation, 2nd Edition, Mario Paz, CBS Publisher.

Class: **First Year M. Tech. Structural Engineering**	Semester- **II**
Course Code: **CES2052**	Course Name: **Mini Project II**

L	T	P	Credits
-	-	4	02

Laboratory Work (Mini Project):
Mini project shall be delivered on one of the advanced topics chosen in consultation with the supervisor, based on dissertation work/ societal problem / special structure. A hard copy of the report (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing single side printed, preferably in TRM format) should be submitted to the Department Post Graduate Committee (DPGC) before delivering the seminar. A copy of the report in soft form must be submitted to the supervisor, along with other details, if any. Minimum 03 presentations should be delivered by the students.

Course Outcomes:
After successful completion of the course, students will be able to,

1. Identify research problem
2. Prepare and present statement of Purpose
3. Perform analysis work.
4. Communicate with outside agencies.
5. Write report and Present the work carried out.
6. Develop self-learning ability.

Class:- **First Year M. Tech Structural Engineering**	Semester-**II**
Course Code: **CES2062**	Course Name: **Advanced Earthquake Engineering (PE-II)**

L	T	P	Credits
3	---	--	3

Course Description:
Design of Earthquake Resistant Structures is offered as a program elective course at the first semester of Civil Structural Engineering postgraduate programme. This course focuses on fundamentals/elements of seismology, conceptual design of earthquake resistant structures, principles of planning, and strong column weak beam concept. This course also focuses on lateral load evaluation and ductile elements. IS cod provisions for ductility of structures and water tanks.
This course intends to build the competency in the students to evaluate loads developed due to earthquake loadings. This theoretical knowledge will help to student for studying behavior of structures under earthquake loading and design structures for EQ Loads.

Course Learning Outcomes:
After successful completion of this course students will be able to:

1. Evaluate lateral loads developed on multi-storeyed structures by the Response Spectrum Analysis Method.
2. Apply ductility requirements for the design of structural components.
3. Assess seismic performance of non-structural components and structural components and identify effective measures to mitigate potential damage.
4. Apply clauses given in IS codes to increase resistance of structures to earthquake force.
5. Apply new techniques for controlling the vibrations of the structures.

Prerequisite:
As a prerequisite to study this course, the students must possess the knowledge of Fundamentals of vibration, natural frequency, resonance condition, mode shapes.

Course Content		
Unit No	**Description**	**Hrs**
1.	**Masonry Buildings** Introduction-Elastic properties of masonry assemblage- Categories of masonry buildings- Behaviour of unreinforced and reinforced masonry walls- Behaviour of	**06**

	walls- Box action and bands- Behaviour of infill walls- Improving seismic behaviour of masonry buildings- Load combinations and permissible stresses- seismic design requirements- Lateral load analysis of masonry buildings. **Structural Walls and Non-structural Elements:** strategies in the location of structural walls- sectional shape+ variations in elevation- cantilever walls without openings- Failure mechanism of non-structures- Effects of non-structural elements on structural system- Analysis of non-structural elements- prevention of non-structural damage.	
2.	**Ductility considerations in Earthquake Resistant Design of RC Buildings** Introduction- Impact of Ductility, Requirements for Ductility, Assessment of ductility, Factors-affecting Ductility, Ductile detailing considerations as per IS 13920 2016. Behaviour of beams, columns and joints in RC buildings during earthquakes- Vulnerability of open ground storey and short columns during earthquakes. Case studies.	**06**
3.	**New Techniques in Seismic Design** Cyclic loading behavior of RC C and pre-stressed concrete elements, modern concepts, base isolation , dampers, Adoptive systems, case studies, Field visit.	**06**
4.	**Water Tank** Seismic design of Elevated RC Circular Water Tanks. Ductility requirements, types of ductility, factors affecting ductility. IS code provisions.	**06**
5.	**Continuous systems** Flexural vibration of beams, Simply supported and cantilever beams, Longitudinal vibrations of bars, Longitudinal waves in bars, Waves and vibration response of simply supported beams under uniformly distributed triangular pulse loading, Matrix formulation of beams with lumped masses.	**06**
6.	**Special Topics in Structural Dynamics** Dynamic effects of wind loads, Moving loads, Vibration caused by traffic, blasting and pile driving. Vibration control by applying new techniques such as Tuned mass Dampers.	**06**

