STRUCTURE AND CURRICULUM
M.E. (Structural Engineering)
(2013-14 onwards)

PEOs and POs of ME (Structural Engineering)

PEO

Graduates

1. Will provide solutions to wide range of structural engineering problems to fulfill needs of industry.
2. Will have successful career in industry, entrepreneurship, academia and research.
3. Will be executives in government, semi-government public and private sectors.
4. Will practice the profession with ethics, social binding and environmental awareness.

PO

Graduates

1. Will be able to discriminate, evaluate, and synthesize existing and new knowledge in structural engineering.
2. Will be able to analyze and solve complex structural engineering problems with critical engineering judgement.
3. Will be able to think originally and conceptually to solve structural engineering problems and evaluate alternative solutions considering safety, environmental and societal needs.
4. Will be able to explore new domains of knowledge in structural engineering through literature survey, formulate problem, and apply appropriate research methodology to advance the knowledge in structural engineering.
5. Will be able to model, analyze and design structural engineering problems using software.
6. Will be able to work in team for achieving common goal and share the learning experience with peers.
7. Will be able to demonstrate the project management skills considering economical and financial factors.
8. Will be able to prepare effective technical reports and document technical findings by adhering to appropriate standards, and make effective presentation, participate in technical discussion amongst peers.
9. Will be able to recognize the need for updating and life-long learning.
10. Will recognize the importance of ethical practices and social responsibility in professional career.
11. Will recognize the need of self-corrections through appropriate action for professional development.

GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra)

Department of Applied Mechanics

Teaching and Evaluation Scheme

ME(Full-Time) in Structural Engineering (2013-14 onwards)

SEMESTER-I

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)						POs Mapping
			L	T	P		Theory			Term Work	Practical/Viva-voce	Total	
							Test	TA	ESE				
THEORY COURSES													
1	AM-541	Theory of Elasticity and Plasticity	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5
2	AM-542	Advanced Structural Analysis	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5
3	AM-543	Dynamics of Structures	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5
4	AM-544	Advanced Concrete Technology	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5
5	AM-545-549	Elective-I	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5
LABORATORY COURSES													
1	AM-555	Lab – Advanced Concrete Technology	-	-	2	2	-	-	-	25	25	50	1,6
2	AM-556	Seminar-I	-	-	2	2	-	-	-	25	25	50	1,6,8,9,10
		TOTAL	**15**	**5**	**4**	**24**	**100**	**100**	**300**	**50**	**50**	**600**	

SEMESTER-II

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)						POs Mapping
			L	T	P		Theory			Term Work	Practical/ Viva-voce	Total	
							Test	TA	ESE				
THEORY COURSES													
1	AM-557	Theory of Plates and Shells	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5
2	AM-558	Earthquake Resistant Design of Structures	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5
3	AM-559	Finite Element Analysis of Structures	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5
4	AM-560	Advanced Reinforced Concrete Design	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5,6,7,8
5	AM-561-AM-570	Elective-II	3	1	-	4	20	20	60	-	-	100	1,2,3,4,5
LABORATORY COURSES													
1	AM-571	Lab-Computer Aided Analysis and Design	-	-	2	2	-	-	-	25	25	50	1,2,3,4,5
2	AM-572	Seminar-II	-	-	2	2	-	-	-	25	25	50	1,2,3,4,5,6,8,10,11
		TOTAL	**15**	**5**	**4**	**24**	**100**	**100**	**300**	**50**	**50**	**600**	

L-Lectures, T-Tutorials, P-Practicals, TA-Teacher Assessment, ESE-End-Semester Examination

Elective-I: 1) AM-545: Prestressed Concrete Design, 2) AM-546: Bridge Engineering, 3) AM-547:Structural Reliability, 4)AM-548:Theory of Elastic Stability 5)AM-549: Fracture Mechanics
Ele-II: 1) AM-561: Advanced Design of Steel Structures, 2) AM-562: Plastic Analysis of Structures, 3) AM-563: Advanced Seismic Analysis and Design, 4) AM-564: Analysis and Design of High Rise Structures

SEMESTER-III

THEORY COURSES													
S. No.	**Course Code**	**Subject**	**Scheme of Teaching (Hrs/Week)**			**Total Credits**	**Scheme of Evaluation (Marks)**						**POs Mapping**
							Theory			**Term Work**	**Practical/Viva-voce**	**Total**	
			L	**T**	**P**		**Test**	**TA**	**ESE**				
1	**	Open Elective	03	01	-	04	20	20	60	-	-	100	
2	GE-612	Environmental Studies[+]	03	-	-	03	20	20	60	-	-	100	1,2,3,4,5
LABORATORY COURSES													
1	AM-615	Dissertation-I	-	-	20	10	-	-	-	50	50	100	1,2,3,4,5,6,8,10,11
		TOTAL	**06**	**01**	**20**	**17**	**40**	**40**	**120**	**50**	**50**	**300**	

[+] **The curriculum designed by Civil Department shall be used and is applicable from 2014-15 batch onwards**

**Open Electives

1. *AM-641:Finite Element Analysis for Engineers (Offered to other departments)
2. GE-611: Research Methodology
3. EE-572: Renewable Energy Technology
4. EE-675: Renewable Energy Technology
5. CS-559: Professional Ethics and Cyber Law
6. CS-560:Web Technologies
7. ET-561: Soft Computing

** This elective is offered for all students of ME II year except students of Structural Engineering. They are required to opt subjects offered by other departments.*

SEMESTER-IV

LABORATORY COURSES													
S. No.	**Course Code**	**Subject**	**Scheme of Teaching (Hrs/Week)**			**Total Credits**	**Scheme of Evaluation (Marks)**						**POs Mapping**
							Theory			**Term Work**	**Practical/ Viva-voce**	**Total**	
			L	**T**	**P**		**Test**	**TA**	**ESE**				
1	AM-616	Dissertation-II	-	-	28	14	-	-	-	50	150	200	1,2,3,4,5,6,8,10,11
		TOTAL	**-**	**-**	**28**	**14**	**-**	**-**	**-**	**50**	**150**	**200**	
		GRAND TOTAL	**36**	**11**	**56**	**79**	**240**	**240**	**720**	**200**	**300**	**1700**	

L-Lectures, T-Tutorials, P-Practicals, TA-Teacher Assessment, ESE-End-Semester Examination

GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra)

Department of Applied Mechanics

Teaching and Evaluation Scheme

ME(Part-Time) in Structural Engineering

SEMESTER-I

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
							Theory			Term Work	Practical/Viva-voce	Total
			L	T	P		Test	TA	ESE			
THEORY COURSES												
1	AM-541	Theory of Elasticity and Plasticity	3	1	-	4	20	20	60	-	-	100
2	AM-542	Advanced Structural Analysis	3	1	-	4	20	20	60	-	-	100
3	AM-544	Advanced Concrete Technology	3	1	-	4	20	20	60	-	-	100
LABORATORY COURSES												
4	AM-555	Lab – Advanced Concrete Technology	-	-	2	2	-	-	-	25	25	50
		TOTAL SEMESTER-I	**12**	**3**	**2**	**14**	**60**	**60**	**180**	**25**	**25**	**350**

SEMESTER-II

THEORY COURSES												
5	AM-543	Dynamics of Structures	3	1	-	4	20	20	60	-	-	100
6	AM-545-549	Elective-I	3	1	-	4	20	20	60	-	-	100
7	AM-557	Theory of Plates and Shells	3	1	-	4	20	20	60	-	-	100
LABORATORY COURSES												
8	AM-551	Seminar-I	-	-	2	2	-	-	-	25	25	50
		TOTAL SEMESTER-II	**9**	**3**	**2**	**14**	**60**	**60**	**180**	**25**	**25**	**350**
SEMESTER-III												
THEORY COURSES												
9	AM-558	Earthquake Resistant Design of Structures	3	1	-	4	20	20	60	-	-	100
10	AM-559	Finite Element Analysis of Structures	3	1	-	4	20	20	60	-	-	100
11	AM-556-570	Elective-II	3	1	-	4	20	20	60	-	-	100
LABORATORY COURSES												
12	AM-571	Lab-Computer Aided Analysis and Design	-	-	2	2	-	-	-	25	25	50
		TOTAL SEMESTER-III	**9**	**3**	**2**	**14**	**60**	**60**	**180**	**25**	**25**	**350**
SEMESTER-IV												
THEORY COURSES												
13	AM-560	Advanced Reinforced Concrete Design	3	1	-	4	20	20	60	-	-	100
14		Open Elective*	3	1	-	4	20	20	60	-	-	100
LABORATORY COURSES												
15	AM-572	Seminar-II	-	-	2	2	-	-	-	25	25	50
		TOTAL SEMESTER-IV	**6**	**2**	**2**	**10**	**40**	**40**	**120**	**25**	**25**	**250**

L-Lectures, T-Tutorials, P-Practicals, TA-Teacher Assessment, ESE-End-Semester Examination

Elective-I: AM-545 Prestressed Concrete
AM-546 Bridge Engineering
AM-547 Structural Reliability
AM-548 Theory of Elastic Stability
AM-549 Fracture Mechanics

Elective-II: AM-556 Advanced Design of Steel Structures
AM-557Plastic Analysis of Structures
AM-558 Advanced Seismic Analysis and Design
AM-559 Analysis and Design of High Rise Structures

Open Elective

AM-641: Finite Element Analysis for Engineers*

** This elective is offered for all students of ME II year except students of Structural Engineering. They are required to opt subjects offered by other departments.*

SEMESTER-V

THEORY COURSES												
S. No.	**Course Code**	**Subject**	**Scheme of Teaching (Hrs/Week)**			**Total Credits**	**Scheme of Evaluation (Marks)**					
							Theory			**Term Work**	**Practical/Viva-voce**	**Total**
			L	**T**	**P**		**Test**	**TA**	**ESE**			
LABORATORY COURSES												
16	GE-612	Environmental Studies+	03	-	-	03	20	20	60	-	-	100
17	AM-615	Dissertation-I	-	-	20	10	-	-	-	50	50	100
		TOTAL			**20**	**10**	**20**	**20**	**60**	**50**	**50**	**200**

SEMESTER-VI

LABORATORY COURSES												
18	AM-616	Dissertation-II	-	-	28	14	-	-	-	50	150	200
		TOTAL	**-**	**-**	**28**	**14**	**-**	**-**	**-**	**50**	**150**	**200**
		GRAND TOTAL	**36**	**11**	**56**	**79**	**240**	**240**	**720**	**200**	**300**	**1700**

L-Lectures, T-Tutorials, P-Practicals, TA-Teacher Assessment, ESE-End-Semester Examination

+ The curriculum designed by Civil Department shall be used and is applicable to 2014-15 batch onwards

AM 541 : Theory of Elasticity and Plasticity

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:

Structural Analysis and Mechanics of Materials, Basic understanding of matrix algebra

Course Objectives

The course is intended to emphasize the importance of theory of elasticity and plasticity in engineering design, particularly in reinforced concrete and steel structures. The course will emphasize the theory behind the practical design.

