Scheme and Syllabus

of

Bachelor of Engineering

in

Civil Engineering

Third Semester to Eighth Semester

Academic Year 2018-19

Panjab University

Chandigarh

Vision

To establish an outstanding centre of excellence for providing a quality engineering education to the students and services to the professional and the community; to produce highly competent Civil Engineers and to employ principles of continual quality improvement to enhance its programme and faculty.

Mission

a) To serve the people of the Society by providing a broad and high quality education to its student for a successful professional career.

b) To conduct strong base and knowledge for innovation.

c) To serve the Construction Industry; Civil Engineering Profession through dissemination of knowledge and technical services.

Program Education Objectives (PEO)

1. To train the students so that they can work and contribute to the infrastructure development projects being undertaken by Govt. and Private or any other sector companies.
2. To train students in such a way that they can pursue higher studies and contributes to the teaching profession/ research and development of Civil Engineering and other allied fields.
3. To train students in a manner that they should function effectively in the multicultural and multidisciplinary groups for the sustainable development and growth of civil engineering projects and profession.

Program Outcomes (PO)

A. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
B. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
C. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
D. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
E. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
F. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

G. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
H. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
I. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
J. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
K. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
L. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Scheme of the B.E. (Civil) Program

Semester III Year II										
Sr. No	**Course Code**	**Course Title**	**Scheme of Teaching**					**University External Marks**	**Internal Sessional Marks**	**Total**
			L	**T**	**P**	**Hrs**	**Credit**			
1	CIV 301	Surveying and Levelling	3	1	0	4	4	50	50	100
2	CIV 302	Solid Mechanics	3	1	0	4	4	50	50	100
3	CIV 303	Structural Analysis I	3	1	0	4	4	50	50	100
4	CIV 304	Transportation Engg. I	3	1	0	4	4	50	50	100
5	CIV 306	Fluid Mechanics II	3	1	0	4	4	50	50	100
6	CIV 351	Surveying Lab	0	0	2	2	1	-	50	50
7	CIV 352	Solid Mechanics Lab	0	0	2	2	1	-	50	50
8	CIV 354	Transportation Engg. Lab	0	0	2	2	1	-	50	50
TOTAL			**15**	**5**	**6**	**26**	**23**	**250**	**400**	**650**

Semester IV Year II										
Sr. No	**Course Code**	**Course Title**	**Scheme of Teaching**					**University External Marks**	**Internal Sessional Marks**	**Total**
			L	**T**	**P**	**Hrs**	**Credit**			
1	CIV 401	Design of Concrete Structures- I	3	1	0	4	4	50	50	100
2	CIV 402	Structural Analysis II	3	1	0	4	4	50	50	100
3	CIV 404	Transportation Engg. II	3	1	0	4	4	50	50	100
4	CIV 405	Concrete Technology	3	1	0	4	4	50	50	100
5	CIV 406	Disaster Management	3	1	0	4	4	50	50	100
6	CIV 407	Engineering Geology	3	1	0	4	4	50	50	100
7	CIV 451	Design of Concrete Structures - Lab	0	0	2	2	1	-	50	50
8	CIV 453	RCD Drawing-I	0	0	2	2	1	-	50	50
TOTAL			**18**	**6**	**4**	**28**	**26**	**300**	**400**	**700**
SURVEY PRACTICAL TRAINING OF 10 DAYS AFTER IV SEMESTER										

Semester V Year III

Sr. No	Course Code	Course Title	Scheme of Teaching					University External Marks	Internal Sessional Marks	Total
			L	T	P	Hrs	Credit			
1	CIV501	Construction Planning and Management	3	1	0	4	4	50	50	100
2	CIV502	Design of Concrete Structures- II	3	1	0	4	4	50	50	100
3	CIV 503	Geotechnical Engg.	3	1	0	4	4	50	50	100
4	CIV 504	Environmental Engg. I	3	1	0	4	4	50	50	100
5	CIV553	Geotechnical Engg.Lab	0	0	2	2	1	-	50	50
6	CIV 555	Survey Practical Training	-	-	-	-	4	-	50	50
7	CIV 552	RCD Drawing –II	0	0	2	2	1	-	50	50
8	CIV 554	Software Lab	0	0	2	2	1	-	50	50
TOTAL			**12**	**4**	**6**	**22**	**23**	**200**	**400**	**600**

Semester VI Year III

Sr. No	Course Code	Course Title	Scheme of Teaching					University External Marks	Internal Sessional Marks	Total
			L	T	P	Hrs	Credit			
1	CIV 601	Design of Steel Structures –I	3	1	0	4	4	50	50	100
2	CIV 602	Irrigation Engg.	3	1	0	4	4	50	50	100
3	CIV 603	Estimation and Rate Analysis	3	1	0	4	4	50	50	100
4	CIV 604	Environmental Engg. II	3	1	0	4	4	50	50	100
5	CIV 605	Foundation Engg.	3	1	0	4	4	50	50	100
6	CIV 653	Steel Drawing-I	0	0	2	2	1	-	50	50
7	CIV 654	Environmental Engg. Lab	0	0	2	2	1	-	50	50
8	CIV 655	Foundation Engg. Lab	0	0	2	2	1	-	50	50
TOTAL			**15**	**5**	**6**	**26**	**23**	**250**	**400**	**650**

INDUSTRIAL PRACTICAL TRAINING OF 4 WEEKS AFTER 6TH SEMESTER

Semester VII Year IV										
Sr. No	**Course Code**	**Course Title**	**Scheme of Teaching**					**University External Marks**	**Internal Sessional Marks**	**Total**
			L	**T**	**P**	**Hrs**	**Credit**			
1	CIV 701	Design of Steel Structures –II	3	1	0	4	4	50	50	100
2	CIV 702	Design of Hydraulic Structures	3	1	0	4	4	50	50	100
3	CIV 703	Hydrology and Dams	3	1	0	4	4	50	50	100
4	CIV-704 CIV 705 CIV 706	Elective-I Bridge Engineering Hydropower Engg Dynamics of structures	3	1	0	4	4	50	50	100
5	CIV 751	Steel Drawing-II	0	0	2	2	1	-	50	50
6	CIV 753	Project-I	0	0	4	4	2	-	50	50
7	CIV 754	Industrial Practical Training	-	-	-	-	4	-	100	100
TOTAL			**12**	**4**	**6**	**22**	**23**	**200**	**400**	**600**

Option I **Semester VIII Year IV**

Sr. No	**Course Code**	**Course Title**	**Scheme of Teaching**					**University External Marks**	**Internal Sessional Marks**	**Total**
			L	**T**	**P**	**Hrs**	**Credit**			
1	CIV 801	Advanced Environmental Engg	3	1	0	4	4	50	50	100
2	CIV 802	Computational methods	3	1	0	4	4	50	50	100
3	CIV 803	Maintenance of Buildings	3	1	0	4	4	50	50	100
4	CIV 804 CIV 805 CIV 806	Elective-II Advanced Transportation Engg. Prestressed Concrete design Earthquake Resistant Design of Structures	3	1	0	4	4	50	50	100
5	CIV 853	Seminar	0	0	2	2	1	-	50	50
6	CIV 854	Project-II	0	0	8	8	4	-	150	150
TOTAL			**12**	**4**	**6**	**26**	**21**	**200**	**400**	**600**
Option II			**CREDITS =21**							
			University External Marks					**Internal assessment marks**		
1	CIV 808	Industrial Training	300					300		

Course Title:			**Surveying-and Levelling**		
Course Code:			**CIV-301**	**Classification:**	**Compulsory Core**
Credits:			**4**	**Contact Hours:**	**4**
1	**Pre-requisites :**		**None**		
2	**Course Objectives**		The objective of the subject is to learn surveying basics, techniques for drawing maps in plane and hiily areas and to give them knowledgee about advances in surveying.		
3	**Course Outcomes**		On successful completion of this course, students will be able to **1.** Familiarize with different kinds of surveying and instruments used. **2.** Carry out leveling of an area and draw contour map. **3.** Do plane table surveying and solve 2- and 3-point problems. **4.** Knowledge of advancemets in surveying **5.** Prepare topographic map of an area using traversing.		
4	**Examination Pattern [End Term Exam]**		Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus:**		**45 Lecture Hours**		
			Section A		
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Compass Surveying	1	Basic principles of Surveying, Traverses, Meridians, Bearings, Included angles from bearing and vice versa, Prismatic Compass, Surveyor's compass, Field work for compass traverse, Plotting and adjustment errors		6 hours
6.02	Unit 2 Levelling & Contouring	1, 2	Basic definitions, Simple Leveling, Terms in Leveling, Precautions, and Differential Leveling. Field Book for Leveling, Profile leveling & Cross-sectioning, Contour Characteristics, Direct & Indirect methods of Contouring		6 hours
6.03	Unit 3 Plane Table Surveying	2	Plane Table and its accessories, Principle, Basic definitions, setting and orienting the plane table, methods of plane tabling, Three point problem, Two point problem.		6 hours
6.04	Unit 4 Theodoite Traversing	2	Basic definitions, Temporary and permanent adjustments, Measuring horizontal and vertical angle,Balancing angles of the traverse,latitudes and departures, consecutive and independent coordinates,Gales Traverse Table		6 hours
			Section B		
6.05	Unit 5 Curves	3,5	Basic Definitions,Degree of Curve,Elements of curve,Setting out of curves with and without theodolite,Combined circular and transition curves		6 hours
6.06	Unit 6 Elements of photogrammetry	4,5	Introduction,Types of photographs,Geometery of aerial photograph,Flying height and scale,Relief displacement in vertical photograph, Stereoscopy, Measurement of parallax and height determination		6 hours
6.07	Unit 7 Remote Sensing	4,5	Introduction, Principle of electromagnetic remote sensing,Remote sensing classification, Imaging characteristics, Extraction of Metric Information from remotely sensed data		6 hours
6.08	Unit 8 Advances in Surveying	4,5	Introduction to GPS & GIS, Components of GIS & GPS, Working principle of GPS, Raster & Vector data representation in GIS and Data analysis		7 hours
			Evaluation/Assessment		
7.1	**Internal Assessment**		**50 (Class Teacher)**		
7.1.1	Assignments/ Quizzes/		15(Minimum 2 Mandatory Assignments)		