References -

Text Books:

1. Earthquake Resistant Design of Structures, P. Agarwal & M. Shrikhande, Prentice Hall Publications.
2. Elements of earthquake Engineering, Jai Krisna, A. R. Chandrashekharan& B. Chandra, South Asian Publishers Private Limited.
3. Principles of Vibration Control, A. K. Mallick.
4. Structural Dynamics, Mario Paz.
5. Earthquake Resistant Structures, Vinod Hosur.

Reference Books:

1. Structural Dynamics: Vibrations and Systems, MadhujitMukophadhyay, Publisher: ANE Books ISBN: 9788180520907, 8180520900 Edition: 01, 2008.
2. Dynamics of Structures, R,W. Clough and J.Penzien, McGraw – Hill Education, 2nd revised Edition, 1993, ISBN -10: 0071132414, ISBN -13: 978-0071132411.
3. Theory of Vibration with applications, Willaim Thomson, CRC Press; 4th edition, 1996, ISBN -10: 0748743804, ISBN -13: 978-0748743803.
4. I. S. 1893 2016, Criteria for Earthquake Resistant Design of Structures. Part I & II.
5. IS 13920 2016, Ductile Detailing of RCC Structures.
6. IS 4326:
7. IS 13828:
8. IS 13827:

Class: **F.Y. M. Tech. Structural Engineering**	Semester: **II**
Course Code: **CES2072**	Course Name: **Theory and Applications of Cement Composites (PE-II)**

L	T	P	Credits
3	--	--	3

Course Description:
The course focuses on various composite materials and study of their properties to understand their behavioral aspects. The main objective of this course is to analyze and design the cement composites elements or structures and study their mechanical behavior, uses and applications.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Formulate constitutive behavior of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behavior.
2. Classify the materials as per orthotropic and anisotropic behavior.
3. Estimate strain constants using theories applicable to composite materials.
4. Analyze and design structural elements made of cement composites.

Prerequisite:
Fundamental knowledge of basic properties of concrete ingredients is required.

Course Content

Unit No	Description	Hrs
1.	**Introduction:** Classification and Characteristics of Composite Materials - Basic Terminology, Advantages Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.	06
2.	**Mechanical Behavior:** Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness - Bounding	06

	Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.	
3.	**Cement Composites:** Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.	**06**
4.	**Mechanical Properties of Cement Composites:** Behavior of Ferrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion	**06**
5.	**Application of Cement Composites:** FRC andFerrocement- Housing, Water Storage, Boats and miscellaneous Structures Composite Materials- Orthotropic and Anisotropic behavior, Constitutive relationship, Elastic Constants.	**06**
6.	**Analysis and Design of Cement Composite Structural Elements** Ferrocement, SIFCON and Fibre Reinforced Concrete.	**06**

References -

Reference Books:

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

Class:- **First Year M. Tech Structural Engineering**	Semester-**II**
Course Code: **CES2082**	Course Name: **Structural Optimization (PE-II)**

L	T	P	Credits
3	**-**	**--**	**3**

Course Description:
Structural optimization can be defined as the process of finding the optimal parameters, which yield maximum or minimum value of an objective function, subject to certain set of specified requirements called constraints. Such problem of optimization is known as constrained optimization problems or nonlinear programming problems. Most design optimization problems in structural engineering are highly nonlinear, involving mixed (discrete and continuous) design variables under complex constraints, which cannot be solved by traditional calculus - based methods and enumerative strategies.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1.Use variationalprinciple for optimization

2.Apply optimization techniques to structural steel and concrete members.

3.Design using frequency constraint.

Prerequisite: Reinforced Concrete Structures, Design of Steel Structures.