Course Outcomes

On successful completion of the course, students will be able:

1. To formulate/establish the basic equations of elasticity &plasticity in Cartesian & polar coordinate system.
2. To differentiate plain stress and plain strain problems of elasticity &plasticity in Cartesian & polar coordinate system.
3. To validate the elasticity concepts for formulating real problems.
4. To apply elasticity principles to the stress analysis under various loading conditions.
5. To comprehend failure mechanisms in materials.

UNIT-1 **BASIC EQUATIONS OF ELASTICITY** 08 Hrs

Introduction, The State of Stress at a Point, The State of Strain at a Point, Basic Equations of Elasticity, Methods of Solution of Elasticity Problems, Plane Stress, Plane Strain, Spherical Co-ordinates, Principal Stresses and Principal Planes. Octahedral stresses

UNIT-2 **TWO-DIMENSIONAL PROBLEMS IN CARTESIAN CO-ORDINATES** 06 Hrs

Introduction, Airy's Stress Function – Polynomials : Bending of a cantilever loaded at the end ; Bending of a beam by uniform load, Direct method for determining Airy polynomial :

Cantilever having Udl and concentrated load of the free end; Simply supported rectangular beam under a triangular load, Fourier Series, Complex Potentials, Cauchy Integral Method, Fourier Transform Method, Real Potential Methods.

UNIT-3 **TWO-DIMENSIONAL PROBLEMS IN POLAR CO-ORDINATES** 05 Hrs

Basic equations, Biharmonic equation, Solution of Biharmonic Equation for Axial Symmetry, General Solution of Biharmonic Equation, Saint Venant's Principle, Thick Cylinder, Rotating Disc on cylinder, Stress-concentration due to a Circular Hole in a Stressed Plate (Kirsch Problem), Saint Venant's Principle, Bending of a Curved Bar by a Force at the end

UNIT-4 **TORSION OF PRISMATIC BARS AND BENDING OF PRISMATIC BEAMS** 06 Hrs

Introduction, St. Venant's Theory, Torsion of Hollow Cross-sections, Torsion of thin-walledtubes, Torsion of Hollow Bars, Analogous Methods, Torsion of Bars of Variable Diameter.

Simple Bending, Unsymmetrical Bending, Shear Centre, Solution of Bending of Bars by Harmonic Functions, Solution of Bending Problems by Soap-Film Method.

UNIT-5 **BASIC CONCEPTS OF PLATICITY** 05 Hrs

Introduction to the theory of plasticity, the yield criteria of metals, stress space representation of yield criteria. stress-strain relations plastic potential, flow rules and maximum work hypothesis. Two dimensional plastic flow problems. Incompressible two dimensional flow, stresses in plastic materials in condition of plane strain, equation of equilibrium the

simplest slip-line fields.

Note: 10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems and formulating real problems.

Reference Books:

1. Timoshenko.S and Goodier.J.N.," Theory of Elasticity", Mc Graw Hill Book Co., Newyork, 1988
2. Sadhu Singh.," Theory of Elasticity", Khanna Publishers,New Delhi.1988
3. Sadhu Singh.," Theory of Plasticity", Khanna Publishers,New Delhi.1988
4. Prasant Kumar., "Elements of Fracture Mechanics", A.H.Wheeler & Co, New Delhi 1989
5. Popov.E.,"Mechanics of Materials", Prentice Hall reprinted Pearson education, 2003.

AM 542 : Advanced Structural Analysis

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:

Fundamentals of Structural Analysis,Matrix algebra, Solution of equations,

Course objectives:

1) To make the students to understand matrix methods of analysis.
2) To make the students apply these methods for analysis using software's.
3) To make the student to analyze various types of structures.

Course Outcomes:

On successful completion of the course, students will be able:

1. To differentiate between various methods of analysis for multistory frames.
2. To categorize and choose appropriate structural analysis method.
3. To analyze the structure using software.
4. To prepare algorithm and flowchart for analysis of structure.
5. To formulate and analyze beams on elastic foundation.

UNIT-1	Flexibility method: Review of basics of flexibility method. Analysis of frames, trusses, space frames, grids (programme/ softwares).	08 Hrs
UNIT-2	Stiffness methods: Review of basics of Stiffness method, Analysis of frames, trusses, space frames and grid structures. Substructure analysis techniques. computer oriented direct stiffness method.(programme/ softwares)	08 Hrs
UNIT-3	Principle of multiple and substitute frame method	05 Hrs
UNIT-4	Beams on elastic foundation: Governing differential equation, solution for finite and infinite beams, energy methods	05 Hrs
UNIT-5	Secondary stresses in frames and trusses.	04 Hrs

TEXT AND REFERENCE BOOKS

1. J.M. Gere & W. Weaver,Analysis of Framed Structures , 2nd edition, 2004,CBS,New Delhi
2. F.W. Beaufait ,Basic concept of Structural Analysis ,1977, Prentice Hall ,Engle-wood cliffs, N.J.
3 T. R. Taucher ,Energy Principles of Structural Mechanics, 2nd edition, 2006, Tata McGraw Hill, New Delhi
4 Harold C.Martin, Introduction To Matrix Methods Of Structural Analysis , , 15th edition, 1966,Tata McGraw Hill, New Delhi
5 M. Heteny,Beams on Elastic Foundation, 2nd edition, 1946, university of Michigan Press, USA
6 M. F. Rubinstein, Matrix computer Analysis of structure, 2nd edition, 1966, Prentice Hall ,Engle-wood cliffs, N.J.

7 Dr. A.S. Meghre & S.K. Deshmukh ,Matrix Method of Structural Analysis 1st edition, 2003,Charotar Publication, Anand-Gujrat

AM-543: Dynamics of Structures

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:
Dynamics of rigid bodies, Structural Analysis, Solution of Differential Equations.

Course Objectives:
To expose the students to the principles of structural dynamics and prepare them to analyse structures subjected to dynamic loading like wind and earthquake loading.

Course Outcomes:
On successful completion of the course, students will be able:
1. To compute the dynamic parameters of SDOF and MDOF systems using free vibration principles.
2. To mol and analyze SDOF and MDOF systems subjected to various dynamic loadings.
3. To differentiate and choose appropriate methods of dynamic analysis for structural engineering problems.
4. To analyze simple beams using continuous mass modeling.
5. To formulate and solve equations of motion for different dynamic systems.

UNIT-1	Characteristics of dynamic loading, Lumped and continuous mass models, Single-Degree-of Freedom (SDOF) systems, Free vibrations, Harmonic loading, Harmonic base motion, Resonance, Dynamic Amplification Factor, Transmissibility, Vibration Isolation.	08 Hrs
UNIT-2	SDOF systems subjected to periodic loading, Fourier Transforms, Introduction to Frequency-domain analysis, SDOF systems subjected impulsive loading, SDOF systems subjected to general dynamic loading, Duhamel's integral.	06 Hrs
UNIT-3	Multi-Degree-of-Freedom (MDOF) systems, Formulation of equations of motion, Free-vibrations, Frequencies and mode shapes, Dynamic modeling of MDOF systems, Static condensation.	05 Hrs
UNIT-4	Orthogonality of normal modes, Mode-superposition method, Modal participation, Classical and non-classical damping, Damping matrix, Rayleigh damping, Fundamental mode analysis methods.	06 Hrs
UNIT-5	Continuous systems, Equations of motion, Free vibrations, Frequencies and mode shapes, Forced vibrations, Modal analysis, Beams subjected to dynamic loading.	05 Hrs

Note: 10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.

TEXT AND REFERENCE BOOKS
1. Ray W. Clough and Joseph Penziene, "Dynamics of Structures", Mc-Graw Hill, 3rd Edition, 1975.
2. Anil K. Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Pearson Education, 3rd Edition, 2007.
3. Roy R. Craig, "Structural Dynamics: An Introduction to Computer Methods", Wiley, 1981.
4. Mario Paz, "Structural Dynamics", Springer, 1997.
5. J.L.Humar, "Dynamics of Structures", Balkema, 2002.
6. Hans Anton Buchholdt, "Structural Dynamics for Engineers", Thomas Telford, 1997.

AM 544 : Advanced Concrete Technology

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:

Knowledge about interaction of concrete making materials and their influence on the properties of concrete.

Course Objectives:

1. To expose the students to the advances in concrete technology and techniques of design of various types of concrete with desired properties.
2. To expose the students to the procedures and techniques of assessment, repair and rehabilitation of concrete structural members.

Course Outcomes:

On successful completion of the course, students will be able:

1. To recall and explain fundamentals of concrete technology.
2. To classify various types of concrete and choose suitable concrete for given condition.
3. To design concrete mixes using different methods.
4. To investigate the causes of damage of concrete
5. To propose the methods for repair and rehabilitation.

UNIT-1 **Review of Concrete Technology** 07 Hrs

Review of various constituents of concrete, mix proportioning methods,

properties of concrete: workability, rheology, permeability, strength , elasticity, shrinkage, creep, Quality control.

UNIT-2 **High Performance Concrete** 06 Hrs

High performance concrete (HPC): materials, cement-superplasticiser compatibility, methods of mix proportioning, concept of particle packing, properties in fresh and hardened state, durability of concrete against aggressive environmental conditions

UNIT-3 ***Special Concretes*** 06 Hrs

Lightweight concrete, High density concrete, Aerated concrete and Self compacting concrete: Constituent materials, mix proportioning, properties and applications,

UNIT-4 **Fibre Reinforced Concrete (FRC):** 06 Hrs

Types of fibers used in concrete. Production of FRC, Properties in fresh state, properties in hardened state: Interaction between fibers and concrete: law of mixture, behavior under tension, compression, bending, impact and fatigue, Ferrocement.