	Class Test	
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	30 (Best of two MTEs)
7.2	**External Assessment (End Term Exam)**	**50**
Text Books		
8.1	Dr. K.R. Arora, Surveying Vol. I & II Standard Book House, New Delhi.	
8.2	Dr. B.C. Punmia, Surveying Vol. I & II Luxmi Publications, New Delhi.	
8.3	Dr. S.K. Duggal: Surveying Vol. I & II Tata McGraw Hill, New Delhi.	
8.4	Y. R. Nagraga & A.	
8.5	Veeraragavan; Surveying Vol. I, Nem Chand Bros., New Delhi	
8.6	C. Venkatramaish Text Book of Surveying, University Press (India) Limited, Hydrabad	
9	Software Required	None
10	Pedagogical Methods	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title:			**Solid Mechanics**		
Course Code:			CIV-302	**Classification:**	Compulsory Core
Credits:			4	**Contact Hours:**	4
1	**Pre-requisites :**		**Knowledge of static equilibrium and static state of body**		
2	**Course Objectives**		The objective of the subject is to equip the students with the understanding of stress and strain and their resultants.		
3	**Course Outcomes**		On successful completion of this course, students will be able to: **1.** To understand the different properties of solid. **2.** To understand the concepts of bending and shear. **3.** To draw the SFD and BMD for any indeterminate structures. **4.** To understand various theories used to understand the behavior of a structure.		
4	**Examination Pattern [End Term Exam]**		Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus:** 45 Lecture Hours				
			Section A		
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Introduction	1,3	Load, reaction; General equilibrium equations; Equilibrium of a point in space; Equilibrium of a member, Concept of free body diagrams Important mechanical properties- Elasticity, Plasticity, Ductility, Brittleness, Malleability, Toughness, Hardness, Strength. Classification of structures		4hrs
6.02	Unit 2 Simple Stress & Strain	1, 3	Introduction, Concept of stress and strain, Stress-strain curves for ductile, brittle materials, Generalized Hooke's law, stress-strain diagram of ductile and brittle material, statically determinate and indeterminate problems, compound and composite bars, thermal stresses. Elastic constants, relations between various elastic constants and its use, Lateral strain, volumetric strain, poisons ratio.		6 hrs
6.03	Unit 3 SFD & BMD	4	Introduction to the concept of reaction diagrams—shear force and bending moment, Role of sign conventions, Types of load, beams, supports, Shear force and bending moment diagrams: simply supported, overhang and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load, and moment, Relationship between load, shear force and bending moment, Different methods for plotting a bending moment and shear force diagrams. Assumptions and derivation of flexural formula for straight beams.		9 hrs
			Section B		
6.04	Unit 5 Complex Stress & Strain	3, 6	Introduction, Normal stress, tangential stress, Rectangular block subjected to normal stress along and across two planes, combination of normal and tangential stress, Concept of principal stress and its computation, Mohr circle, Principal strains, computation of principal stresses from the principal strains.		4 hrs
6.05	Unit 4 Sectional Properties	1, 3	Introduction, Centroid of simple and built up section, second moment of area, Bending stress calculation for beams of simple and built up section, composite sections (flitched sections), Shear stress, Variation of bending and shear stress along the depth of section. Combined direct and bending stresses, Middle third rule.		10 hrs
6.06	Unit 6 Strain Energy	4	Introduction, Load deflection curve, Resilience and Impact Loading, Strain energy for gradually applied, Strain energy for suddenly applied, Strain energy for impact loading and shear stress.		4 hrs
6.07	Unit 7 Circular Shaft	5	Torsion, basic assumptions, derivation of torsion equation, Power transmitted by shafts, analysis and design of solid and Hollow shafts based on strength and stiffness, Sections under combined bending and torsion, equivalent bending and torsion.		5 hrs
6.08	Unit 8 Failure Theory	4	Maximum principal stress theory, Maximum shear stress theory, Distortion Energy theory, Strain Energy theory.		3 hrs

Evaluation/Assessment:		
7.1	**Internal Assessment**	**50** (Class Teacher)
7.1.1	Assignments/ Quizzes/ Class Test	15(Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**
7.2	**External Assessment (End Term Exam)**	**50**
Text Book		
8.1	Strength of Material S. Ramamrutham by TMH	
8.2	Mechanics of Material B.C.Punmia, Luxmi Publications	
8.3	Strength of Material R.K. Rajput, S. Chand Publications	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title:			**Structural Analysis I**		
Course Code:			CIV-303	**Classification:**	Compulsory Core
Credits:			4	**Contact Hours:**	4
1	**Pre-requisites :**		**Knowledge of static equilibrium and static state of body**		
2	**Course Objectives**		The objective of the subject is to equip the students with the basics of analysis of structures. The main aim is to let the students understand the various conventional methods of analysis of determinate structures.		
3	**Course Outcomes**		On successful completion of this course, students will be able to: **1.**To understand the concepts of static analysis of structure. **2.**To analyze the behavior of columns/compression members **3.**To understand the different parameters of analysis. **4.**To understand the behavior of hollow sections **5.**To understand the behavior of determinate structure under moving load. **6.**To draw the SFD and BMD for any determinate structures.		
4	**Examination Pattern [End Term Exam]**		Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus:** 45 Lecture Hours				
Section A					
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Introduction	1,3	static determinacy, degree of freedom and stability of structure, Principal of superposition		3 hrs
6.02	Unit 2 Determinate Truss	1, 3	Introduction, determination of forces in member of trusses by method of joints, method of sections		5 hrs
6.03	Unit 3 Thin Cylinder & Sphere	4	Introduction, stresses and strains in thin cylinders and spherical shell, volumetric change, thin vessels subjected to internal pressure.		4 hrs
6.04	Unit 4 Column	5	Definitions and examples of instability of columns; criteria for stability of columns, Euler's theory of columns buckling, Euler's equation for various end restraints, Rankine formula.		6 hrs
Section B					
6.05	Unit 5 Deflection in Determinate Beam	3, 6	Double Integration Method and Macaulay's Method, moment area method, conjugate beam method, unit method and strain energy method. Maxwell's reciprocal theorem.		10 hrs
6.06	Unit 6 ILD & Rolling Load	4	Construction of Influence lines for reaction, shear forces and bending moment for simply supported beams, Influence lines for forces in members of frames Determination of shear force, bending moment at a section and absolute shear force and bending moment due to single point load, uniformly distributed load, several point loads etc.		8 hrs
6.07	Unit 7 Dam & Retaining Wall	1, 3	Introduction, limit of eccentricity for no tension in the section, core of the section, middle third rule		4 hrs
6.08	Unit 8 Arches	4	Introduction and types of Arch, Analysis of three hinged arches for Point Loads and UDL, Influence lines for horizontal thrust, shear force, bending moment, radial shear and normal thrust for three hinged arch.		5 hrs
Evaluation/Assessment:					
7.1	**Internal Assessment**		**50** (Class Teacher)		
7.1.1	Assignments/		15(Minimum 2 Mandatory Assignments)		

	Quizzes/ Class Test	
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**
7.2	**External Assessment (End Term Exam)**	**50**
Text Book		
8.1	Theory of Structures Vol 1 B. C. Punamia and Jain Laxmi Publication	
8.2	Strength of Materials R. S. Khurmi, S. Chand	
8.3	Structural Analysis (I&II) S.S. Bhavikatti, Vikas Publishing House	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title		Transportation Engineering-I		
Course Code		CIV-304	**Classification**	Compulsory Core
Credits		4	**Contact Hours**	4
1	**Pre-requisites**	**Fundamental knowledge about roads**		
2	**Course Objectives**	**1.** To Study highway project planning fundamentals **2.** To prepare students to apply their understanding of highway geometric elements **3.** Sustainable and effective useof engineering approach for designing various elements of road		
3	**Course Outcomes**	On successful completion of this course,students will be able to Demonstrate and Apply the use of **1.**Geometric design of road elements **2.** Types of materials and construction 3. Failures in construction 4. Types of highways 5. Surveys required for highway construction		
4	**Examination pattern**	Examiner will set 7 questions ofvequaal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each snd the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus: 4**5 Lecture Hours;			

SECTION A				
6.00	**Units**	**Course Outcome Covered**	**Contents**	**Lecture Hours**
6.01	Unit 1 Introduction	5	Principles of Highway Planning, Classification of roads, Highway alignment, Basic requirements of ideal alignment, Factors controlling alignment in plain & hill roads, Engineering surveys for highway alignment	05 hours
6.02	Unit 2 Highway Geometric design	1	Cross-section Elements, camber, Sight distances, carriageway, horizontal curves, Extra-widening, Super-elevation, vertical curves	06 hours
6.03	Unit 3 Highway materials	2	Properties of Sub grade & Pavement Component materials, Tests on sub-grade soil, Aggregates and Bituminous material	06 hours
6.04	Unit 4 Highway construction	2,3	Earthen/gravel Roads, Water Bound Macadam, Wet Mix Macadam, Bituminous Pavements, Cement Concrete Pavements	06 hours
SECTION B				
6.05	Unit 5 Highway Maintenance	2,3	Pavement Failures, Pavement Evaluation, Maintenance and Strengthening measures	06 hours
6.06	Unit 6 Traffic characteristics	1,2,3,4	Road User Characteristics, Driver Characteristics, Vehicular Characteristics	05 hours
6.07	Unit 7 Traffic Studies	2,3,4	Volume & Speed Studies, O-D Surveys, Parking Study	04 hours
6.08	Unit 8 Traffic Safety	1,5	Causes and types of accidents, Use Of ITS	03 hours
6.09	Unit 9 Highway control Measures	1	Road Signs, Road markings, Road Islands, Road Signals	04 hours