Course Content

Unit No	Description	Hrs
1.	**Introduction:** Simultaneous Failure Mode and Design, Classical External Problems.	06
2.	**Calculus** of Variation: Variational Principles with Constraints.	06
3.	**Linear Programming,** Integer Programming, Nonlinear Programming, Dynamic Programming.	06
4.	**Geometric** Programming **and** Stochastic Programming.	06

5.	**Applications:** Structural Steel and Concrete Members, Trusses and Frames.	**06**
6.	**Design:** Frequency Constraint, Design of Layouts.	**06**

Reference Books:

1.Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer, Springer.
2.Variational methods for Structural optimization, Cherkaev Andrej, Springer

Class:- **First Year M. Tech Structural Engineering**	Semester-**II**
Course Code: **CES2092**	Course Name: **Design of Bridges and Flyovers (PE-III)**

L	T	P	Credits
3	-	--	3

Course Learning Outcomes:
At the end of this module student would be able to;
1. Study various components and loadings on bridge
2. Analyse and design of super-structure of various bridges and flyovers
3. Analyse and design of sub-structure of various bridges and flyovers

Course Content

Unit No	Description	Hrs
1.	**Introduction** Introduction, types, geometric design parameters, loading standards	06
2.	**Design of slab and girders of bridges** Design of deck slab, slab culvert, box culvert, longitudinal and cross girders.	06
3.	**Theory of bridges** Pieguads and Courbon's theory,design problem	06
4.	**Multi-span bridges and flyovers** Analysis and Design of Multi-span bridges, flyovers	06
5.	**Foundation design** Design of bridge foundation, piers, abutments, wing walls	06
6.	**Bearing and joints** Design of various joints, bearings for various types of bridges	06

Reference Books:
1. Dr.V.K.Raina- Concrete Bridge Practice Tata McGraw Hill. Delhi
2.Dr.B.C.Punmia, Ashok Kumar Jain, Arun Kumar Jain - Reinforced Concrete Structures ,Vol. II Laxmi Publications.
3. Jagadish & Jayaram - Design of Concrete Bridges , Tata McGraw Hill.
4.Victor - Design of Concrete Bridges , Tata McGraw Hill.

Class: **First Year M. Tech Structural Engineering**	Semester-**II**
Course Code: **CES2102**	Course Name: **Design of Pre-stress Concrete Structures (PE-III)**

L	T	P	Credits
3	**-**	**--**	**3**

Course Description:
Pre-stressed concrete is a form of concrete used in construction which is "pre-stressed" by being placed under compression prior to supporting any loads beyond its own dead weight. This compression is produced by the tensioning of high-strength "tendons" located within or adjacent to the concrete volume, and is done to improve the performance of the concrete in service. Tendons may consist of single wires, multi-wire strands or threaded bars, and are most commonly made from high-tensile steels, carbon fiber or aramid fiber. The essence of pre-stressed concrete is that once the initial compression has been applied, the resulting material has the characteristics of high-strength concrete when subject to any subsequent compression forces, and of ductile high-strength steel when subject to tension forces. This can result in improved structural capacity and/or serviceability compared to conventionally reinforced concrete in many situations.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1.Explain the concept of pre-stressing, behavior of the pre-stressed structures vis-à-vis that of the RCC structure.

2.Choose the decision with respect to the choice of pre-stressed section over RCC.

3.Describe the application of these techniques in civil engineering construction.

4.Analyze the various pre-stressed components of the structures and design the same.

5.Design the various pre-stressed components of the structures and design the same.

Prerequisite: Reinforced Concrete Structures, Strength of materials, Concrete Technology.

Course Content		
Unit No	**Description**	**Hrs**
1.	Mechanics of Pre-stressed concrete, Advantages of pre-stressed concrete, High strength materials- concrete and steel, Classification and types of pre-stressing, Stress concept, Strength concept and Load balancingconcept	**06**
2.	Introduction to losses of pre-stress, Loss due to elastic deformation of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, friction and anchorage slip. Pre-tensioning and Post-tensioning losses, immediate and time dependent losses,systems of pre-stressing.	**06**
3.	Analysis and design of pre-stress concrete beams, box, T and I Sections, shear, deflection, I.S. recommendations for quality of materials, pre-stressing steel, pre-stressing equipment and design. Design of end block by IS code method.	**06**
4.	Analysis and Design of continuous beams, linear transformation and concordant cable profile.	**06**
5.	Analysis and design of cylindrical structures in pre-stressed concrete- pipes and tanks.	**06**
6.	Composite construction, behavior, I.S. recommendations for composite action, differential shrinkage and creep, deflection and flange width of composite beams, Analysis and design of composite beam, and shrinkage stresses.	**06**