UNIT-5 **Repairs and Rehabilitation of Concrete** 05 Hrs

Types of damages; Sources or causes of damages; Damage assessment and evaluation models,

Non destructive testing methods,methods of repairs and rehabilitation.

TEXT AND REFERENCE BOOKS

1. A M Neville, Properties of Concrete, 4th edition, 2006, ELBS with Longman, UK
2. M L Gambhir, Concrete Technology, 3rd edition, 2006, Tata McGraw Hill, New Delhi
3. M S Shetty, Concrete Technology, 2008, S. Chand & Co., New Delhi
4. R.N.Raikar, Diagnosis and treatment of structures in distress, Published by R&D Centre of Structural Designers & Consultants Pvt.Ltd., Mumbai, 1994.
5. Raikar, R.N., "Learning from failures - Deficiencies in Design", Construction and Service - R and D Centre (SDCPL), Raikar Bhavan, 1987
6. Handbook on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi, 2002.
7. Balaguru P.N. andShah S.P., Fibre Reinforced Cement Composites, McGraw Hill, New Delhi
8. Hannant D.J., Fibre Cements and Fibre Concretes, John Willey and Sons, New York
9. Naaman, A.E., Ferrocement and Laminated Cementitious Composites, Techno Press, USA

AM-545: Elective-I: Pre-stressed Concrete Design

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:

Basics of RCC design and Fundamentals of prestressed concrete

Course Objectives:

3. To expose the students to the analysis and design methods of pre-stressed concrete structural elements.
4. To make the students aware of the codal provisions regarding prestressed concrete with emphasis on their relevance.

Course Outcomes:

On successful completion of the course, students will be able:

1. To differentiate between behavior of P.S.C. and R.C.C. members.
2. To visualize the effect of prestressing on stress condition across the cross-section of the member.
3. To analyze the stresses, evaluate the losses of prestress and determine the behavior of determinate and indeterminate prestressed concrete members.
4. To determine the ultimate flexural, shear, and torsional strength of PSC member.
5. To design the PSC members using limit state concept (IS-1343) and apply to various members like beams, slabs and flat slab.

UNIT-1 **Review of prestressed concrete concepts** 5 Hrs

Prestressing concepts, Analysis of prestress, Thrust line, Losses of prestress

UNIT-2 **Flexural analysis** 6 Hrs

Analysis at transfer and service loads, Cracking moment, Kern points, Pressure

line, Ultimate strength, Stress variation in steel, Ultimate limit state, Analysis of rectangular and flanged sections.

UNIT-3 ***Design of members*** 6 Hrs

Design for axial tension, Design for flexure, Preliminary design, Final design of Type-I,II and III members, Detailing requirements.

UNIT-4 **Cantilever and Continuous beams** 8 Hrs

Analysis of cantilever beams, cable profile, Continuous beams, Primary and Secondary stresses, Pressure line, Linear transformation of cable, Concordant cable profile, Partially continuous beams, Analysis for ultimate strength, Moment redistribution.

UNIT-5 **Prestressed Slabs** 5 Hrs

Analysis and design of one-way slabs, two way flat slabs.

Note: 10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.

TEXT AND REFERENCE BOOKS

1. Krishna Raju N., "Prestressed concrete", Tata McGraw Hill Company, New Delhi 1998
2. Mallic S.K. and Gupta A.P., "Prestressed concrete", Oxford and IBH publishing Co. Pvt. Ltd. 1997.
3. Rajagopalan, N, "Prestressed Concrete", Alpha Science, 2002
4. Ramaswamy G.S., "Modern prestressed concrete design", Arnold Heinimen, New Delhi, 1990
5. Lin T.Y. "Design of prestressed concrete structures", Asia Publishing House, Bombay 1995.
6. David A.Sheppard, William R. and Philips, "Plant Cast precast and prestressed concrete – A
   design guide", McGraw Hill, New Delhi 1992.

AM-546- Elective-I: Bridge Engineering

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites: The students willing to study this course need to have studied earlier the methods of structural analysis, and principles of analysis and design of reinforced concrete/steel structures, and that of prestressed concrete structures in general.

Course Objectives:

The objectives of this course are to review the fundamental concepts followed by detailed study of principles of analysis and design of superstructure and substructure of RCC/Steel bridges with emphasis on structural engineering involved in design of various modern types of bridges for roads and railways, conforming to the codal provisions mentioned by IRC, MOST, IS used in India.

Course Outcomes:

On successful completion of the course, students will be able:

1. To enlist, classify and recommend the structural forms used for bridges.
2. To select different standard loads for road/railway bridges conforming to IRC, MOST, Railway Ministry codes as per current practice.

3. To analyze the bridge spans for train of moving loads.
4. To design road bridges using different forms and materials, and prepare detailed drawings of the same.
5. To design railway bridges using different forms and materials, and prepare detailed drawings of the same.

UNIT-1	Review of elementary knowledge about bridges, General arrangement of various types of bridges: arch type, slab type, slab and beam type, plate girder type, open-web girder, suspension type, cable stayed type, etc.	02 Hrs
UNIT-2	Loading standards for road/railway bridges conforming to IRC, MOST, Railway Ministry codes; impact factor, centrifugal force, wind loads, hydraulic forces, longitudinal forces, seismic forces, earth pressure, buoyancy, etc; Load combinations for different limit state designs	06 Hrs
UNIT-3	Design procedure for road bridges: Approach to design, choice of materials, composite construction, analysis and design of all super structural elements of various types of bridges	12 Hrs
UNIT-4	Design procedure for railway bridges: Deck type, semi-through and through type, considerations of erection loads	08 Hrs
UNIT-5	Details of bridge bearings and expansion joints, parapets, railings, etc.	02 Hrs

Note: 10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.

TEXT AND REFERENCE BOOKS

1. E.C Hambly, Bridge Deck Behaviour, E & FN SPON Publications.
2. V.K. Raina , Concrete Bridge Practice, Analysis, Design and Economics, Tata McGraw- Hills Publishing Company Limited.
3. M.J. Ryall, G.A.R Parke, J.E. Harding, The Manual of Bridge Engineering, Thomas Telford Publishers.
4. R. Rajagopalan, Bridge Superstructure, Tata McGraw- Hills Publishing Company Limited.
5. S. Ponnuswamy , Bridge Engineering, Tata McGraw – Hills Publishing Company Limited.
6. M. G. AswaniI, V.N.Vazirani, M.M. Ratwani , Design of Concrete Bridges, Khanna Publishers.
7. K. S. Rakshit, Design and Construction of Highway Bridges, New Central Book Agency (P) Ltd, Pune
8. . D. Johnson Victor - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
9. T.R. Jagadeesh, M.A. Jayaram - Design of Bridge Structures, Prentice-Hall of India
10. N. Krishna Raju - Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
11. David Lee – Bridge Bearings and Expansion Joints,E & FN Spon
12. Joseph E. Bowles – Foundation Analysis and Design, McGraw-Hill International Edition
13. Nainan P. Kurian – Design of Foundation Systems, Narosa Publishing House
14. Indian Road Congress codes IRC-6, 18, 21, 112
15. Indian Standard Codes (latest versions): 456-2000, 1893-2002, 1343

AM-547: Elective-I: Structural Reliability

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:
Basic principles of structural analysis and design

Course Objectives:
To expose the students to the principles of structural reliability.

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

1. To carry out statistical analysis of materials and loads.
2. To determine structural reliability using different reliability methods.
3. To apply the principles for reliability analysis of concrete structures safety.
4. To apply Code provisions for reliability based design.
5. To correlate fundamentals of probability theory to structural reliability.

UNIT-1 Fundamentals of Probability theory, Concepts of Structural safety, design method, basic statistics and probability data reductions. Histograms, sample correlation, Random variables, discrete and continuous variables, common probability distributions. 05 Hrs

UNIT-2 Resistance distributions and parameters, statistical analysis of materials-steel, concrete, bricks and mortar, characterization of variables, allowable stresses, probabilistic analysis for live load, gravity load and wind load. 06 Hrs

UNIT-3 Structural reliability, computation of basic Structural reliability, reliability analysis of simple elements, level II reliability methods, Basic variables and failure surface FOS method reliability of systems, multiple failure modes, redundant and non-redundant systems, series, parallel and combined systems, Fault tree, Event tree analysis. 06 Hrs

UNIT-4 Monte Carlo methods of analysis study of structural safety, generation of random numbers ,continuous discrete and jointly distributed variables, application to reliability analysis of concrete structures. 05 Hrs

UNIT-5 Reliability based design load and resistance factors of design, safety checking formats 08 Hrs

and code calibrations, IS Code provisions, introduction to stochastic process. Decision analysis, Simple risk decision problems, decision models, decision tree,

decision criteria, decision based on existing information, prior analysis.

Note: 10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.

TEXT AND REFERENCE BOOKS

1. R. E .Melchers, Structural Reliability, analysis and predictions, Ellis- Horwood Ltd. Chichester UK.
2. Edward Haugen, probilistic approaches to design, JohnWiley and sons.
3. R. Ranganathan , Reliability analysis and design of structures, Tata Mc-Graw Hill.

AM 548: Elective-I: Theory of Elastic Stability

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:
Basic principles of structural analysis, theory of elasticity and structural dynamics.
Course Objectives:
To expose the students to the principles of elastic stability.
Course Outcomes:
On successful completion of the course, students will be able:

1. To carry out buckling analysis of beam-column for combined axial force and torsion.
2. To compute critical loads for various structural members under buckling.
3. To apply generalized linear theory for stability analysis of arches.
4. To perform buckling analysis of plates and cylindrical shells.
5. To explain the principles of dynamic analysis of stability.