Evaluation/Assessment		
7.1	**Internal Assessment**	**50** (Subject Incharge)
7.1.1	Assignments/Quizzes/Class Test	15(Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	30 (Best of two MTEs)
7.2	**External Assessment (End Term Exam)**	**50**(Subject Incharge)

Text Book		
8.1	Khanna S.K.,and Justo,C.E.G. " Highway Engineering", Nem Chand and Brothers,Roorkee,2014.	
8.2	Kadiyali,L.R." Principles and Practice of Highway Engineering", khanna publishers,New Delhi,2002	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ PPT/ Live Examples/ Group Discussion/study Tours and Task

Course Title:		**Fluid Mechanics II**			
Course Code:		CIV-306	**Classification:**	Compulsory Core	
Credits:		4	**Contact Hours:**	4	
1	**Pre-requisites :**	Fluid Mechanics-I			
2	**Course Objectives**	1. The objective of the course is to give information about the application of different types of flows and also to study how the hydraulic energy can be used in hydraulic machines. 2. The course will detail about the variations in the design of the channels based on the type of flow and obstructions carried by them such as contractions and humps etc. The various designs of irrigation structures to be learnt are based on the basics studied in this class.			
3	**Course Outcomes**	1. The student would be able to learn the basic equations and concepts related to their application for designing various types of open channels. 2. Apart from study of channels, the students will also learn about the impact of free jets on various types of plates and apply this information on the topics of turbines and pumps and hence the hydroelectric generation plant. 3. Overall, this course will give a general overview of fluid processes taking place within channels and will be helpful to apply in other courses of Civil engineering.			
4	**Examination Pattern [End Term Exam]**	Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			
5	**Outline Syllabus:** 45 Lecture Hours				
Section A					
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	1	1	Flow classifications, Basic resistance Equation for open channel flow. Chezy, Manning, Bazin and Kutter formulae. Variation of roughness coefficient, Conveyance and normal depth, Velocity Distribution. Most efficient flow sections; rectangular, trapezoidal and circular.		5 hrs
6.02	2	1,3	Energy and specific Energy in an open channel; Critical depth for rectangular and trapezoidal channels. Momentum and specific force in open channel flow, Alternate depths and Sequent depths, Applications of specific energy to transitions and Broads crested weirs.		5 hrs
6.03	3	1,3	Different Equation of water surface profile; limitation, properties and classification of water and surface profiles with examples, Computation of water surface profile by graphical, numerical and analytical approaches.		5 hrs
6.04	4	1,2,3	Theory of Jump, Elements of jump in a rectangular Channel, length and height of jump, location of jump, Energy dissipation and other uses, Surge as a moving hydraulic jump. Positive and negative surges.		5 hrs
Section B					
6.05	1	1,3	Drag and lift: deformation Drag and pressure drag. Drag on a sphere, cylinder and Airfoil: Lift-Magnus Effect and circulation, lift on a circular cylinder.		5 hrs
6.06	2	1,3	Force exerted by fluid jet on stationary flat plate, Force exerted by fluid jet on moving flat plate, Force exerted by fluid jet on stationary curved vane, Force exerted by fluid jet on moving curved vane.		5 hrs
6.07	3	1,2,3	Head and efficiencies of hydraulic turbines, Work done and efficiencies of Pelton Wheel, Francis and Kaplan turbines, Surge tanks.		5 hrs
6.08	4	1,2	Main components and working of reciprocating pumps, Work done by single and double acting pumps, Coefficients of discharge, slip, percentage slip and negative slip of reciprocating pumps.		5 hrs

6.09	5	2,3	Main components and working of centrifugal pumps, Work done by impeller Head of Pump, Losses and efficiencies, Specific speed, NPSH, Cavitation in centrifugal pumps.	5 hrs
Evaluation/Assessment:				
7.1	**Internal Assessment**		**50** (Class Teacher)	
7.1.1	Assignments/ Quizzes/ Class Test		15(Minimum 2 Mandatory Assignments)	
7.1.2	Attendance		5(Depends upon Percentage of Attendance in Class)	
7.1.3	Mid Term Exam		**30 (Best of two MTEs)**	
7.2	**External Assessment (End Term Exam)**		**50**	
Text Book				
8.1	Hydraulic and Fluid Mechanics, Modi and Seth, Standard Book House, Delhi			
8.2	Flow in open channel , Subramanya K. McGraw Hill.			
8.3	Fluid Mechanics, R. J. Garde and A. Z. Mirjaguaker			
9	**Software Required**		None	
10	**Pedagogical Methods**		White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task	

Course Title:		**Surveying Lab**		
Course Code:		CIV-351	**Classification:**	Compulsory Core (P)
Credits:		1	**Contact Hours:**	2
	Outline Syllabus: 26 Lecture Hours			
1.00	**Experiment/Problem**	**Content**		
1.01	Lab Expt./Problem 01	Measurement of bearing and angles with compass, adjustment of traverse by graphical method.		
1.02	Lab Expt./Problem 02	To perform leveling of a given area and draw contour map.		
1.03	Lab Expt./Problem 03	Plane table survey, different methods of plotting two point & three point problem.		
1.04	Lab Expt./Problem 04	Setting up temporary and permanent adjustment of a theodolite. Measurement of horizontal angles by repetition and reiteration methods using a theodolite.		
1.05	Lab Expt./Problem 05	Setting out of a curve by Rankine,s method of tangential angles		
1.06	Lab Expt./Problem 06	Setting out of a curve by offsets from the chords produced		
1.07	.Lab Expt./Problem 07	Remote Sensing: Pocket and Mirror Stereoscopes, Stereo Vision test for3-D studies, Study of aerial photograph under stereoscopes.		
1.08	.Lab Expt./Problem 08	Use of GPS softwares: To determine the coordinates of a station by point positioning.		
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5 (Depends upon percentage of attendance in class)		
2.03	Mid Term Viva-Voce	**30 (Best of two)**		
3.00	Software Required	AutoCAD.		
4.00	Pedagogical Methods	White/Black Board/PPT/Video Lectures/ Lab Work using equipments/Computers/Printers.		

Course Title:		**Solid Mechanics Lab**		
Course Code:		CIV-352	**Classification:**	Compulsory Core
Credits:		1	**Contact Hours:**	2
	Outline Syllabus: 26 Lecture Hours			
		Section A		
1.00	**Expt./Problem**	**Content**		
1.01	Lab Expt./Problem 01	To determine the Hardness of the given Specimen using Rockwell hardness test		
1.02	Lab Expt./Problem 02	To determine the Hardness of the given specimen using Brinell hardness test		
1.03	Lab Expt./Problem 03	Determine the Impact strength through Izod test and Charpy test		
1.04	Lab Expt./Problem 04	Draw Stress Strain curve for Ductile and Brittle material in tension		
1.05	Lab Expt./Problem 05	Draw Stress Strain curve for Ductile and Brittle material in compression		
1.06	Lab Expt./Problem 06	Draw shear stress, shear strain curve for ductile and brittle material in torsion strength testing		
1.07	Lab Expt./Problem 07	Draw load deflection curve for spring in loading and unloading conditions		
1.08	Lab Expt./Problem 08	To determine the load carrying capacity of the leaf spring		
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5(Depends upon Percentage of Attendance in Class)		
2.03	Mid Term Viva-Voce	**30 (Best of two)**		
3	Software Required	**AutoCAD**		
4	Pedagogical Methods	**White/Black Board/ PPT/ Video Lecture/ Lab Equipments/Computers/Printers**		

Course Title:		**Transportation Engineering Lab**		
Course Code:		CIV-354	**Classification:**	Compulsory Core
Credits:		1	**Contact Hours:**	2
	Outline Syllabus: 26 Hours			
		Section A		
1.00	**Expt./Problem**	**Content**		
1.01	Lab Expt./Problem 01	Sieve Analysis of fine and coarse aggregates, Specific Gravity and Water Absorption Test		
1.02	Lab Expt./Problem 02	Aggregate Crushing Value Test		
1.03	Lab Expt./Problem 03	Aggregate Impact Value Test		
1.04	Lab Expt./Problem 04	Los Angles Abrasion Value Test		
1.05	Lab Expt./Problem 05	Aggregate Soundness Test, Flakiness Index and Elongation Index Test		
1.06	Lab Expt./Problem 06	Penetration Test of bitumen		
1.07	Lab Expt./Problem 07	Ductility Test of bitumen		
1.08	Lab Expt./Problem 08	Softening Point Test and Viscosity Test		
1.09	Lab Expt./Problem 09	Flash Point and Fire Point Test		
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5(Depends upon Percentage of Attendance in Class)		
2.03	Mid Term Viva-Voce	**30 (Best of two)**		
3	Software Required	**AutoCAD**		
4	Pedagogical Methods	**White/Black Board/ PPT/ Video Lecture/ Lab Equipments/Computers/Printers**		