References -

Text Books:

1. Prestressed Concrete- N. Rajaopalan (2012): Narosa Publishing House

2. Fundamentals of Prestressed Concrete- Sinha.N.C. and.Roy.S.K. (1998):', *S.Chand and Co.*

Reference Books:

1. Design of Prestressed Concrete Structures- Lin, T.Y. and Burns, N.H. (2004):', *3rdEdition, John Wiley and Sons.*

2. Design of Reinforced Concrete Structures - S. Ramamrutham (2013): *DhanpatRai Publishing Company.*

3. Prestressed Concrete- Krishna Raju (2000): *Tata McGraw Hill Publishing Co.*

Class:- **First Year M. Tech Structural Engineering**	Semester-**II**
Course Code: **CES2112**	Course Name: **Theory of Thin Plates and Shells (PE-III)**

L	T	P	Credits
3	**-**	**--**	**3**

Course Description:
This course is a Program offered Elective course in FY M Tech program in Semester II. This course, deals with the theory of plate and shell structures, using the membrane and bending theories for various types of shells and their applications. In this course, thin plate will be analyzed by Classical Plate Theory Bending Buckling problems will be discussed for Plates.

Course Outcomes:
After successful completion of this course student will be able to:
1. Analyze various problems using different theories based on plates and shells.
2. Derive equilibrium equations related with different theories of plates and shells.

Prerequisite: Theory of Structural Analysis.

Course Content

Unit No	Description	Hrs
1.	**Fundamental concepts of plate analysis** Elasticity approach to solution, Stress, Strain, Plane Stress and Strain, Constitutive relationships, Equilibrium Equations	06
2.	**Classical plate theory** Assumptions, boundary conditions, Stress Resultants, General Equations	06
3.	**Analysis of plate by Navier'smethod** Simply supported plates and various boundary and loading conditions. Problems.	06
4.	**Analysis of plate by Levy's method** Simply supported plates and various boundary and loading conditions. problems	06
5.	**Membrane theory of Shells** Introduction, Types of theories, membrane theory of cylindrical Shell equilibrium equations, limitations, problems	06

6.	**Bending theory of Shells** Equilibrium equation , Bending theory , synclastic and anticlastic shell, problems on bending theory	**06**

Reference Books:

1. Timoshenko, S. "Theory of plates and shells" McGraw Hills Book Comp 8th edition 2014
2. Chandrashekhar K, "Theory of Plates" Universities Press (India) Limited 9th edition 2013.
3. Chandrashekhar K, "Analysis of Thin Concrete Shells" New Age International (P) Ltd.
4. Ramaswamy , "Design of concrete shell" roofs CBS publishers and distributors New Delhi
5. Reddy, J. N. "Theory and analysis of elastic plates and shells" Taylor & Francis, 2007.

Class:- **First Year M. Tech Structural Engineering**	Semester-**II**
Course Code: **CES2122**	Course Name: **Design of Advanced Concrete Structures (PE-IV)**

L	T	P	Credits
3	**-**	**--**	**3**

Course Description:
The course 'advanced design of concrete structures' mainly focuses on analysis and design of various concrete elements and structures subjected to different types of loads using latest methods of analysis and design.. The analysis and design of concrete structures namely bunkers, silos, water tanks, flat slabs, grid floor slabs deep beam etc. forms the core content of the course. The RCC structures exposed to higher temperatures or fire are also considered for analysis and determining their capacity in the event of fire.

Course Outcomes:
At the end of the course, the student will be able to:
1. Analyze the special R.C.C. structures.
2. Design and prepare detail structural drawings

Prerequisite: The student should possess fundamental knowledge of concrete technology, RCC, earthquake engineering and basic methods of analysis and design of RCC elements and structure.