UNIT-1 Buckling of elastic columns: Theory of bending, Euler loads for different constraints, Beam-columns, Buckling of beams subjected to axial force with torsion 06 Hrs

UNIT-2 Buckling of elastic frames: Stiffness and flexibility matrices of beam-columns, 06 Hrs

Critical loads for frames and continuous beams, Buckling as a eigenvalue problem

UNIT-3 High arches: Approximate theory for arches, Effect of imperfections, Generalized 06 Hrs

linear theory for circular arches

UNIT-4 Buckling of rectangular plates with various boundary and loading conditions, 06 Hrs

Buckling of cylindrical shells

UNIT-5 Dynamic analysis of stability: Types of dynamic loads, Vibration of 06 Hrs

columns/frames, Nonconservative loads and flutter, Pulsating loads and parame resonance, Theorems of Lagrange-Dirichlet and of Liapunov, Stability of

continuous elastic systems

References:

1. Timoshenko S P and Gere J M, Theory of Elastic Stability, McGraw Hill, New York
2. S H Crandall, Engineering Analysis, McGraw Hill, New York
3. F.Bleich, Buckling of Metal Structures, McGraw Hill, New York
4. Chajes, Principles of Structural Stability Theory, Prentice-Hall, New Jersey
5. G J Simitses, An Introduction to The Elastic Stability of Structures, Prentice-Hall, New Jersey

AM-549: FRACTURE MECAHINCS

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:

Usual undergraduate courses strength of materials / mechanics of solids or materials should have been studied earlier.

Course Objectives:

The postgraduate students would learn the typical ways of structural failures due to fracture.

Course Outcomes:

On completion of the course, the students would be able:

1. To describe fundamental concepts of fracture mechanics.
2. To classify and illustrate different yield criteria, and predict the useful life of structures.
3. To compute and interpret various fracture parameters.
4. To investigate plastic deformations near crack-tip as per different fracture models.
5. To determine experimentally fracture toughness of given specimens and suggest repairing techniques.

UNIT-1 06Hrs

Overview of fracture mechanics: Historical cases of failures by fracture, fracture modes

UNIT-2 06Hrs

Yield criteria, crack initiation, growth and fracture mechanisms, LEFM, EPFM, life estimation

UNIT-3 06Hrs

Fracture strength, Energy release rate (G), crack-tip stresses and displacements, stress-intensity-factor (K) for different geometries and loadings, relation between K and G

UNIT-4 06Hrs

Plastic deformations near crack-tip, J-integral, Irwin's model, Dugdale's approach, Mixed mode fracture

UNIT-5 06Hrs

Fracture toughness testing, crack arrest and repairing techniques

Note: *10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.*

TEXT AND REFERENCE BOOKS

1. K Ramesh, Engineering Fracture Mechanics, e-book, IIT Madras, 2007
2. D Broek, Elementary Engineering Fracture Mechanics, Martinus Nijhoff Publishers, The Hague, 1982
3. T L Anderson, Fracture Mechanics: Fundamentals and Applications, CRC Press Book, 2004
4. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw-Hill, New Delhi, 2009
5. Meguid S A, Engineering Fracture Mechanics, Elsevier Applied Science, London, 1989
6. Kanninen M F and Popelar C H, Advanced Fracture Mechanics, Oxford University Press, New York, 1985
7. Gdoutos E E, Fracture Mechanics-An Introduction, Kluwer Academic Publishers, Dordrecht, 1993

AM 555: Lab-Advanced Concrete Technology

Teaching Scheme		**Evaluation Scheme**		
Practicals	2 Hrs/Week	Practical Exam	25	Marks
Tutorials		Term Work	25	Marks
Total Credits	01			

Course Objectives:

1. To make the students understand standard procedure of testing of properties of concrete in the hardened state.
2. To make the students understand the methods of evaluation of strength of existing concrete.

Course Outcomes:

On successful completion of the course, students will be able:

1. To test and evaluate the properties of concrete with and without fibers in fresh and hardened state.
2. To compare and appraise mix proportioning procedures of various international codes.
3. To evaluate the quality of concrete using NDT.

Term Work:

It shall consist of

A) Record of following experiments performed in the laboratory,

EXP. 1	Comparative experimental study of ACI, DOE and IS methods of concrete mix proportioning	4 Hrs
EXP. 3	Determination of modulus of elasticity of concrete	2 Hrs
EXP. 4	Determination of permeability of concrete	2 Hrs
EXP. 5	Determination of tensile strength of normal and fibre reinforced concrete using split tension test	2 Hrs
EXP. 6	Determination of flexural strength of normal and fibre reinforced concrete	2 Hrs
EXP. 7	Determination of shear strength of normal and fibre-reinforced concrete	2 Hrs

EXP. 8 Determination of strength of concrete using NDT methods 2 Hrs

B) Report based on visit to an existing building for assessment of quality of concrete using NDT methods. 4Hrs.

AM 556: Seminar-I

Teaching Scheme		**Evaluation Scheme**	
Practicals	2 Hrs/Week	Practical Exam	25 Marks
Tutorials		Term Work	25 Marks
Total Credits	01		

Course Objectives:

To make the students collect, compile, comprehend and present research literature in any field of Structural Engineering.

Course Outcomes:

On successful completion of the course, students will be able:

1. To search literature from different sources to appraise the state-of-the-art.
2. To compile and prepare a technical report from the collected literature.
3. To present the literature in a comprehensive manner.

Term Work:

The seminar-I shall consist of collection of literature from a chosen field of Structural Engineering from various sources. The candidate shall prepare a technical report in a prescribed format and present before a panel of examiners consisting of guide and two faculty members of the department. The course shall be administered as below.

1. The student shall chose a topic based on brief literature survey within first week.
2. The student shall carry-out detailed literature survey of the chosen topic within next three weeks.
3. The student shall compile the collected literature within next two weeks and present a mid-semester seminar to the panel of examiners.
4. The student shall prepare a technical report of the collected literature in the prescribed format and submit to the guide for corrections during the next three weeks.
5. The student shall prepare the final report after corrections and submit within the prescribed due date.
6. The student shall give final presentation before the panel of examiners on the scheduled date.

Evaluation:

1. The term-work shall be evaluated by the guide based on the volume of quality literature collected and quality of the technical report prepared.
2. The practical examination shall be evaluated by panel of examiners based on the presentations.

SEMESTER-II

Course code: AM 557: Theory of Plates and Shells

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:

Fundamentals of strength of materials, theory of elasticity and analytical and numerical methods of solving higher order partial differential equations

Course Objectives:

1. **To expose the students to the analysis of plates with various supporting and loading conditions**
2. **To expose the students to the analysis of different types of shells**

Course Outcomes :

On successful completion of the course, students will be able:

1. To classify various types of plates and shells
2. To apply various methods for the analysis of plates and shells
3. To choose a method for the analysis
4. To compare the results of analysis by various methods
5. To examine the structural behavior of plates and shells.

UNIT-1 **Fundamentals of analysis of plates** 8 Hrs

Review of plane stress and plane strain problems of elasticity, moment curvature relationships,Classification of plates with reference to deflection, Long rectangular thin plate with small deflections

UNIT-2 **Analysis of rectangular plates** 8 Hrs

Kirchoff's small deflection theory of thin plates, Navier and Lavy's method, boundary conditions , lateral and in plane loading , Finite difference solution

UNIT-3 ***Analysis of circular plates*** 8 Hrs

Symmetrical bending of plate, differential equation in polar coordinates, uniformly loaded and concentrically loaded plates with various boundary conditions, circular plate with a hole.

UNIT-4 **Analysis of shells: Membrane theory** 8 Hrs

Classification of shells, Membrane theory, analysis of shells of revolutions: circular, cylindrical, elliptical, hyperbolic and paraboloidal shells

UNIT-5 **Analysis of shell and Folded plate** 8 Hrs

Bending theory of analysis of shells

Folded plate: structural behaviour , three shear equation, Simpson and Whitney's methods

TEXT AND REFERENCE BOOKS

7. Timoshenko and Kreiger, "Theory of Plates and Shells", Tata McGraw Hill Company, New Delhi 1998
8. Szillard R., "Theory and analysis of plates", Prentice Hall, 1974.
9. Szillard R., "Theories and applications of plate analysis: classical, numerical and engineering methods", John Wiley and Sons, 2004
10. Chandrashekhara K., " Theory of plates", University press India Ltd., Hyderabad, 2001
11. Ramaswamy G.S., "Design and construction of concrete shell roofs", CBS Publishers and Distributors, India, 1986
12. Reddy J.N. , " Theory and analysis of elastic plates and shells", CRC, 2nd edition, 2006

AM-558: Earthquake Resistant Design of Structures

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:

Basic principles of structural dynamics

Course Objectives:

To expose the students to the analysis and design principles of Earthquake resistant structures using code provisions.

Course Outcomes:

On successful completion of the course, students will be able:

1. To explain the basic concepts in seismology and correlate to earthquake engineering.
2. To construct response spectrum of an earthquake and correlate to the construction of design spectra.
3. To formulate analytical model of MDOF systems subjected to earthquake loading for a given time history and analyze using response spectrum methods.
4. To apply the code procedures for seismic analysis, design and detailing of RC building frames.
5. To explain and suggest a suitable seismic resistant measure for masonry load bearing structures.

UNIT-1	Seismology, Causes of earthquake, Plate Tectonic theory, Continental drift theory, elastic rebound theory, measurement of earthquakes, magnitude and intensity, failures in past earthquakes	05 Hrs
UNIT-2	Response Spectrum theory, strong motion and their measurement, characteristics of earthquake ground motion, response spectrum, displacement, pseudo-velocity and pseudo-acceleration spectra, tripartite spectra, characteristics of earthquake spectra, MCE and DBE, Construction of site Design spectra	06 Hrs
UNIT-3	Multi-Degree-of-Freedom (MDOF) systems subjected to earthquake ground motion, Formulation of equations of motion, review of free-vibrations, and mode superposition method, response spectrum method of analysis, modal combination rules, time-history analysis	06 Hrs
UNIT-4	Estimation of earthquake forces using IS:1893-2002-Part-I, Seismic coefficient and response spectrum analysis, asymmetrical structures, accidental eccentricity, Earthquake resistant design philosophy	05 Hrs
UNIT-5	Earthquake resistant design principles, ductility, inelastic behavior, ductile detailing of RC members as per IS:13920, design of beams and columns, masonry structures, provisions of IS:4326	08 Hrs

Note: 10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.