	Course Title	**Design of Concrete Structures -I**		
	Course Code	**CIV - 401**	**Classification:**	**Compulsory Core**
	Credits	**4**	**Contact Hours**	**4**
1	**Pre- requisites**	**Knowledge of Basic Constituents of Reinforced Concrete**		
2	**Course Objectives**	The objective of the subject is to understand the different design theories and make the students efficient in the design of various basic structural components.		
3	**Course Outcomes**	On successful completion of this course, students will be able to **1.** Explain the difference in methods of design of structural components **2.** Design basic components such as Beams, Columns, Slabs, footings and Staircase. **3.** Follow the BIS codal Provisions for the structural component design **4.** Understand the difference in various types of beams and their utility according to the situation. **5.** Understand the various concepts of one way, two way slabs and other structural components **6.** Apply all the necessary checks to make the designs safe. **7.** Learn about the various design consideration used in Earthquake resistant design.		
4.	**Examination pattern (End Term Examination)**	The examiner will set total seven questions. First Question is compulsory covering whole syllabus (ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part. Use of IS 456-2000, SP–16(Charts only), IS 1893:2002 is allowed.		
5	**Outline Syllabus: lectures/ Contact Hours: 45**			
		Section A		
6.00	**Units**	**Course Outcome Covered**	**Content**	**Lecture Hours**
6.01	Unit 1 Introduction to Limit State Design Method	1	Reinforced concrete, definition, properties of materials, grades of concrete and reinforcing steel, stress-strain curves for concrete & steel , permissible stresses, design philosophies working stress design, ultimate strength and limit state design method.	5hrs
6.03	Unit 2 Design of Beams	1,2,3,4,6	Design of singly reinforced & doubly reinforced rectangular beam sections in Flexure, Shear, Check it for Development length and Deflection. Design of Flanged Sections , Introduction to Bond & Torsion using Limit State method	10hrs
6.04	Unit 3 Design of Footings	2	Types of footings, Design of isolated footing under Axial and eccentric loading , combined footing (rectangular and trapezoidal)	4hrs
Section B				
6.05	Unit 4 Design of Slabs	3,5,6	Design of one-way slab and two-way rectangular slab using IS 456 for various boundary conditions, detailing of reinforcement in slab	8HRS
6.06	Unit 5 Design of Columns	2	Limit State of Collapse (Compression) Columns and their classification, reinforcement in columns, assumptions, short columns subjected to axial load, short columns subject to axial, uniaxial and biaxial bending (using SP:16).	8hrs
6.07	Unit 6 Design of staircase	2,6	Introduction to various types of stairs, Terminology, design of dog legged stair.	4hrs
6.08	Unit 7 Earthquake resistant design	7	Concepts of seismic design, Provisions of IS: 1893-2002 for lateral loads, Provisions of IS: 4326, Provisions of IS: 13920	3hrs
7	**Evaluation/Assessment:**	**50 (Internal)**		
7.1	**Internal Assessment**	**50** (Class Teacher)		
7.1.1	Assignments / Quizzes/ Class Test	15 (Minimum two Mandatory Assignments)		
7.1.2	Attendance	5 (Depends upon Percentage of attendance in Class)		

7.1.8	Sessional	30 (One best of 2)
7.2	**External Assessment (End Term Exam)**	**50**
	Text books	
8.1	A.K. Jain , “Limit State Design”, Nem Chand & Bros. Roorkee	
8.2	N. Krishna Raju, R.N. Pranesh ,”Reinforced Concrete Design”, New Age Internation Publisher	
8.3	Punmia & Jain, “Reinforced Concrete Structures”, Luxmi Publications.	
8.4	Pankaj Aggarwal & Manish Srikhande, “Earthquake Resistant Design of Structures “, Prentice Hall of India	
8.5	M.L. Gambhir, “Concrete Technology” McGraw Hill	
8.6	IS: 1893-2002, Indian Standard Criteria for Earthquake Resistant	
8.7	Design of Structures, Part I, General Provisions, BIS, New Delhi	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Group Discussion and Task

Course Title:			**Structural Analysis II**		
Course Code:			CIV-402	**Classification:**	Compulsory Core
Credits:			4	**Contact Hours:**	4
1	**Pre-requisites :**		**Knowledge of Structural Analysis I**		
2	**Course Objectives**		The objective of the subject is to equip the students with the basics of analysis of structures. The main aim is to let the students understand the various conventional methods of analysis of indeterminate structures.		
3	**Course Outcomes**		On successful completion of this course, students will be able to: **1.** To understand the concepts of static analysis of structure. **2.** To analyze the behavior of columns/compression members **3.** To understand the different parameters of analysis. **4.** To understand the behavior of hollow sections **5.** To understand the behavior of indeterminate structure under moving load. **6.** To draw the SFD and BMD for any indeterminate structures.		
4	**Examination Pattern [End Term Exam]**		Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus:** 45 Lecture Hours				
Section A					
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Introduction	1,3	Introduction to statically indeterminate structures, Static and Kinematic indeterminacy, Compatibility Equations, Influence lines for indeterminate structures using Muller Breslau's Principle.		4 hrs
6.02	Unit 2 Force Method	1, 3	Method of Consistent Deformation, Three moment theorem, Analysis of Fixed subjected to point loads and UDL, sinking and rotation of support in fixed beam.		5 hrs
6.03	Unit 3 Moment Distribution Method	4	Introduction, absolute and relative stiffness of members, stiffness and carry-over factors, distribution factors, analysis of statically indeterminate beams and rigid frames (sway and non-sway type) due to applied loads and uneven support settlements.		7 hrs
6.04	Unit 4 Slope Deflection Method	1, 3	Introduction, slope-deflection equations, analysis of statically indeterminate beams and rigid frames (sway and non-sway type) due to applied loads and uneven support settlements. Lateral load analysis of multistory frames, portal method and cantilever method		6 hrs
Section B					
6.05	Unit 5 Strain Energy Method	3, 6	Strain energy for linear elastic system, Castigliano's first theorem and its application for deflection calculation in beams and rigid frames, minimum strain energy theorem, Castgliano's second theorem and its application for analysis of beams and rigid frames, unit load method and its application for analysis of beams and frames		7 hrs
6.06	Unit 6 Column	4	Analysis and deflection calculation using Minimum Strain Energy Theorem, Castigliano's theorems and Unit load Method.		4 hrs
6.07	Unit 7 Two Hinged Arch	5	Analysis of two Hinged Arches, Shear Force and Normal Thrust, Effect of Rib Shortening, Parabolic Arch subjected to concentrated load and UDL, Circular Arches, Reaction Locus, Influence lines		7 hrs
6.08	Unit 8 Cable & Suspension Bridge	4	Introduction, shape of a loaded cable, cable carrying point loads and UDL, cables with ends at different level, suspension bridge with two hinged and three hinged stiffening girders.		5 hrs
Evaluation/Assessment:					
7.1	**Internal Assessment**		**50** (Class Teacher)		
7.1.1	Assignments/ Quizzes/ Class Test		15(Minimum 2 Mandatory Assignments)		

7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**
7.2	**External Assessment (End Term Exam)**	**50**
Text Book		
8.1	Theory of Structures Vol 2 B. C. Punamia and Jain Laxmi Publication	
8.2	Structural Analysis (I&II) S.S. Bhavikatti, Vikas Publishing House	
8.3	Indeterminate Structures R. L. Jindal, S. Chand	
8.4	Theory of Structures S Ramamrutham Dhanpat Rai Publication	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title		Transportation engineering-II		
Course Code		CIV-404	**Classification**	Compulsory core
Credits		4	**Contact hours**	4
1	**Pre-Requisites**	**Transportation Engineering I**		
2	**Course Objectives**	**1.** To study various design elements of railways **2.** To design various design elements of a railway track **3**. Airport design elements and basis of their design		
3	**Course Outcomes**	On successful completion of this course, students will be able to Demonstrate and Apply the use of **1.** Geometric design of railway elements **2.** Types of materials and construction for various track fittings 3. Signals in railways 4. Airports and their layout 5. Drawing of wind rose diagram		
4	**Examination Pattern**	Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus:** 45 Lecture Hours			
SECTION A				
6.00	**Units**	**Course Outcome Covered**	**Contents**	**Lecture hours**
6.01	Unit 1 Introduction to railway Engineering	1,2	Development of Indian Railways, Organization of Indian railways	01
6.02	Unit 2 Railway Gauges	1,2	Definition of gauge, Choice of gauges, Uniformity of gauges, Loading and Construction gauge, Gauges on world railways	02
6.03	Unit 3 Railway tracks	1,2	Requirements of a good track, Track specifications on Indian railways, Detailed cross-section of Single/Double track on Indian Railways	**03**
6.04	Unit 4 Components of Railway Tracks	1,2	Rails: functions, composition of rail steel, requirement, selection of rail sections, Buckling of rails Sleepers: Functions, requirement & classification, Track fixtures and fastenings: purpose & types, Ballast: functions, Requirements & types, Coning of wheels, Tilting of rail, Rail Joints: an ideal rail joint, types & creep of rails	07
6.05	Unit 5 Geometric Design of Railway Tracks	1,2	Alignment of tracks, Gradients, Horizontal curves, Super-elevation, Equilibrium cant, Cant-Deficiency, transition Curves	**06**
6.06	Unit 6 Points and Crossings	1,2	Functions, Various structures provided in turnouts and its working, Types of track junctions & their layout	04
SECTION B				
6.07	Unit 7 Railway stations and yards	1,2	Site selection for a station, Marshalling Yard, locomotive yard, Equipments at railway stations, Classification of railway stations	05
6.08	Unit 8 Signalling & Interlocking	1,2,3	Objectives, Types of signals in stations and yards, Automatic Signalling & Interlocking	04
6.09	Unit 9 Airport	4	Aircraft characteristics, factors for site selection, Airport classification, Imaginary surfaces, approach zones, Turning	**05**

	Planning		zones	
6.10	Unit 10 Runway orientation & Design	4,5	Wind Rose Diagram, Basic Runway length, Correction, Geometric Design Element, Runway Configuration, Exit taxiway	05
6.11	Unit 11 Visual Aids	4	Marking & Lighting of Runways, Taxiway Lighting, Direction Indicator Wind Direction Indicator, IFR/VFR	05

Evaluation/Assessment	50 [Internal]	50 [External]
7.1	Internal Assessment	50(Subject Incharge)
7.1.1	Assignments/Quizzes/Class Test	15(Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	30 (Best of two MTEs)
7.2	Externall Assessment	50(Subject Incharge)

Text- Book	
8.1	Saxena,S.C., Arora, S.P." A textbook of railway engineering".Dhanpat Rai & sons, Delhi,2012. Khanna,S.K.,Arora, M.G., and Jain,S.S.," Airport Planning and Design", Nem Chand & Bros..Roorkee.1999.
8.2	Aggarwal,M.M." Railway Engineering", Prabha & Company,New Delhi,1997.
9	**Software Required** None
10	**Pedagogical Methods** White/Black Board/ PPT/ Live Examples/ Group Discussion/study Tours and Task