Course Content

Unit No	Description	Hrs
1.	**Analysis and design of slabs– Yield line theory** Various patterns of yield lines, Assumptions in yield line theory, Equilibrium and virtual work method of analysis, Design of various slabs such as rectangular, circular using yield line theory.	06
2.	**Design of Reinforced Concrete Members for Fire Resistance:** Introduction, ISO 834 standard heating conditions, Grading orclassifications, Effect of high temperature on steel and concrete,Effect of high temperatures on different types of structural members,Analytical determination of the ultimate bending moment, Capacityof reinforced concrete beams under fire.	06

3.	**Analysis and design of deep beam:** Introduction, Assumptions and analysis of deep beam,Design of rectangular beams	**06**
4.	**Analysis and design of flat and grid slabs:** Introduction, Proportioning of flat slabs, Design by direct design method, Analysis and design of rectangular grid floors by Timoshenko's plate theory.	**06**
5.	**Elevated service reservoir** Rectangular and Circular type and flat bottom only, Design of staging for wind and earthquake forces, Effect of joint reactions and continuity.	**06**
6.	**Design of Special structures** Introduction, Design of rectangular and circular bunkers and silos Design of Shear wall.	**06**

Reference Books:

1. Advance R.C.C. Design by S.S.Bhavikatti. New Age International Publishers
2. Reinforced Concrete Structures–Vol. II by B.C. Punmia, Ashok K. Jain, Arun K. Jain. Laxmi Publications, New Delhi.
3. Fundamentals of Reinforced Concrete by N.C. Sinha and S.K. Roy. S. Chand & Co. Ltd, New Delhi.
4. Advanced Reinforced Concrete Design (2nd Edition) by P.C. Varghese, Prentice Hall of India, 2008.
5. Reinforced Concrete design by Dr. H. J. Shah, Charotar Publishing House
6. Reinforced Concrete Structural Elements (3rd Edition), by Purushothaman P. Tata Mc Graw- Hill Publishing Co, 2004.
7. IS: 456-2000, IS 3370 Indian Standard code of practice, Bureau of Indian Standards, New Delhi.

Class: **First Year M. Tech Structural Engineering**	Semester-**II**
Course Code: **CES2132**	Course Name: **Design of Industrial Structures (PE-IV)**

L	T	P	Credits
3	---	--	3

Course Description:
This is introduced at the second semester of F Y M Tech Structural Engineering. This covers the design of various industrial structures- gantry girders, portal frames, steel bunkers & silos, chimneys, water tanks and connections.

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

1. Design the Steel Gantry Girders.
2. Design the Steel Portal, Gable Frames.
3. Design Steel Bunkers and Silos.
4. Design Chimneys and Water Tanks.

Prerequisite:
This course requires the knowledge of structural analysis and design of basic structural elements of steel structures

Course Content

Unit No	Description	Hrs
1	**Steel Gantry Girders** – Introduction, loads acting on gantry girder, permissible stress, types ofgantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.	06
2	**Portal Frames** – Design of portal frame with hinge base, design of portal frame with fixed base -Gable Structures – Lightweight Structures.	06
3	**Steel Bunkers and Silos** – Design of square bunker – Jansen's and Airy's theories – IS Codeprovisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.	06
4	**Chimneys** – Introduction, dimensions of steel stacks, chimney lining, breech openings andaccess ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of	06

	foundation.	
5	**Water Tanks** – Design of rectangular riveted steel water tank – Tee covers – Plates – Stays –Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts.	**06**
6	**Design of pressed steel water tank** – Design of stays – Joints – Design of hemispherical bottomwater tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation	**06**