TEXT AND REFERENCE BOOKS

7. Ray W. Clough and Joseph Penziene, "Dynamics of Structures", Mc-Graw Hill, 3rd Edition, 1975.
8. Anil K. Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Pearson Education, 3rd Edition, 2007.
9. Mario Paz, "Structural Dynamics", Springer, 1997.
10. Steven Kramer, "Geotechnical Earthquake Engineering", Pearson Education, 2003
11. D.J.Dowrick, "Earthquake Resistant Design for Engineers", Wiley
12. S.K.Duggal, "Earthquake Resistant Design of Structures", Oxford University press, 2007
13. Vinod Hosur, "Earthquake Resistant Design of Building Structures", Wiley, 2013
14. IS: 1893(Part-I) -2002, "Criteria for earthquake resistant design of structures" Bureau of Indian Standards
15. IS:13920-1993, "Ductile Detailing of Reinforced Concrete Structures subjected to seismic forces-code of practice" Bureau of Indian Standards, New Delhi

16. IS: 4326-1993, "Earthquake resistant design and construction of buildings-code of practice", Bureau of Indian Standards

AM-559: Finite Element Analysis of Structures

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:
Usual undergraduate courses in calculus, statics, dynamics, and mechanics of materials should have been studied earlier. Knowledge of matrix algebra is essential.

Course Educational Objectives:
Students would learn the mathematical procedure amenable to computers known as finite element method.

Course Outcomes:
On successful completion of the course, the students would be able:
1. To describe the finite element method, identify different types of finite elements and apply to structural analysis.
2. To formulate variational methods for analysis of various types of structures.
3. To choose appropriate isoparametric elements and solve structural problems.
4. To estimate errors in a finite element analysis to arrive at convergence of the solution.
5. To create appropriate finite element models in accordance with physics of the problems.

The students would be able to analyze structural engineering problems either with the help of commercial software's or self-developed computer programs in suitable computer langauge.

UNIT-1	Introduction to finite element method, Types of finite elements, Properties of various finite elements	08 Hrs
UNIT-2	Variational methods of formulation: Principle of stationary potential energy, Rayleigh-Ritz method, formulation by weighted residual methods: Galerkin and other methods, Mixed formulation	08 Hrs
UNIT-3	Isoparametric elements: Triangular, quadrilateral, tetrahedral, hexahedral, etc; Numerical integrations, Static condensation, Load considerations and stress calculations, Patch test	08 Hrs
UNIT-4	Error estimation and convergence: Sources of error, ill-conditioning, discretization error, convergence rate, mesh revision methods	08 Hrs
UNIT-5	Modeling considerations: Physical behavior vs element behavior, element shapes and interconnection, pilot studies, material properties, loads and reactions, connections in structures, boundary conditions, stress concentrations	08 Hrs

Note: *10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.*

TEXT AND REFERENCE BOOKS

1. R D Cook, D S Malkus, M E Plesha and R J Witt, Concepts and applications of finite element analysis, 4th edition, John Wiley & Sons, Inc., Singapore

2. T R Chandrupatla and A D Belegundu, Introduction to finite elements in engineering, 3rd edition, Pearson Prentice Hall, India

3. J N Reddy, An introduction to the finite element method, 3rd edition, Tata McGraw Hill, India

4. K J Bathe, Finite element procedures, Phi Learning Private Limited, New Delhi, 2010

5. Y M Desai, T I Eldho and A H Shah, Finite element method with applications in engineering, Pearson, Delhi

AM-560: Advanced Reinforced Concrete Design

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:
Usual undergraduate course in elementary theory and design of RCC structures should have been studied earlier.

Course Objectives:
Students would learn the analysis and design methods with respect to advanced special RCC structures like liquid retaining structures, industrial structures like bunkers, silos, and chimneys, and deep foundations like raft and piles.

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

1. To interpret and apply the provisions of relevant IS-code for design of various RCC structure.
2. To identify structural behavior and compute the stresses developed in various components of RCC structures due to different loading.
3. To design various RCC structures using relevant codes and standards.
4. To select judiciously suitable type of foundation for various situations and design.
5. To give complete detailing of the designed RCC structure.

UNIT-1	Analysis and design of liquid retaining structures like on- and under- ground water tanks: Provisions of IS 3370; Durability requirements, crackwidth, deflection and strength analyses; various methods of analysis and design of sections	08 Hrs
UNIT-2	Analysis and design of liquid retaining overhead structures like water tanks circular and rectangular in plan; Analysis and design of supporting frames	10 Hrs
UNIT-3	Analysis and design of industrial RCC chimneys	06 Hrs
UNIT-4	Analysis and design of industrial square/circular bunkers and silos	06 Hrs
UNIT-5	Analysis and design of combined footings, strip footings, raft and pile foundations	10 Hrs

Note: *10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.*

TEXT AND REFERENCE BOOKS

1. B C Punmia, A K Jain and A K Jain, Comprehensive Design of RCC Structures, Laxmi Publications (P) Ltd, New Delhi

2. P C Varghese, Advanced Reinforced Concrete Design, 2nd Edition, Prentice-Hall of India Pvt Ltd, New Delhi, 2005

3. S Ramamrutham, Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company, New delhi, 2007

4. N Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers & Distributors, Delhi

AM-561: Elective-II: Advanced Design of Steel Structures

Teaching Scheme	**Evaluation scheme**
Lecture 3Hrs/week	**Test 20 Marks**
Tutorials 1Hr/week	**Teachers Assessment 20 Marks**
Total credits 4	**End-semester Examination 60 Marks**

Prerequisites
Design of various structural components of steel structures along with its connections like tension members compression members, beams columns, column bases, plate girders, gantry girders, trusses.

Course Objectives:
1. To expose students to analysis of and design of various steel structures.
2. To expose students to industrial steel structure design problems
3. To expose students to solve steel design problems using software.

Course Outcomes
On successful completion of the course, students will be able:
1. To analyse and design knee braced truss bent with hinged, fixed and partially fixed bases with and without gantry load.
2. To identify the structural behavior of components of steel factory shed and steel building.
3. To compare the analysis and design of steel factory shed with gable frames with and without gantry loads using relevant IS-code.
4. To design plate girder bridges for broad gauge railway.
5. To assess the suitability of light gauge steel sections for structural members and design

UNIT-1 Analysis and design of knee braced trussed bent with hinged, fixed and partially fixed bases without gantry. Design of knee brace, roof column and its base. 06 Hrs
Various types of column configurations in case of knee braced trussed bent with gantry loads.
Design of stepped columns and bases under various load combinations.

UNIT-2 Analysis and design of gable portal frame with and without gantry loads. Design of bracket supporting gantry loads. 06 Hrs

UNIT-3 Open web frames for industrial shed, trussed purlins, analysis and design of two storey building. 06 Hrs

UNIT-4 Design in light gauge steel –forms of light-gauge sections, local buckling of thin elements, multiple stiffened compression elements, axially loaded column, laterally supported beams. 06 Hrs

UNIT-5 Plate Girder Bridges - Types of floor systems, design of deck type plate Girder bridges for broad gauge railway, horizontal truss bracings and end cross frames. 06 Hrs

Tutorials-design problems based on above syllabus preferably using software.
References Books

1. Ramchandra – Design of Steel Structures Vol – II, Standard Book House, Delhi
2. A.S. Arya and J.L. Ajmani – Design of Steel Structures, Nemchand & Bros., Roorkee
3. Teaching Resource for Structural Steel Design – INSDAG Kolkatta
4. IS: 800 – 1984 Code of Practice for General Construction in Steel
5. IS: 875 – 1964 Code of Practice for Structural Safety of Building: Loading Standards (Revised)
6. IS: 4137 – 1967 Code of practice for Heavy Duty electric Overhead Traveling Crane
7. Steel Designers Manual – ELBS
8. John E. Lotheres – Advanced Design in Structural Steel, Prentice Hall
9. D. Johnson Victor - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
10. T.R. Jagadeesh, M.A. Jayaram - Design of Bridge Structures, Prentice-Hall of India
11. N. Krishna Raju - Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
12. IS: 800 – 1984 Code of Practice for General Construction in Steel
13. IS: 875 – 1964 Code of Practice for Structural Safety of Building: Loading Standards (Revised)
14. IS: 1915 – 1961 Code of Practice for Steel Bridges
15. IS: 800 – 2007 Code of Practice for General Construction in Steel
16. Comprehensive Design of Steel Structures, B.C.Punmia, A.K.Jain ,Laxmi Publications(P)Ltd, New Delhi.

AM-562: Elective – II : Plastic Analysis of Structure

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:
Fundamentals of design of RCC structures.

Course objectives:
1) To make the students to understand I plastic analysis of structures.
2) To make the the students to apply these methods for analysis.
3)) To make the the student to analyze various types of structures.

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

1. To construct yield line patterns for various shapes of slabs for different support conditions.
2. To analyze and design slabs using yield line theory.
3. To describe the plastic behavior of RC structural sections.
4. To apply theorems of plastic collapse to analysis and design of beams and frames.
5. To estimate deflection in beams and frames.

UNIT-1	Yield line theory : Introduction, Yield line patterns, Moment capacity along yield lines, Isotropic and orthotropic reinforcement. Analysis by virtual work and equilibrium method limitations of yield line analysis	06 Hrs
UNIT-2	Computation of ultimate load , analysis and design of various slab using yield line theory.	06 Hrs
UNIT-3	Plastic analysis **:** Introduction, concepts of simple plastic collapse, collapse criteria Conditions of plastic analysis**,** Plastic moment capacity	06 Hrs
UNIT-4	Theorems of plastic collapse : Static, Kinematic and Uniqueness theorem, Methods of analysis and design, Application to beams and frames	06 Hrs
UNIT-5	Estimation of deflections in R.C beams and frames, load test and acceptance criteria	06 Hrs

Assignment: It shall consist of a set of innovative tutorials/problems based on the above theory.

TEXT AND REFERENCE BOOKS

1. Philip G. Hodge,Plastic Analysis of structures, 1959,McGRAW- Hill BOOK Company ,INC. New York Toronto london
2. B.G.NEAL, The plastic Methods Of Structural Analysis, Second Edition ,Chapman & Hall LTD London
3. R.H. Wood, Plastic and elastic design of slabs and plates, 1961,Ronald Press ,New York.
4. L.L.Johns and R.H.Wood , Yield Line analysis of Slabs, 1967 American Elsevier Publication Co. New York.
5. IS 456-2000: Code of practice for plain and R. C. BIS, New Delhi.
6. N. Subramanian, Design of steel structures,Oxford University Press, New Delhi 110001

AM-563: Elective-II- Advanced Seismic Analysis and Design

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:
Basic principles of structural dynamics and earthquake engineering

Course Objectives:
To expose the students to the advancements in analysis and design of Earthquake resistant structures.