Course Title		Concrete Technology		
Course Code		CIV - 405	Classification:	Compulsory Core
Credits		4	Contact Hours	4
1	Pre- requisites	This course requires the student to know about the basic of civil engineering, fundamentals of chemistry, building materials.		
2	Course Objectives	1. To prepare the graduates as best civil engineers with an excellent comprehension of fundamentals of concrete structure at micro and macro levels and applications of different types of cement and concretes, besides keeping them abreast with latest developments in concrete technology at the National and International levels. 2. To give them all inputs required to help them attain professional expertise and establish themselves as renowned concrete technologists. 3. To enable them develop interest in concrete technology area and pursue academic / research assignments by providing information regarding innovative developments on special concretes, eco-friendly and smart concretes, sustainable development and special concretes in concrete technology		
3	Course Outcomes	On successful completion of this course, students will be able to 1. To identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy. 2. To acquire and apply fundamental knowledge in the fresh and hardened properties of concrete. 3. To evaluate the effect of the environment on service life performance, properties and failure modes of structural concrete and demonstrate techniques of measuring the Non Destructive Testing of concrete structure. 4. To develop an awareness of the utilization of waste materials as novel innovative materials for use in concrete. 5. To design a concrete mix which fulfils the required properties for fresh and hardened concrete		
4.	Examination pattern (End Term Examination)	The examiner will set total seven questions. First Question is compulsory covering whole syllabus (ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part.		
5	Outline Syllabus: 45 lectures			
Section A				
6.00	Units	Course Outcome Covered	Content	Lecture Hours
6.01	Unit 1 Properties of Concrete	1,2	Introduction to concrete, cement, Hydration of Cement. Workability, strength, shrinkage and temperature effects, creep, permeability, fire resistance, thermal properties and durability of concrete, stress strain characteristics of concrete, sulphate attack, acid attack.	8
6.02	Unit 2 Chemical and Mineral Admixtures	2,4	Accelerators, retarders, plasticizers, super plasticizers, waterproofing admixtures, silica fumes, high volume fly ash concrete, gas forming agents, workability agents. Grouting agents, corrosion inhibiting agents, coloring agents.	6
6.03	Unit 3 Quality Control of Concrete	1,3	Need of quality control, factors causing variation in quality of concrete, field control, advantages of quality control, statistical quality control, acceptance criteria, quality management in concrete construction, tools for quality management	6
6.04	Unit 4 Concrete under Special Circumstances	3,4	Hot weather concreting, cold weather concreting, underground concreting, under water construction.	5
Section B				

6.05	Unit 5 Deterioration of Concrete and its prevention	1,2	Corrosion of reinforcement in concrete, factors influencing corrosion, damages caused by corrosion, preventive measures in construction, tests for existing structures, remedial measures.	4
6.06	Unit 6 Special Concretes	3	Light weight concrete, ultra light weight concrete, vacuum concrete, waste material based concrete, mass concrete, shotrcrete, ferrocement, fibre reinforced concrete, polymer concrete composites, gap graded concrete, no fines concrete, ready mix concrete.	8
6.07	Unit 7 Self Compacting Concrete	2,3	Materials for SCC, requirements for SCC, workability requirements for fresh SCC, production and placing, slump flow test, J-ring test, V-funnel test, L box test, U box tests, full box test.	5
6.08	Unit 8 Mix Design	5	Design of concrete mixes as per IS:10262:2009.	5

7	**Evaluation/Assessment:**	**50 (Internal)**	**50 (External)**
7.1	**Internal Assessment**	**50** (Class Teacher)	
7.1.1	Assignments / Quizzes/ Class Test	15 (Minimum two Mandatory Assignments)	
7.1.2	Attendance	5 (Depends upon Percentage of attendance in Class)	
7.1.8	Sessional	30 (One best of 2)	
7.2	**External Assessment (End Term Exam)**	**50**	

	Text books
8.1	M.L.Gambhir, "Concrete technology",Tata McGraw-Hill publishing Company Ltd, New Delhi
8.2	A.R. Santhakumar, "Concrete Technology", Oxford University press, New Delhi, 2009
8.3	M.S. Shetty, "Concrete Technology", S. Chand & Company Ltd., New Delhi, 2013.
8.4	A.M.Neville,"Properties of Concrete", English Language Book Society/Longman Pub, 1988
8.5	P.K.Mehta and J.M.M.Paulo, "Concrete – Microstructure – Properties and Material", ICI, Indian First Edition, Reprint 1999.
8.6	N.Krishna Raju, "Design of Concrete Mix", CBS Pub., 1985.

9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Group Discussion and Task

Course Title:		Disaster Management		
Course Code:		CIV-406	Classification:	Compulsory Core
Credits:		4	Contact Hours	4
1	Pre-requisites :	Knowledge of Advanced surveying and building construction.		
2	Course Objective(s)	1. To create awareness amongst students to basic issues of natural and manmade disasters. 2. To ensure the understanding of the disaster management cycle and relationship amongst vulnerability, preparedness, prevention and mitigation. 3. To invoke minimum ability and sensitivity amongst students to respond to disasters in their area of living and working. 4. To develop technical prowess and to mitigate the effects of disasters by capacity building amongst engineering fraternity towards formulation and implementation of disaster management strategies. 5. To relate amongst the basic approaches adopted in disaster risk reduction and institutional mechanism adopted in country towards creating resilient society.		
3	Course Outcome(s)	On successful completion of this course, students will be able to 1. Understand genesis and causes of natural and manmade disaster within the framework of fundamental concepts of basic sciences and engineering. 2. Perceive the vulnerability of their living and working places and level of preparedness within the existing setup of disaster management. 3. Analyze and critically examine the vulnerability of a region and to employ adequate strategy and tools of intervention. 4. Build capacity to use specialized problem solving skills, methodologies and technology. 5. Setup priorities to develop coherent and adaptable disaster management plan.		
4	Examination Pattern [End Term Exam]	Examiner will set 7 questions of 10 marks each. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and will be compulsory. Rest of the question paper will be divided into two parts having 3 questions each from Sections -A and -B, and the candidate is required to attempt at least 2 questions from each part.		
5	Outline Syllabus: 45 Lecture Hours			
Section A				
6.00	Units	Course Outcomes covered	Content	Lecture Hours
6.01	Unit 1: Introduction, Disaster Mitigation, Risk Assessment, Management System	1,2	Define and describe disaster, hazard, emergency, vulnerability, risk and disaster management, Identify and describe the types of natural and non-natural disasters, Important phases of Disaster Management Cycle. Natural Hazards: causes, distribution pattern, consequences and mitigation measures for earth quake, tsunami, cyclone, flood, landslide drought etc. Man-made hazards: causes, consequences mitigation measures for various industrial hazards/disasters, Preparedness for natural disasters in urban areas. Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems. Emergency medical and essential public health services, response and recovery operations, reconstruction and rehabilitation.	15 hours
6.02	Unit 2: Capacity Building	2	Gender sensitive disaster management approach and inculcate new skills and sharpen existing skills of government officials, voluntary activists, development of	7 hours

			professional and elected representative for effective disaster management, role of media in effective disaster management, overview of disaster management in India, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines.	
Section B				
6.05	**Unit 3:** Earthquake Engg. Natural disasters and mitigation	3,4	Performance of Buildings and Structures : Main causes of damage : Intensity of earthquake forces, lack of strength and integrity in buildings, quasi- resonance, lack of ductility, lack of detailing. Earthquake Effects: On ground and soil liquefaction, buildings, structures, power plants, switch yards, equipments and other lifeline structures, release of poisonous gases and radiation. Lessons Learnt from the Past Earthquakes.	10 hours
6.06	**Unit 4:** Application of Geo-informatics and Advanced Techniques	3,4	Use of Remote Sensing Systems (RSS) and GIS in disaster Management, role of knowledge based expert systems in hazard scenario, using risks-time charts to plan for the future, early warning systems.	7 hours
6.07	**Unit 5:** Integration of Public policy	5	Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management.	6 hours
Evaluation/Assessment				
7.1	**Internal Assessment**		**50 (Class Teacher)**	
7.1.1	Assignments/ Quizzes/ Class Test		15 (Minimum 2 Mandatory Assignments)	
7.1.2	Attendance		5 (Depends upon Percentage of Attendance in Class)	
7.1.3	Mid Term Exam		30 (Best of two MTEs)	
7.2	**External Assessment (End Term Exam)**		**50**	
Text Books				
8.1	Iyengar, “Natural Hazards in the Urban Habitat”,C.B.R.I, Tata McGraw Hill Publications.			
8.2	R.B.Singh, “Disaster Management”, Rawat Publications			
8.3	G.K.Ghosh, “Disaster Management”, A.P.H Publishing Corporation.			
8.4	Introduction to Remote Sensing : Campbell, J.B, Taylor & Francis, CBS Publishers & Distributers, New Delhi,2003			
	Reference / Other Recommended Books			
8.5	Sachindra Narayan, “Anthropology of Disaster Management”, Gyan Publishing House			
8.6	B C Bose, “Modern Encyclopaedia of Disaster and Hazard Management”, Rajat publications.			
9	Software Required		None	
10	Pedagogical Methods		White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task	