1. Dr. N. Subramanian, "Design of Steel Structures", Oxford University Press, New Delhi.
2. K. S. Sai Ram, "Design of Steel Structures", Pearson
3. "Limit State Design of Steel Structures",Dr V. L. Shah and Veena Gore, Structures Publications
4. M. R. Shiyekar ,"Limit State Design in Structural Steel", , PHI Learning
5. S. K. Duggal, "Design of Steel Structures", Tata Mc-Graw Hill publishing company Ltd., New Delhi.
6. Dayaratnam, "Design of Steel Structures", Wheeler Publishing, New Delhi.
7. Ram Chandra, "Design of Steel Structures",Vol.I&Vol.II - Standard Book House, New Delhi.
8. A.S.Arya and J.L.Ajamani, "Design of Steel Structures", Nemchand and Bros., Roorkee
9. Vazirani & Ratwani. "Design of Steel Structures",
10. B.C.Punmia, Jain & Jain "Design of Steel Structures", Laxmi Publication, New Delhi.
11. ",E.H.Gaylord and C.N. "Design of Steel Structures",Gaylord, Mc-Graw Hill, NewYork.
12. J.E.Lothers, "Design in Structural Steel Structures", Prentice Hall New Jersy.

Class: **Final Year M. Tech Structural Engineering**	Semester-II
Course Code: **CES2142**	Course Name: **Design of formwork (PE-IV)**

L	T	P	Credits
3	--	--	3

Course Description:
Design of formwork is elective course offered in 2nd semester which mainly focusses on types and design of falsework required for concrete structures (i.e. formwork). Although cost of formwork contributes significantly to the total reinforced concrete constructioncost and formwork failure will result in a very complicated construction problem, formwork design is oftenneglected and left to the foreman to design. Therefore, in this course emphasis is given on materials used for form work, design of various formworks for regular structural members, design of formwork for special structures, some special formwork systems and failure of formwork.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Select proper formwork, accessories and material.
2. Design the form work for Beams, Slabs, columns, Walls and Foundations.
3. Design the form work for Special Structures.
4. Explain the working of flying formwork.
5. Judge the formwork failures through case studies.

Prerequisite:
Basic knowledge of concrete technology and construction procedures.

Course Content

Unit No	Description	Hrs
1.	**Introduction:** Introduction to formwork system, Requirements of formwork and Factors affecting Selection of Formwork	04
2.	**Formwork Materials** Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Horizontaland Vertical Formwork Supports.	04

3.	**Formwork Design:** Concepts, Formwork Systems and Design for Foundations, Walls, Columns,Slab and Beams.	**08**
4.	**Formwork Design for Special Structures**: Shells, Domes, Folded Plates, OverheadWater Tanks, Natural Draft Cooling Tower, Bridges.	**08**
5.	**Flying Formwork**: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete,Formwork Management Issues –Pre- and Post-Award.	**06**
6.	**Formwork Failures:** Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction.	**06**

References -

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

SEMSTER - III

Class: **S. Y. M. Tech. Structural Engineering**	Semester- **III**
Course Code: **CES3012**	Course Name: **Internship**

L	T	P	Credits
-	-	2	**Audit**

Field Work:

In the field training work, the student is expected to get training in the industry, related to structural engineering for duration of 4 weeks for at least 6 hours per day. Student should work as an employer of the organization. He should learn work culture and latest development in structural engineering. Student should write a report on the field training and submit to department for ISE evaluation at the beginning of third semester. Student should include the certificate from company regarding satisfactory completion of the field training.

Course Outcomes:

After successful completion of the course, students will be able to,

1. Identify training area
2. Prepare on site work report of training
3. Perform analysis work
4. Communicate with agencies
5. Generate report and Present the work carried out

Class: **S Y M. Tech. Structural Engineering**	Semester- **III**
Course Code:**CES3022**	Course Name: **Self-Learning: MOOC / Certificate course**

L	T	P	Credits
-	-	-	03

Online Certification Course:

1. Student should select any one course floated by NPTEL related to their dissertation topic in consultation with supervisor.
2. Student should report and maintain file of weekly submission as per assignments given by NPTEL.
3. Student should attach weekly grade sheet in the hard copy form to weekly submission file.
4. Final written exam is compulsory to all and it will be scheduled by NPTEL.
5. Submit the final grade sheet with course completion certificate.
6. The final grades will be given based on grades offered by NPTEL and file submission.

Course Outcomes:

After successful completion of the course, students will be able to,

1. Develop technical competence in skills of structural engineering field.
2. Apply the techniques for structural engineering practice.
3. Develop oral and written presentation skills for structural engineering projects.
4. Design and interpret data for structural engineering projects.