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

1. To recall and explain basic principles of earthquake resistant analysis and design.
2. **To formulate analysis algorithm of MDOF structures using numerical integration methods.**
3. **To debate the necessity of inelastic seismic analysis.**
4. **To explain the procedure of performance based seismic design and obtain performance point for a given seismic demand.**
5. **To enlist different vibration control techniques and explain their behavior under seismic loading.**

UNIT-1	Review of basics of earthquake engineering, response spectrum theory, modal analysis, response-spectrum and time-history analysis of MDOF structures.	05 Hrs
UNIT-2	Reduction of DOF, static condensation, modeling of MDOF systems, Rayleigh-Ritz method, selection of Ritz vectors, numerical evaluation of response, time-stepping methods, Newmark-Beta method	06 Hrs
UNIT-3	Inelastic analysis of structures, force-deformation relations, effects of yielding, response spectrum for yield deformation and yield strength, yield strength-ductility relation, inelastic design spectrum	06 Hrs
UNIT-4	Performance based design, Performance criteria, Push-over analysis, capacity spectrum method, performance point	05 Hrs
UNIT-5	Vibration control systems, passive, active, hybrid and semi-active systems, base-isolation, base-isolation principles and systems, linear theory of base-isolation, energy-dissipation systems, Tuned-mass dampers	08 Hrs

Note: 10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.

TEXT AND REFERENCE BOOKS

6. Ray W. Clough and Joseph Penziene, "Dynamics of Structures", Mc-Graw Hill, 3rd Edition, 1975.
7. Anil K. Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Pearson Education, 3rd Edition, 2007.
8. Mario Paz, "Structural Dynamics", Springer, 1997.
9. Steven Kramer, "Geotechnical Earthquake Engineering", Pearson Education, 2003
10. D.J.Dowrick, "Earthquake Resistant Design for Engineers", Wiley
11. S.K.Duggal, "Earthquake Resistant Design of Structures", Oxford University press, 2007
12. T.T.Soong and G.F.Dargush, "Passive energy dissipation systems in structural Engineering", John Wiley, 1997
13. J.M.Kelly, "Earthquake-Resistant Design with Rubber", Springer-Verlag, 1997
14. Vinod Hosur, "Earthquake Resistant Design of Building Structures", Wiley, 2013
15. IS: 1893(Part-I) -2002, "Criteria for earthquake resistant design of structures" Bureau of Indian Standards
16. IS:13920-1993, "Ductile Detailing of Reinforced Concrete Structures subjected to seismic forces-code of practice" Bureau of Indian Standards, New Delhi
17. IS: 4326-1993, "Earthquake resistant design and construction of buildings-code of practice", Bureau of Indian Standards

AM 564: Elective-II: Analysis and Design of High Rise Structures

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites :

This subject introduces students to the special requirements necessary for the successful design of high rise buildings. The basic knowledge of topics required : structural floor, framing and foundation systems, wind and earthquake loading, structural analysis techniques including computer-aided analysis.

Course Objectives

Analysis and Design of tall buildings are necessary for civil engineers because now a day's many high rise structures are getting constructed due to high land cost and to accommodate more population in lesser area. The various structural systems and the methods of analysis and design will be taught in this course. The behavior of building for wind and earthquake loading and how it affects the design of structural systems and the building services will be focused in this course**.**

Course Outcomes:

On successful completion of this subject students should be able:

1. To explain the multi-disciplinary nature of designing a tall building and the role of a structural engineer in the design of tall buildings
2. To describe the design criteria and loading conditions for tall buildings
3. To develop conceptual designs of lateral load resisting systems and foundation systems for different buildings and soil types
4. To compute dynamic wind loads on tall buildings using the dynamic response factor approach
5. To identify, compare and contrast different structural systems using case studies of tall buildings

UNIT-1 **General Considerations** 06 Hrs

Introduction; Definition of a tall building ; Lateral load design

	philosophy; Concept Of premium for height; Factors responsible for slimming down the weight of structural frame; Development of high-rise architecture; structural concepts	
UNIT-2	**Design Criteria**: Design philosophy, static and dynamic approach, Structural systems and concepts, Effect of openings. Large panel construction. Foundation superstructure interaction. Wind effects, Nature of wind; Extreme wind conditions; Characteristics of wind; Provisions of IS875(Part3); Wind tunnel engineering – Introduction, Description, of wind tunnels; Objectives of wind tunnel tests, Rigid model studies, Aero elastic Tall building behavior during earthquakes; Philosophy of earthquake design; Provisions of IS1893(Part1).	06 Hrs
UNIT-3	**Gravity and Lateral Load Resisting Structural Systems:** High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, Steel-Concrete Composite Floor Systems Aluminum Facades , Modeling for approximate analysis, accurate analysis, subsystem interaction, differential movement, creep and shrinkage effects, temperature effects and fire.	06 Hrs
UNIT-4	**Stability of Tall Buildings**: Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity loading, simultaneous first order and P-Delta analysis, translational, Torsional instability. Lateral Systems for Steel Buildings, Lateral Systems for Concrete Buildings, Lateral Systems for Composite Construction	06 Hrs
UNIT-5	**Foundations**: Introduction, Bearing capacity: Shallow and deep foundations; Settlement analysis, Different types of foundations and their designs: Raft, Piles, and Well foundation; Foundations subjected to dynamic loads.	06 Hrs

Reference Books :

1. B. S. Taranath , "Structural analysis and design of tall buildings", McGraw-Hill, latest edition.
2. B. S.Taranath , "Steel, Concrete and Composite design of tall buildings", McGraw-Hill, latest edition.
3. B.S.Smith and A.Coull, "Tall building structures," John Wiley & Sons, latest edition

Additional References:

1. Schuellar, W , "High Rise Building Structures" , John Wiley and Sons
2. LinT.Y. and Burry D.Stotes, "Structural Concepts and Systems for Architects and Engineers ", John Wiley, 1994.
3. Lynn S.Beedle, " Advances in Tall Buildings", CBS Publishers and Distributors, Delhi,1996.
4 Y. P. Gupta, "High Rise Structures: Design and Construction Practices in middle level cities"
5. Farzad neaim, " Handbook on seismic analysis and design of structures"
6. E Dowrick D J, " Earthquake resistant Design for engineers & Architects"
7. Park & Paulay, "Reinforced Concrete Structures:

AM-571: Lab- Computer Aided Analysis and Design

Teaching Scheme		**Evaluation Scheme**	
Practicals	2 Hrs/Week	Term Work	25 Marks
		Viva voce	25 Marks
Total Credits	1		

Prerequisites:

Students should know theory of structural analysis and design.

Course Objectives:

Students would learn the use of structural engineering softwares for analysis and design of structures.

Course Outcomes:

On completion of the course, the students would be able:

1. To recognize the different facilities available in application softwares for analysis and design of structures
2. To analyze and design various types of components in RCC structures using the softwares

3. To analyze and design various types of components in steel structures using the softwares
4. To model, analyze and design simple structures using structural engineering softwares.

UNIT-1 08 Hrs

Introduction to application Softwares: STAAD/ NISA Civil/ SAP etc with simple examples

UNIT-2 06 Hrs

Analysis and design of RCC members: Beams, Slab, Column, Footings, Retai walls, etc

UNIT-3 06 Hrs

Analysis and design of Steel Structures: Trusses for roofs/bridges, Pin Jointed Space Frame, etc

Note: Term work shall consist of suitable exercises done in laboratory based on the syllabus. Viva-voce examination, based on the record of term work submitted by the candidate, shall be conducted by the internal and external examiners appointed by the Head of the department.

AM 572: Seminar-II

Teaching Scheme		**Evaluation Scheme**		
Practical	2 Hrs/Week	Practical Exam	25	Marks
Tutorials		Term Work	25	Marks
Total Credits	01			

Course Educational Objectives:

To make the students collect, compile, comprehend and present research literature in a chosen field of Structural Engineering suitable for dissertation work

Course Outcomes Expected:

Students will be able to

1. To search literature from different sources to appraise the state-of-the-art in the chosen field.
2. To compile and prepare a technical report of the collected literature and present.
3. To identify the possibility of problem formulation for dissertation

Term Work:

The seminar-II shall consist of collection of literature from a chosen field of Structural Engineering from various sources. The candidate shall prepare a technical report in a prescribed format and present before a panel of examiners consisting of guide and two faculty members of the department. The course shall be administered as below.

1. The student shall chose a topic based on brief literature survey within first week.
2. The student shall carry-out detailed literature survey of the chosen topic within next three weeks.
3. The student shall compile the collected literature within next two weeks and present a mid-semester seminar to the panel of examiners.
4. The student shall prepare a technical report of the collected literature in the prescribed format and submit to the guide for corrections during the next three weeks.
5. The student shall prepare the final report after corrections and submit within the prescribed due date.
6. The student shall give final presentation before the panel of examiners on the scheduled date.

Evaluation:

1. The term-work shall be evaluated by the guide based on the volume of quality literature collected and quality of the technical report prepared.

2. The practical examination shall be evaluated by panel of examiners based on the presentations.

GE612- ENVORONMENTAL STUDIES

Evaluation Scheme

- Test 20 Marks
- Teacher Assessment 20 Marks
- End-Semester Examination S 60 Marks

Course Educational Objectives:

- Become aware of the importance of soil, water and air for humans and other life forms on the Earth.
- Become aware of the species extinction and loss of biodiversity.
- Become aware of the various national and international efforts that are in place for conserving the environment.
- Get acquainted with national laws and global environment conservation guidelines.

Course Outcomes Expected: The students will be able to:

- Understand the physical and chemical foundations of the Earth and its environment.
- Understand evolution of human societies and major transformations brought by the industrialization.
- Learn about the basics of environmental economics.