Course Title:		**Engineering Geology**			
Course Code:		CIV-407		**Classification:**	Compulsory Core
Credits:		4		**Contact Hours:**	4
1	**Pre-requisites :**	**Knowledge about Planning and analysis of various projects needed for any type of construction**			
2	**Course Objectives**	The course content should be taught and learning imparted with the aim to develop theoretical knowledge and design skills so that they are able to:- 1. To study the geological features of Earth 2. To study the Engineering properties of different rocks 3. Study about application of Geology in planning and designing of different Civil Engineering Projects.			
3	**Course Outcomes**	The theory should be taught along with examples in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes: 1. Understand the geological features based upon the available documents. 2. Understand the engineering properties of the rocks 3. Understand the application of knowledge of Geology in planning and designing of different Civil Engineering Projects			
4	**Examination Pattern [End Term Exam]**	The examiner shall set total seven questions. First Question is compulsory covering whole syllabus (ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part. Use of IS-800-2007 & Steel Tables is allowed.			
5	**Outline Syllabus: 45** Lecture Hours				
		Section A			
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 General Geology	1	Importance of Engg. Geology applied to Civil Engg. Practices. Weathering, definition, types and effect. Geological works of rivers, wind, glaciers as agents of erosion, transportation and deposition		4 hours
6.02	Unit 2 Rocks & Minerals	1,2	Minerals, their identification, igneous, sedimentary & metamorphic rocks. Classification of rocks for engineering purposes. Rock quality designation (RQD).		4 hours
6.03	Unit 3 Structural Geology	1,3	Brief idea about stratification, apparent dip, true dip, strike and in conformities. Folds, faults & joints : definition, classification relation to engineering operations.		4 hours
6.04	Unit 4 Engineering Geology	3	Geological considerations in the Engg. Projects like tunnels, highways, foundation, dams, reservoirs.		2 hours
6.05	Unit 5 Earthquake	3	Definition, terminology, earthquake waves, intensity, recording of earthquake.		2 hours
		Section B			
6.06	Unit 6 Engineering properties of rocks and laboratory measurement	1,3	Uniaxial compression test, tensile tests, permeability test, shear tests, size and shape of specimen rate of testing. Confining pressure, stress strain curves of typical rocks. Strength of intact and fissured rocks, effect of anisotropy, effect of saturation and temperature		5 hours
6.07	Unit 7 In-situ determination of Engg. Properties of Rock masses	3	Necessity of in-situ tests, uniaxial load tests in tunnels and open excavations, cable tests, flat jack test, shear test, pressure tunnel test. Simple methods of determining in situ stresses, bore hole test.		5 hours
6.08	Unit 8 Improvement in properties of Rock	1,2,3	Pressure grouting for dams and tunnels, rock reinforcement rock bolting.		4 hours

	masses		
Evaluation/Assessment:		50 [Internal]	50 [External]
7.1	**Internal Assessment**	**50** (Class Teacher)	
7.1.1	Assignments/ Quizzes/ Class Test	15(Minimum 2 Mandatory Assignments)	
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)	
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**	
7.2	**External Assessment (End Term Exam)**	**50**	
Text Book			
8.5	D.S.Arora, Engineering Geology, Mohindra capital Publisher		
8.6	Parbin Singh, Engineering Geology by S.K. Kataria and sons		
8.7	B.P. Verma, Rock Mechanics for Engineering, Khanna Publishers		
8.8	Gokhale KVGK, "Principles of Engineering. Geology", B.S. Publications, Hyderabad 2011.		
9	**Software Required**	None	
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task	

Course Title:		**Design of Concrete Structures - Lab (Practical)**		
Course Code:		CIV - 451	**Classification:**	Compulsory Core (P)
Credits		1	**Contact Hours**	2
	Outline Syllabus: 26 Lecture Hours			
1.00	**Experiment/ problem**			
1.01	Lab Expt./ Problem 01	To determine the Specific Gravity of cement.		
1.02	Lab Expt./ Problem 02	To determine the Standard Consistency.		
1.03	Lab Expt./ Problem 03	To determine Initial and Final Setting time of Cement.		
1.04	Lab Expt./ Problem 04	To determine Soundness of Cement.		
1.05	Lab Expt./ Problem 05	To determine the Compressive Strength of Cement.		
1.06	Lab Expt./ Problem 06	To determine the Compressive Strength of Bricks.		
1.07	Lab Expt./ Problem 07	To determine the Transverse Strength of Tiles.		
1.08	Lab Expt./ Problem 08	To determine the Compressive Strength of Concrete.		
1.09	Lab Expt./ Problem 09	To determine workability of Concrete(by slump test and compaction factor test)		
1.10	Lab Expt./ Problem 10	Non Destructive testing.		
1.11	Lab Expt./ Problem 10	To determine abrasive resistance of tiles		
Evaluation/ Assessment:		50 (Internal)		
2.00	Internal Assessment	50 (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5 (Depends upon percentage of attendance in class)		
2.03	Mid Term Viva-Voce	30 (Best of two)		
3.00	Software Required	None		
4.00	Pedagogical Methods	White/Black Board/PPT/Video lectures/ Lab Work using equipments/ Computers/ Printers		

Course Title:		**Reinforced Concrete Drawing I (Using AUTOCAD)**		
Course Code:		CIV – 453	**Classification:**	Compulsory Core (P)
Credits		1	**Contact Hours**	2
	Outline Syllabus: 26 Lecture Hours			
1.00	**Experiment/ problem**	**Content**		
1.01	Lab Expt./ Problem 01	Drawing and detailing of reinforcement in beams		
1.02	Lab Expt./ Problem 02	Drawing and detailing of reinforcement in columns		
1.03	Lab Expt./ Problem 03	Drawing and detailing of reinforcement in isolated and combined footings		
1.04	Lab Expt./ Problem 04	Drawing and detailing of reinforcement in slabs.		
1.05	Lab Expt./ Problem 05	Drawing and detailing of stairs		
Evaluation/ Assessment:				
2.00	Internal Assessment	50 (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5 (Depends upon percentage of attendance in class)		
2.03	Mid Term Viva-Voce	30 (Best of two)		
3.00	Software Required	AutoCAD		
4.00	Pedagogical Methods	White/Black Board/PPT/Video lectures/ Lab Work using equipments/ Computers/ Printers		

Course Title:			**Construction Planning and Management**		
Course Code:			CIV-501	**Classification:**	Compulsory Core
Credits:			4	**Contact Hours:**	4
1	**Pre-requisites :**		**Knowledge about Planning and analysis of various projects needed for any type of construction**		
2	**Course Objectives**		The course content should be taught and learning imparted with the aim to develop theoretical knowledge and design skills so that they are able to:- 1. apprise the students about planning the project 2. get the knowledge about works management 3. know about various types of construction equipments and their applications.		
3	**Course Outcomes**		The theory should be taught along with examples in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes: 1. Employ appropriate practices to organize and manage personnel, materials, equipment, costs, time, and quality of a construction project 2. Understand construction project control processes 3. Understand Project Cost Analysis techniques 4. Apply appropriate equipment to project activities		
4	**Examination Pattern [End Term Exam]**		The examiner shall set total seven questions. First Question is compulsory covering whole syllabus(ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part. Use of IS-800-2007 & Steel Tables is allowed.		
5	**Outline Syllabus:** 45 Lecture Hours				
			Section A		
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Introduction	1	Need for project planning and management, Three phases of project planning, Bar Chart, Milestone Chart, Uses and Drawbacks, Evolution of networks, Terminology.		2 hours
6.02	Unit 2 PERT Programme (Evolution and Review Technique	1,2	Brief History of Evolution of PERT Salient features, construction of PERT network, multiple time estimates and network analysis, earlier events time, latest even time, forward pass and backward pass, event slack, concept of critical path and its identification, data reduction, Application of statistics to probability of achieving a target data, suitability of PERT for research projects.		4 hours
6.03	Unit 3 CPM (Critical Path Method)	1,2	Definitions, network construction. Fundamental rules, assignment of duration of activities, determination of project schedule, activity time estimates earliest start and earliest finish, latest start and latest finish time-float types-free float, independent float, Interfering float -0 their significance in project control, identification of critical path, Updating.		4 hours
6.04	Unit 4 Project Cost Analysis	3	Types of project costs direct and indirect cost-time relationships, cost slopes straight-line and segmented approximations, optimum cost and optimum duration, examples on crashing, Comparison of CPM and PERT.		4 hours
			Section B		
6.05	Unit 5 Construction engineering	3,4	Factors affecting selection of construction equipment, Types of equipment; cost of owning and operating equipment depreciation cost; obsolescence cost; investment cost; operating cost; economic life of equipment; maintenance and repair cost.		4 hours
6.06	Unit 6 Earth Moving Machinery	4	Tractor and related equipment; bulldozers; angle dozers; rippers; scrappers; power shovels; dragline; slack line; clamshells hoes; trenching machines.		4 hours
6.07	Unit 7 Construction	4	Cement concrete plants for grading, batching, mixing, types of mixers, handling and transporting concrete, concrete pumps, placing concrete,		4 hours

	Equipments		compacting concrete, bituminous mix plants, pavers and finishers.	
6.08	Unit 8 Hoisting and Transporting Equipment	4	Hoists winches, cranes, belt conveyors, ropeways trucks and wagons, balancing the capacity of hauling units with the size of excavator.	4 hours

Evaluation/Assessment:		
7.1	**Internal Assessment**	**50** (Class Teacher)
7.1.1	Assignments/ Quizzes/ Class Test	15(Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**
7.2	**External Assessment (End Term Exam)**	**50**
Text Book		
8.1	L.S. Srinath, PERT AND CPM (Principles and Applications) 2nd Edition, McGraw Hill.	
8.2	R. L. Peurifoy, Construction Planning, Equipment and Methods (4th Edition), TMH.	
8.3	Mahesh Verma, Construction Equipment, Planning and Application, Khanna Publishers.	
8.4	B. C. Punmia & KK Khandelwal, Project Planning and Control with PERT & CPM, Laxmi Publications	
8.5	Peurifoy, Construction Planning,Equipment & Method, McGraw Hill	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