Class: **S Y M. Tech. Structural Engineering**	Semester- **III**
Course Code: **CES3032**	Course Name: **Dissertation Phase-I**

L	T	P	Credits
-	-	8	04

Dissertation phase I and synopsis approval presentation:
Under the guidance of faculty called as _Supervisor', PG student from second year is required to do innovative and research oriented work related to various theory and laboratory courses he/she studied during previous semesters. Dissertation work should not be limited to analytical formulation, experimentation or software based project. Student can undertake an interdisciplinary type project with the prior permission of DPGC from both departments.

Synopsis:
Student need to carry out exhaustive literature survey with consultation of his/her supervisor for not less than 25 reputed national international journal and conference papers. Student should make the Synopsis Submission Presentation (SSP) with literature survey report to DPGC and justify about the innovativeness, applicability, relevance and significance of the work. At the time of presentation, student shall also prepare Synopsis of the work and submit to department for approval. Student shall submit synopsis of dissertation as per the prescribed format in 02 copies to department.

Course Outcomes:
After successful completion of the course, students will be able to,

1. Identify research problem from literature survey
2. Prepare research design for identified problem
3. Prepare synopsis report
4. Present the work plan to be carried out.

Class: **S Y M. Tech. Structural Engineering**	Semester- **III**
Course Code: **CES3042**	Course Name: **Dissertation Phase-II**

L	T	P	Credits
-	-	12	06

Dissertation phase II:
Phase II evaluation is based on End semester Examination (ESE) which is based on the work during the semester. It is expected that student shall present preliminary results from his/her work during the semester with report as per prescribed format. DPGC including external examiner as expert will approve the report and progress of student.
ISE will be evaluated DPGC and ESE will be evaluated by DPGC and one external expert. Student will submit a report (soft bound before 1 week of date of presentation) as per prescribed format and present to DPGC for ISE and ESE. If student is not showing satisfactory performance in, then he/she will be given grace period of two weeks. After two weeks student will again be evaluated as per guidelines given in rules and regulations.

Course Outcomes:
After successful completion of the course, students will be able to,

1. Prepare the set up for experimentation/ develop/ learn software.
2. Perform experimental/software analysis for validation of research work.
3. Generate report of work carried out.
4. Present the work carried out.

SEMSTER - IV

Class: **S Y M. Tech. Structural Engineering**	Semester- **IV**
Course Code: **CES4012**	Course Name: **Dissertation Phase-III**

L	T	P	Credits
-	-	10	06

Dissertation Phase III:
Student is required to give a presentation on the progress of his/her dissertation work in front of supervisor and DPGC. It is expected that up to this stage almost 90% of dissertation work is almost completed. Student will make the presentation and seek the suggestions from the supervisor and DPGC. Supervisor and DPGC will ensure that work carried out by the student till this stage is satisfactory and in compliance with synopsis of the dissertation submitted by student. This is In Semester Evaluation (ISE).

Course Outcomes:
After successful completion of the course, students will be able to,

1. Perform experimental/software analysis for developing research work
2. Generate report work carried out.
3. Present the work carried out.

Class: **S Y M. Tech. Structural Engineering**	Semester- **IV**
Course Code:**CES4022**	Course Name: **Dissertation Viva Voice**

L	T	P	Credits
-	-	18	10

Dissertation Phase IV:
This is final presentation, i.e., viva voce of the dissertation. Student will be allowed to make this presentation only if he has submitted duly completed and certified dissertation report. Students will make the presentation in front of supervisor, DPGC and external supervisor. Examiners will check whether the dissertation work is in full compliance with synopsis of dissertation or not. Dissertation will assess on the basis of quality of dissertation work, efforts taken by the student, quality of paper(s) published on the dissertation work, etc. Student should publish work carried by him along with supervisor in reputed journals as per institute rules and regulations.

Course Outcomes:
After successful completion of the course, students will be able to,

1. Perform experimental/software analysis for developing research work.
2. Generate report work carried out.
3. Publish a research paper in journals/conference.
4. Prepare report using total work done as dissertation report
5. Present the work carried out.