UNIT-1 *Natural Resources, Water Resources*: use and over utilization of surface and ground water , Floods Draught, conflicts over water, *Dams*: Benefits and problem, *Energy Resources*: Growing energy needs, Renewable and non-renewable energy sources, use of alternate energy sources. *Land Resources*: Land degradation, soil erosion and desertification. Role of an individual in conservation of natural resources. 6 Hrs

UNIT-2 Global level efforts towards environment conservation and pollution control. Role of India at Global level pollution, conservation and policies of Government of India towards control of river pollution. Policy of Government of Maharashtra toward control of various pollution. Environment Protection Act, vehicular emission standards, Noise Pollution (Regulation and Control) Rules, Concept of ISO 14000 6 Hrs

UNIT-3 *Biodiversity and its conservation*: Bio-geographical classification of India, Biodiversity National and Local levels. India as a mega diversity nation, Hot spots of biodiversity, Endangered and epidemic species of India, *Conservation of biodiversity*: In-situ and Ex-situ conservation of biodiversity, Forests. 6 Hrs

UNIT-4 *Environmental pollution:* Definition, Causes, Effects and control measures of Air Pollution, Water Pollution, Noise Pollution, Thermal Pollution, Nuclear hazards, Electronic waste. 6 Hrs

Solid waste management: Causes, effects and control measures of urban and industrial wastes.

UNIT-5 **(Civil Engineering)** 6 Hrs

Urban problems related to water and energy, Water conservation and rain water harvesting and watershed management, Climate change, Nuclear accidents, Role of an individual in prevention.

ASSIGNMENT: Assignment shall consist of power point presentation of related topic by individual student.

TEXTS AND REFERENCE BOOKS

1. Textbooks of Environmental Studies for Understand courses by Erach Bharucha, UGC, New Delhi.
2. Environment Studies by R. Rajgopalan, Oxford University Press.
3. Environment Protection Act 1986.

AM-641: Open-Elective -FINITE ELEMENT METHOD FOR ENGINEERS

Teaching **Evaluation Scheme**

Scheme

Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Prerequisites:
The UG level courses like Solid/Fluid Mechanics, Theory of Elasticity and Plasticity, Theory of Structures/Machines, Heat Transfer, Calculus, Differential Equations, Linear Algebra, etc should have been studied earlier respectively by students of different branches of engineering.

Course Objectives:
This course is designed to introduce FEM as a numerical technique that employs a philosophy of piecewise approximations of solutions to problems described by differential equations. Since this method uses a mathematical structure common to various physical theories, it is intended to make students aware of the generality of the method irrespective of students' branch of engineering.

Course Outcomes:
On successful completion of the course, the students would be able:

1. To describe the finite element method, identify different types of finite elements and apply to respective engineering problems.
2. To formulate variational methods for analysis of various engineering problems.
3. To analyse 1-D, 2-D and 3-D engineering problems using finite element method.
4. To estimate errors in a finite element analysis to arrive at convergence of the solution.
5. To create appropriate finite element models in accordance with physics of the problems.

UNIT-1: Preliminaries: 05 Hrs
Basic concept of FEM, Some mathematical concepts and formulae, weak formulation of boundary value problems, variational methods of approximation

UNIT-2: Finite element analysis of 1D problems-Part I: Basic steps of FEA, Applications to heat transfer, fluid mechanics, solid mechanics problems; analysis of bending of beam by Euler-Bernoulli and Timoshenko theories, analysis of plane frames; 10 Hrs

UNIT-3: : Finite element analysis of 1D problems-Part II: 6 Hrs
Approximation errors, various measures of errors, convergence and accuracy of solution; isoparametric formulations and numerical integration, Computer implementation

UNIT-4: Finite element analysis of 2D problems-Part I: 10 Hrs
Boundary value problems, mesh generation and imposition of boundary conditions, Applications to heat transfer, fluid mechanics, solid mechanics problems; library of elements and interpolation functions, numerical integration and modeling considerations

UNIT-5: Finite element analysis of 2D problems-Part II & 3D problems : 09 Hrs
Analysis of plane elasticity; flows of viscous incompressible fluids, bending of elastic plates**;** Computer implementation; FEA of 3D problems

Note: *10 Hrs of tutorials will be suitably distributed for the above five units for hands on experience of solving numerical problems.*

TEXT AND REFERENCE BOOKS

1. J N Reddy, An Introduction to the Finite Element Method, Mc-Graw-Hill, Inc., New Delhi, 1993
2. Bathe K J, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, NJ, 1982
3. Cook R D, D S Malkus, and M E Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New York, 1989

4. Zienkiewicz O C and R L Taylor, The Finite Element Method, Vol. I, Basic Formulation and Linear Problems, McGraw-Hill, London, 1989

5. Hughes T J R, The Finite Element Method (Linear, Static and Dynamic Finite Element Analysis), Prentice-Hall, Englewood Cliffs, NJ, 1987

6. Desai C S and J F Abel, Introduction to the Finite Element Method, Van Nostrand-Reinhold, New York, 1972

7. Chandropatla T R and A D Belegundu, Introduction to Finite Elements in Engineering, Prentice-Hall, Englewood Cliffs, NJ, 1991

8. Shames I H, Mechanics of Fluids, McGraw-Hill, New York, 1962

9. Holoman J P, Heat Transfer, McGraw-Hill, New York, 1986

10. Nagotov E P, Applications of Numeric Methods to Heat Transfer, McGraw-Hill, New York, 1978

11. Kreyszig E, Advanced Engineering Mathematics, John Wiley, New York, 1988

12. Dym C L and I H shames, Solid Mechanics: A Variational approach, McGraw-Hill, New York, 1973

13. Timoshenko S P and J N Goodier, Theory of Elasticity, McGraw-Hill, New York, 1970

14. Willems N and W M Lucas, Jr., Structural Analysis for Engineers, McGraw-Hill, New York, 1978

15. Szilard R, Theory and Analysis of Plates, Prentice-Hall, Englewood Cliffs, NJ, 1974

16. Timoshenko S P and S Woinowsky-Krieger, Theory of Plates and Shells, McGraw-Hill, New York, 1959

17. Stroud A H and D Secrest, Gaussian Quadrature Formulas, Prentice-Hall, Englewood Cliffs, NJ, 1966

GE 611: Research Methodology

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Unit-I

Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature review.

Unit-II

Basic Concepts of Probability, Probability Axioms, Measures of Central Tendency, Measures of Dispersions, Measures of Symmetry, Measures of Peakedness. Regression Analysis – Simple Linear Regression, Multiple linear Regression, Correlation. Tests of Hypothesis and Goodness of Fit: Definition of null and alternative hypothesis, students't' distribution: properties, application with example. Chi-square distribution: definition, constants of Chi-square distribution. Application with example. F-test: example of application.

Unit-III

Optimization Techniques: Linear Programming, Simplex Method, Dual Simplex, Sensitivity Analysis. Artificial Variable Technique, Dynamic Programming, Introductory concepts of non-linear programming.

OR

Unit-III

Modeling and simulation:

Introduction to modeling: Concept of system, continuous and discrete systems. Experimental Methods: Importance of experimental analysis, guidelines for designing experiments, uncertainty and error analysis, concept of uncertainty, propagation of uncertainty, planning experiments from uncertainty analysis.

Unit-IV

Fuzzy logic: Introduction, Concepts, Basic Fuzzy Mathematical Operations, Fuzzy databases, Membership Functions, Fuzzy Linear Programming, Neural Networks: Artificial Neural Networks, architectures and algorithms, Basic neuron models, Neural network models, Learning algorithms, Genetic Algorithms: Introduction to genetic algorithm, Operators, Applications.

Unit-V

Interpretation and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Writing a technical paper, plagiarism and its implications.

References:

1. S.P.Gupta, "Statistical Methods", S. Chand & Sons.

2. Kothari C.R. (2011), " Research Methodology-Methods and Techniques", New Age International Publishers, New Delhi.

3. Gupta S.L. and Gupta Hitesh (2011), "Research Methodology-Text and cases with SPSS applications" International Book House Pvt. Ltd., New Delhi.

4. Rao V and H. Rao, (1996), "C++, Neural Networks and Fuzzy Logic", BPB Publications, New Delhi.

5. Goldberg, D.E. (2000), "Genetic Algorithms in Search, Optimization & Machine Learning", Addison Wesley Longman (Singapore) Pte. Ltd., Indian Branch, Delhi.

6. George J. Klir and Bo Yuan (2010), "Fuzzy Sets and Fuzzy Logic", PHI Learning Pvt. Ltd, New Delhi.

CS 557: Professional Ethics & Cyber Law

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Course Educational Objectives:

- Describe Professional & Philosophical Ethics
- Describe the process of Securing Intellectual Property
- Enable Students on how to Recover the Evidence and Investigation
- Demonstrate on how to secure own presence online
- Describe Cyber Law provision related to all type cyber crimes

Course Outcomes Expected:

At the end of the course the student will be able to

CO1: Make defensible decision making based on Professional & Philosophical Ethics

CO2: Develop process to file an IPR Application

CO3: Investigate and Recover Cyber Evidence

CO4: Implement Cyber Security

CO5: Suggest legal action to be taken against the cyber crimes

UNIT-1 Computer and Philosophical ethics and ethical decision making

Legal concepts and their implications on the computing professions, Philosophical foundations for ethics, Defensible decision making in ethical situations, solving ethical dilemma, Professional ethics and moral issues / Codes of Conduct, Reliability verses Trust: The Computing Dilemma, Computers and work, Privacy and Information, Social Issues and broad impact of computers, Professional responsibilities and implications, Hacking and hacker ethics.

UNIT-2 Intellectual property issues in cyberspace

Introduction to intellectual property Protections via Trade Secrets, Trademarks, Patents, Etc.

Contracting to protect intellectual property, Protection options - Encryption / PGP, copyright on web-content, copyright on software,

UNIT-3 Basic concepts of technology and law

digital contracts, digital signatures, role and functions of certifying authorities, Cyberforensis, computer forensics and law, forensic evidence, Forensics casework, investigative incident-response actions,

UNIT-4 Cyberethics

Cyberethics, philosophical challenges to Cyberethics, Computer crimes and criminal law, Computer viruses and worms - International computer crimes, Cybercrimes, Ethical consideration to computer crimes, Types of incidents,

Stages of incident response, incident prevention and detection, Threats in cyberspace, Blended attacks.