		Design of Concrete Structures-II			
Course Code		**CIV - 502**		**Classification:**	**Compulsory Core**
Credits		**4**		**Contact Hours**	**4**
1	**Pre- requisites**	Knowledge of Basic Constituents of Reinforced Concrete Design-I			
2	**Course Objectives**	1. To learn about design of continuous beams. 2. To study about design of RCC structures subjected to torsion. 3. To learn about types and design of various types of footings. 4. To study the ultimate load theory for design of RCC slabs. 5. To study retaining walls, domes and water tanks.			
3	**Course Outcomes**	On successful completion of this course, students will be able to 1. To access the suitability of various types of footings for the structure. 2. To calculate the ultimate load for the different type of slabs. 3. To design the Beams in torsional behaviour. 4. To design the spherical structures. 5. To design complex structures like members subjected to torsion, retaining walls, domes and water tanks.			
4.	**Examination pattern (End Term Examination)**	The examiner will set total seven questions. First Question is compulsory covering whole syllabus (ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part.			
5	**Contact Hours: 45**				
		Section A			
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Design of Foundation	1	Design of Strap beam footings, Raft footing and Pile foundations		12
6.02	Unit 2 Design of beams	3,5	Introduction to continuous beams, Design of circular beams, Design for Torsional Moment and shear,		6
6.03	Unit 3 Retaining Walls	5	Types, behaviour, stability requirements, design of cantilever and counterfort type retaining walls.		10
		Section B			
6.04	Unit 5 Design of continuous beams	1	Design of Continuous beams using IS code		5
6.05	Unit 6 Domes	4,5	Design of Spherical and conical domes.		4
6.06	Unit 7 Design of water tanks	5	Design of circular and rectangular tanks resting on ground, underground water tanks and overhead tanks		8
7	**Evaluation/Assessment:**				
7.1	**Internal Assessment**	**50** (Class Teacher)			
7.1.1	Assignments / Quizzes/ Class Test	15 (Minimum two Mandatory Assignments)			
7.1.2	Attendance	5 (Depends upon Percentage of attendance in Class)			
7.1.8	Sessional	30 (One best of 2)			
7.2	**External Assessment (End Term Exam)**	**50**			
	Text books				
8.1	A.K. Jain , “Limit State Design” , Nem Chand & Bros. Roorkee.				

8.2	Punmia, “Limit State Design”, Luxmi Publications.	
8.3	Punmia & Jain, “Reinforced Concrete Structures” , Luxmi Publications.	
8.4	S. Ramamurtham, “Design of Reinforced Concrete Structure”, Dhanpat Rai Publishing Company.	
8.5	Syal & Goel, “Reinforced Concrete Structures”, Wheeler Publisher Allahabad.	
8.6	N. Krishna Raju, R.N. Pranesh ,”Reinforced Concrete Design”, New Age Internation Publisher	
8.7	Pankaj Aggarwal & Manish Srikhande, “Earthquake Resistant Design of Structures “, Prentice Hall of India	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Group Discussion and Task

Course Title:		**Geotechnical Engineering**		
Course Code:		CIV-503	**Classification:**	Compulsory Core
Credits:		4	**Contact Hours:**	4
1	**Pre-requisites :**	Knowledge of Mechanics of Solids, Fluid Mechanics, and Engineering Geology.		
2	**Course Objectives**	1. To study the classification and characteristics of soils. 2. To impart the knowledge of Compaction, and Consolidation of soil. 4. To understand the concept of effective stress principle and its applications. 5. To study the permeability of soils and solve seepage problems. 6. To study the shear strength of soil and its determination. 7. To acquaint the students with the earth pressure and its assessment.		
3	**Course Outcomes**	After the completion of this course, the students will be able to: 1. Classify soil and grade its size to further determine physical properties. 2. Perform computations to assess compaction required to achieve maximum dry density. 3. Estimate the foundation settlement of structures using consolidation principles. 4. Determine the permeability and seepage characteristics of soil layers. 5. Compute shear strength of soil using the prescribed testing methods. 6. Estimate the earth pressure acting on basement walls and retaining structures.		
4	**Examination Pattern [End Term Exam]**	Examiner will set 7 questions of 10 marks each. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus: 45** Lecture Hours			
		Section A		
6.00	**Units**	**Course Outcomes Covered**	**Content**	**Lecture Hours**
6.01	UNIT 1 Basic Concepts	1	Basic definitions in soil mechanics. Weight volume relationship, phase diagrams, Particle Size Analysis, Types of soil water, capillary action, Frost heave, frost boil, Prevention of frost action, Shrinkage & swelling of soils, Slaking of clay, Bulking of sand.	5 hours
6.02	UNIT 2 Classification and Characteristics of Soils	1	Indian Standard classification System, Consistency limits & their use and determination, various indices, shrinkage parameters, sensitivity, thixotropy & activity of soils.	5 hours
6.03	UNIT 3 Compaction	1, 2	Definition and object of compaction Standard proctor test & Modified proctor test, Compaction curve. Factors affecting compaction, Effect of compaction on soil properties. Field compaction methods their comparison of performance and relative suitability. Field compactive effort. Field control of compaction by proctor needle.	5 hours
6.04	UNIT 4 Consolidation	3	Definition and object of consolidation difference between compaction and consolidation. Concept of various consolidation characteristics i.e. a_v, m_v and C_v primary and secondary consolidation. Terzaghi's method for one-dimensional consolidation. Consolidation test. Normally consolidated and over consolidated clays importance of consolidation settlement in the design of structures.	6 hours
		Section B		
6.05	UNIT 5 Effective Stress Principle	1, 4	Concept of effective stress principle, effect of water table fluctuations on effective stress, Seepage pressure, critical hydraulic gradient and quick sand condition.	5 hours

6.06	UNIT 6 Permeability and Seepage	4	Darcy's law and its validity seepage velocity. Co-efficient of permeability and its determination, Factors affecting '*K*' and brief discussion average permeability of stratified soil deposits.	5 hours
6.07	UNIT 7 Shear Strength	5	Stress analysis of a two - dimensional stress system by Mohr circle, Coulomb - Mohr strength theory, Revised Mohr-Coulomb's Equation, Relations between principle stresses at failure, Shear strength tests-Direct shear Test, Triaxial test, Unconfined Compression test, Different types of soils, Liqefaction of sands, Shear characteristics of Cohesive & Cohesionless soils.	8 hours
6.08	UNIT 8 Earth Pressure	6	Terms and symbols used for a retaining wall. Movement of wall and the lateral earth pressure. Rankine's and Coulomb's theory for lateral earth pressure. Culmann's graphical construction and Rehbann's graphical construction.	5 hours

Evaluation/Assessment:		50 [Internal] 50 [External]
7.1	**Internal Assessment**	**50** (Class Teacher)
7.1.1	Assignments/ Quizzes/ Class Test	15 (Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5 (Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**
7.2	**External Assessment (End Term Exam)**	**50**

	Text Book(s)
8.1	Terzaghi K and Peck R B "Soil mechanics in Engineering Practice" John Wiley and Sons, New York, 1995.
8.2	Terzaghi K "Theoretical Soil Mechanics", John Wiley and Sons, New York, 1943
8.3	Ranjan G and Rao ASR "Basic and Applied Soil Mechanics" New Age International Pvt. Ltd., Publishers, New Delhi, 2000
8.4	Murthy V N S Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil Engineering) ", 2002.
8.5	Donald P. Coduto "Foundation Design: Principles and Practices", Pearson Education, Eastern Economy Edition, 2000.

9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title:			**Environmental Engineering I**		
Course Code:			CIV-504	**Classification:**	Compulsory Course
Credits:			4	**Contact Hours/week:**	4
1	**Pre-requisites :**		**Applied Chemistry and General environmental aspects in society**		
2	**Course Objectives**		1. To study various physical-chemical and biological characteristics and their significance on water quality. 2. To analyze water demand and design water networks for a city. 3. To analyze and treat water for domestic use. 4. Concept of Rain water harvesting.		
3	**Course Outcomes**		After the completion of this course, the students will be able to know : 1. The concepts of water supply systems. 2. Sources of water supply. 3. Domestic Water treatment. 4. Pumping requirements for water distribution. 5. Rain water harvesting. 6. Air Pollution Basics		
4	**Examination Pattern [End Term Exam]**		Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus:** 45 Hours				
			Section A		
6.00	**Units**	**Course Outcome Covered**	**Content**		**Hours**
6.01	UNIT 1 Natural Water Sources	1, 2	Groundwater and springs Definition - various types of wells - well construction and development - specific yield and various tests - Infiltration wells and galleries; choice of source of water supply.		5hrs
6.02	UNIT 2 Quality of water	1,3	Testing of various physical-chemical and biological characteristics and their significance; water borne diseases and their control, standards of quality for different uses of water		7 hrs
6.03	UNIT 3 Water treatment	2,3	Data and background information for the design of water supply system Municipal water demands and demand variations, Population forecasting and water demand estimations; Intakes and transmission systems, pipes for transporting water and their design Water treatment schemes; Basic principles of water treatment; Design of plain sedimentation, coagulation and flocculation, filtration: slow, rapid and pressure; Disinfection units; Fundamentals of water softening, fluoridation and de-fluoridation, and water desalinization and demineralization, Necessity of pumping, classification of different type of pumps and their characteristics		10 hrs
			Section B		
6.04	UNIT 4 Water supply systems	3, 4	Water distribution systems and appurtenances; Water supply network design and design of balancing and service reservoirs; operation and maintenance of water supply systems.		12 hrs
6.05	UNIT 5 Clean Production tools	4,5	Reuse, recycle, recovery, source reduction life cycle analysis; environmental cost accounting, Small scale and household level water purification system and water fixtures, Urban rain water disposal/rain water harvesting;		8 hrs
6.06	UNIT 6 Miscellaneous	6	Air and Noise pollution (sources, effects and control), noise level standards, Indoor air Pollution, EIA		3 hrs
			Evaluation/Assessment:		
7.1	**Internal Assessment**		**50** (Class Teacher)		
7.1.1	Assignments/ Quizzes/		15(Minimum 2 Mandatory Assignments)		