UNIT-5 Information technology Act 2000

Scope, jurisdiction, offense and contraventions, powers of police, adjudication

TEXT AND REFERENCE BOOKS

1. *Computers, Ethics, And Social Values*, Johnson and Nissenbaum, 1994 Prentice Hall
2. *Cybersecurity operations Handbook,John Rittinghouse,William Hancock*
3. *Computer ethics,Deborah G.Johnson,third edition,Pearson education*

CS 558: Web Technologies

Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Test	20 Marks
Tutorials	1 Hrs/Week	Teacher Assessment	20 Marks
Total Credits	4	End-Semester Examination	60 Marks

Total Hours required for this course: 60 Hours.

Course Educational Objectives:

- Explain the basics of WWW & Internet + hardware involved
- Explain basic concepts in HTML & CSS
- Enable Students on how to make use of Internet Marketing
- Demonstrate on various ways of Securing own website
- Demonstrate importance of E-Commerce and Mobile Websites

Course Outcomes Expected:
After completion of course students will be able to

CO1: Differentiate Network Hardware, Internet and how it works
CO2: Create a simple web pages using HTML & CSS
CO3: Promote themselves on Internet using Internet Marketing
CO4: Secure their online presence
CO5: Monetize their skills using E-Commerce solution.

UNIT-1 **World Wide Web:** Introduction, History, Internet v/s WWW, Internet v/s Intranet, Introduction to Networking, LAN, MAN, WAN, PAN

Introduction to Network Hardware: Switches, Routers, Hubs, Gateways, Other Hardware

UNIT-2 **Introduction to HTML:** Introduction, HTML Editors, Creating a Simple Web Page, HTML Tags/Elements, Formatting Tags, Presentation Tags and HTML Attributes

Cascaded Style Sheets: Introduction to Style Sheets, Properties, Style by ID/Class & Tag Name

UNIT-3 **Online Marketing:** Tracking Website performance with Google Analytics, Using Google AdWords and AdSense, Social Media Marketing, Email Marketing

Search Engine Optimization: Introduction, SEO best practices, Online Reputation Management, Web Master Tools, Registering to Major Search Engines

UNIT-4 **Web Security:** Introduction, Network Security Model, Symmetric Cipher Models, Digital Signature, PGP, S-MIME, Web Security Considerations, Secure Electronic

Transactions

Safety precautions: Firewall, Virus and its related threats and countermeasures

UNIT-5 **Domain & Hosting:** Introduction, **E-Commerce:** Payment Gateways

Mobile Compatible website: Introduction, Introduction to HTML5 & CSS3

EE 572: RENEWABLE ELECTRIC TECHNOLOGY

(Institute level open elective)

(To be implemented from 2014)

Teaching Scheme		**Evaluation Scheme**	
Lectures	03Hrs/ Week	Test	20Marks
Tutorial	01Hrs/ Week	Teacher Assessment	20Marks
		End Semester Exam	60Marks
Total Credits	04		

UNIT-1 Distributed Generation**:** Distributed Generation with Fossil Fuels, Concentrating Solar Power (CSP) Technologies, Biomass for Electricity, Micro-Hydropower Systems, Fuel Cells, Electrical Characteristics of Real Fuel Cells, Types of Fuel Cells, Hydrogen Production

UNIT-2 Wind Power Systems**:**

Historical Development of Wind Power, Types of Wind Turbines, Power in the Wind, Impact of Tower Height, Maximum Rotor Efficiency, Wind Turbine Generators, Speed Control for Maximum Power, Average Power in the Wind, Simple Estimates of Wind Turbine Energy, Specific Wind Turbine Performance Calculations, Wind Turbine Economics

UNIT-3 The Solar Resource**:**

The Solar Spectrum, The Earth's Orbit, Altitude Angle of the Sun at Solar Noon, Solar Position at any time of Day, Sun Path Diagrams for Shading Analysis, Solar Time and Civil (Clock) Time, on a Collecting Surface, Monthly Clear-Sky Insolation, Solar Radiation Measurements, Average Monthly Insolation

UNIT-4 Photovoltaic Materials and Electrical Characteristics**:**

The PV I–V Curve Under Standard Test Conditions (STC), Impacts of Temperature and Isolation on I –V Curves, Shading Impacts on I–V Curves, Crystalline Silicon Technologies, Thin-Film Photovoltaic Systems, Current–Voltage Curves for Loads, Grid-Connected Systems, Grid-Connected PV System Economics, Stand-Alone PV Systems, PV-Powered

Water Pumping

BOOKS:

1. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Wiley-IEEE Press August 2004
2. Siegfried Heier, "Rachel Waddington Grid Integration of Wind Energy Conversion Systems",Wiley Publications
3. "Power Generation Renewables" by PEP (Professional Engineering Publishers) Wiley publications
4. Thomas Ackermann, "Wind Power in Power Systems", Wiley publication

Teacher Assessment:

Assessment will be based on following:

1. Assignments
   10 Marks
2. MCQ
   10 Marks

TEXT AND REFERENCE BOOKS

1. Thomas Powell,"HTML & CSS: The Complete Reference", Fifth Edition by.
2. Jon Duckett ,"Beginning HTML, XHTML, CSS, and JavaScript". – Wrox Publication.
3. Head First HTML with CSS & XHTML – O'Reilly Publication.
4. HTML, CSS, JavaScript for Dummies.

ET 561: Soft Computing

Teaching Scheme		**Evaluation Scheme**	
Lectures :	03Hrs/Week	Test	20 Marks
Tutorials :	01Hrs/Week	Teacher Assessment	20 Marks
Total Credits :	04	End-Semester Examination	60 Marks

Prerequisites :

Course Educational Objectives:

- To introduce students about Soft Computing Techniques.
- To explain students Fuzzy sets & its Applications.
- To introduce students to Genetic Algorithm fundamentals.
- To explain students concepts and categories of Neural Network

Course Outcomes : Students will be able to

- Describe Soft Computing Techniques
- Gain knowledge of Fuzzy sets
- Understand the Neural Network concepts.
- Understand and apply Genetic Algorithms.

UNIT-1

Fuzzy Logic

Basic concepts of Fuzzy systems, Conventional and fuzzy sets, fuzzy relations, fuzzy operations, fuzzy operators and operations, fuzzification, defuzzificaztion methods, application of fuzzy logic.

UNIT-2

Neurocomputing

Feed forward, feedback and competitive neural network. Models of Neurocomputing: Perceptron Training, Back propagation learning, Hopfield nets. Additional models.

UNIT 3:

Adaptive Resonance Theory I & II

Self-organizing feature map, ADALINE. Applications in pattern classification and image understanding.

UNIT-4

Genetic Algorithms

The basic operators, Schema theorem, convergence analysis, stochastic models, applications in search and optimization. Learning with GA & NN.

UNIT-5

Composite use of fuzzy logic

Neural network & Genetic Algorithms. Chaos Theory, Fusion of Neuro, Fuzzy, GA and Chaos theory and applications

TEXT AND REFERENCE BOOKS

18. David E. Goldberg: Genetic Algorithms in search optimization, and machine learning, Addition Wesley, MA
19. S. Haykin, Neural Networks – A comprehensive Foundation, Macmillan College Publishing Company, New York
20. H.J. Zimmermann, Fuzzy set theory and its application, 2nd revised edition, Allied Publishers Ltd
21. G.J. Klir, B. Yuan: Fuzzy sets and Fuzzy Logic, Theory and applications, PHI
22. R.L. Devaney, An Introduction to Chaotic Dynamical Systems, Addition Wesley, 2nded
23. B. Yegnanarayana, Artificial Neural Networks, PHI
24. Resource available on e-learning site http://www.e-gecaect.com

Teacher Assessment:

Teachers Assessment is based on one of the or combination of few of following

1) Simulation

2) Application Development

3) Power point presentation

4) Question & Answer / Numerical solution

5) Study of Industry processes and its presentation

6) Mini projects

AM 615 : Dissertation-I

Teaching Scheme		**Evaluation Scheme**	
Practical	20 Hrs/Week	Viva voce	50 Marks
Tutorials		Term Work	50 Marks
Total Credits	10		

Prerequisites:

Students should have theoretical and practical knowledge of structural engineering.

Course Objectives:

To make the students collect, compile, comprehend, formulate dissertation problem and present in a chosen field of Structural Engineering.

Course Outcomes:

On successful completion of the course, students will be able:

1. To search literature from different sources to appraise the state-of-the-art in the chosen field.
2. To compile and prepare a technical report of the collected literature and present.
3. To formulate/define the problem for dissertation.

Term Work:

The Dissertation-I shall consist of collection of literature from a chosen field of Structural Engineering from various sources. The candidate shall formulate/define analytical and/or experimental problem for carrying out dissertation work. The candidate shall prepare a technical report in a prescribed format and present before a panel of examiners consisting of guide and two faculty members of the department.

Evaluation:

1. The term-work shall be evaluated by the guide based on the volume of quality literature collected, quality of the technical report prepared and extent of problem formulation/definition.
2. The viva voce examination shall be conducted by panel of examiners based on the presentations.

AM 616: Dissertation-II

Teaching Scheme		**Evaluation Scheme**	
Practical	28 Hrs/Week	Viva voce	150 Marks
Tutorials		Term Work	50 Marks
Total Credits	14		

Prerequisites:

Students should have completed Dissertation-I satisfactorily.

Course Objectives:

Student will carry out analytical and/or experimental research oriented work in the field of structural engineering.

Course Outcomes:

On successful completion of the course, students will be able:

1. To appraise literature in a given field of structural engineering.
2. To identify and formulate problem in structural engineering based on appraisal of literature/field condition.
3. To solve the identified problem using appropriate methodology.
4. To interpret, discuss debate and draw conclusions.
5. To write and present technical paper based on the research work.

Term Work:

The Dissertation-II shall consist of a complete analytical and/or experimental work in Structural Engineering containing literature survey, problem formulation, solution, results, interpretations, discussions and conclusions certified by guide and an internal evaluation committee. The candidate shall prepare a technical report in a prescribed format and present before a panel of examiners consisting of guide and two faculty members of the department before final submission in spiral bound.

Evaluation:

1. The term-work shall be evaluated by the guide based on the completeness of the work, minimum one paper publication in Conference/Journal and pre-submission presentation before internal evaluation committee.
2. The viva voce examination shall be conducted by a panel of examiners consisting of guide and external examiner outside the university appointed by the Chairman, Examination Committee.