	Class Test	
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**
7.2	**External Assessment (End Term Exam)**	**50**
Text Book		
8.1	Environmental Engineering;:Baljeet S. Kapoor, New Age Publishers	
8.2	Water Supply Engineering;:S. K. Garg, Khanna Publishers	
8.3	Environmental Engineering;:P. Venugopala Rao, PHI	
8.4	Water Supply & Sanitation Engineering; :Gurcharan Singh, Std. Publishers	
8.5	Environmental Engineering; :Peavy and Rowe, McGraw Hill Publishers	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title:		**Reinforced Concrete Drawing II(Using AUTOCAD)**		
Course Code:		CIV – 552	**Classification:**	Compulsory Core (P)
Credits		1	**Contact Hours**	2
	Outline Syllabus: 26 Lecture Hours			
1.00	**Experiment/ problem**	**Content**		
1.01	Lab Expt./ Problem 01	Drawing and detailing of reinforcement in continuous beams		
1.02	Lab Expt./ Problem 02	Drawing and detailing of reinforcement in strap footings		
1.03	Lab Expt./ Problem 03	Drawing and detailing of reinforcement in curved beams with typical Sections.		
1.04	Lab Expt./ Problem 04	Drawing and detailing of retaining walls (cantilever and counter fort type).		
1.05	Lab Expt./ Problem 05	Drawing and detailing of Spherical and conical domes with a typical cross section.		
1.06	Lab Expt./ Problem 06	Drawing and detailing of reinforcement in Rectangular and Circular water tanks resting on ground.		
1.07	Lab Expt./ Problem 07	Drawing and detailing of reinforcement in Raft and Pile foundations.		
Evaluation/ Assessment:				
2.00	Internal Assessment	50 (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5 (Depends upon percentage of attendance in class)		
2.03	Mid Term Viva-Voce	30 (Best of two)		
3.00	Software Required	AutoCAD		
4.00	Pedagogical Methods	White/Black Board/PPT/Video lectures/ Lab Work using equipments/ Computers/ Printers		

Course Title:		**Geotechnical Engineering Lab**		
Course Code:		CIV-553	**Classification:**	Compulsory Core (P)
Credits:		1	**Contact Hours:**	2
	Outline Syllabus: 26 Lab Hours			
1.00	**Experiment/Problem**	**Content**		
1.01	Lab Expt./Problem 01	Determination of water content.		
1.02	Lab Expt./Problem 02	Determination of field density by Core cutter method		
1.03	Lab Expt./Problem 03	Determination of field density by Sand replacement method		
1.04	Lab Expt./Problem 04	Grain size Analysis by Mechanical Method.		
1.05	Lab Expt./Problem 05	Grain size Analysis by Hydrometer Method.		
1.06	Lab Expt./Problem 06	Determination of Specific Gravity by Pycnometer.		
1.07	Lab Expt./Problem 07	Determination of Liquid Limit, Plastic limit.		
1.08	Lab Expt./Problem 08	Determination of Permeability of soils.		
1.09	Lab Expt./Problem 09	Determination of In-Situ California Bearing Ratio of soil.		
1.10	Lab Expt./Problem 10	Determination of optimum moisture content & maximum dry density of soil by Standard Proctor Compaction Test (SPCT).		
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5 (Depends upon percentage of attendance in class)		
2.03	Mid Term Viva-Voce	**30 (Best of two)**		
3.00	**Text Books/Manuals**			
3.01	Laboratory Manual in Soil Engineering by A. K. Duggal, NITTTR, Chandigarh			
3.02	Engineering Soil Testing by Shamsher Prakash and P.K.Jain, Nem Chand & Bros, Roorkee			
4.00	Software Required	AutoCAD.		
5.00	Pedagogical Methods	White/Black Board/PPT/Video Lectures/ Lab Work using equipments/Computers/Printers.		

Course Title:		**Software Lab**		
Course Code:		CIV-554	**Classification:**	Compulsory Core
Credits:		1	**Contact Hours:**	2
	Outline Syllabus: 26 Lecture Hours			
		Section A		
1.00	**Expt./Problem**	**Content**		
1.01	Lab Expt./Problem 01	Analysis of Beams with different support conditions and loading conditions using STAAD Pro Software.		
1.02	Lab Expt./Problem 02	Analysis of 2- D Portal Frame for vertical and horizontal loading (Multi storeyed and Multi Bay) using STAAD Pro Software.		
1.03	Lab Expt./Problem 03	Analysis and Design of 3- D frame (Multi storeyed and Multi Bay) using STAAD Pro Software.		
1.04	Lab Expt./Problem 04	Analysis and Design of Roof Truss for wind load. using STAAD Pro Software.		
1.05	Lab Expt./Problem 05	Design of foundations using STAAD Foundation		
1.06	Lab Expt./Problem 06	Design of Road Section using MX-Road software		
1.07	Lab Expt./Problem 07	Layout Plan of an area using Arch GIS software		
1.08	Lab Expt./Problem 08	Testing and Analysis of Beams using ATENA software		
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5(Depends upon Percentage of Attendance in Class)		
2.03	Mid Term Viva-Voce	**30 (Best of two)**		
3	Software Required	STAAD Pro, MX-Road, Arch GIS, ATENA		
4	Pedagogical Methods	**White/Black Board/ PPT/ Video Lecture/ Lab Equipments/Computers/Printers**		

Course Title:		**Survey Practical Training**		
Course Code:		CIV-555	**Classification:**	Compulsory Core (Pr.)
Credits:		4	**Contact Hours:**	10days
	Outline Syllabus:			
1.00	**Experiment/Problem**	**Content**		
1.01	Students are required to prepare a topographical map of a given area using triangulation survey involving use of such instruments as theodolite, plane table and Total Station, etc.			
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Faculty Panel)		
2.01	Lab Performance	10		
2.02	Attendance	5 (Depends upon percentage of attendance in class)		
2.03	Report and Map	20 (Depends upon quality, accuracy and relevance of the report and map).		
2.04	Viva-Voce	15		
3	Software Required	AutoCAD.		
4	Pedagogical Methods	White/Black Board/ PPT/ Video Lecture/Lab, equipments/Computers/Printers.		

Course Title:		**Design of Steel Structures - I**			
Course Code:		CIV-601		**Classification:**	Compulsory Core
Credits:		4		**Contact Hours:**	4
1	**Pre-requisites :**	**Solid Mechanics and Structural Analysis I**			
2	**Course Objectives**	The course content should be taught and learning imparted with the aim to develop theoretical knowledge and design skills so that they:- 1. acquainted with the basics of Steel structural elements 2. Learn design procedures of various components used in fabrication of Steel structures. Should know the importance of IS 800:2007 & steel tables..			
3	**Course Outcomes**	The theory should be taught along with examples in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes: 1. Understanding the designs of joints in bolted connections and welded connection. 2. Understanding the design of tension, compression and flexural members using application of bolted and welded connections. 3. Understanding the different types of columns bases and foundations. 4. Understanding the design of trusses using all the concepts learnt in this subject.			
4	**Examination Pattern [End Term Exam]**	The examiner shall set total seven questions. First Question is compulsory covering whole syllabus(ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part. Use of IS-800-2007 & Steel Tables is allowed.			
5	**Outline Syllabus:** 45 Lecture Hours				
		Section A			
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Bolted & welded joints	1	Terminology, Specifications for bolted & welded connections, Types of joints, Efficiency of bolted joint, Framed Connections (Beam to Beam & Beam to Column, Types of welds & welded joints, stresses in welds, design of welds.		8 hours
6.02	Unit 2 Tension members	1,2	Types of tension members, net & gross areas, permissible stresses. Design of members subjected to axial loads, tension member splice.		8 hours
6.03	Unit 3 Compression members	2	Failure modes of columns, end conditions & effective length of columns, various empirical formulae. IS code formula, General codal provisions for design of compression members. Built up compression members, lacing and battening of compression members, splicing of compression members.		8 hours
		Section B			
6.04	Unit 5 Column bases and foundations	1,3	Types of column bases, design of slab base, Gusseted base & grillage foundations.		8 hours
6.05	Unit 6 Design of flexural members	2	Failure modes permissible stresses, design of laterally supported and unsupported beams.		5 hours
6.06	Unit 7 Design of roof truss	1,2,4	Design and Drawing details of a steel roof truss bolted/welded with given forces in various members.		8 hours
Evaluation/Assessment:			50 [Internal]	50 [External]	
7.1	**Internal Assessment**		**50** (Class Teacher)		
7.1.1	Assignments/ Quizzes/ Class Test		15(Minimum 2 Mandatory Assignments)		
7.1.2	Attendance		5(Depends upon Percentage of Attendance in Class)		
7.1.3	Mid Term Exam		**30 (Best of two MTEs)**		
7.2	**External Assessment (End Term Exam)**		**50**		

	Text Book	
8.1	S.S Bhavikatti, Design of steel structures by Limit State Method, I .K. International Publishing House Pvt. Ltd..	
8.2	S.K.Duggal, Design of steel structures, McGraw Hills Publication.	
8.3	N. Subramanian, Design of steel structures, Oxford University Press	
8.4	K.S.Sai Ram, Design of steel structures, Pearson Education	
8.5	Karuna Roy Ghosh, Limit State Design of steel structures, PHI learning Pvt. Ltd., New Delhi	
8.6	General construction in Steel- Code of practice(Third Revision)—IS 800-2007 and Steel Tables	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title		**Irrigation Engineering**			
Course Code		**CIV - 602**	**Classification:**	**Compulsory Core**	
Credits		**4**	**Contact Hours**	**4**	
1	**Pre- requisites**	**Fluid Mechanics I**			
2	**Course Objectives**	The objective of this course is to introduce the students with various methods of Irrigation, regarding canal losses, tube wells, Irrigation projects & investigations and important concept of River training works.			
3	**Course Outcomes**	On successful completion of this course, students will be able to 1. The student would be able to learn the basics about necessity of irrigation, its importance, various methods of surface and sub-surface irrigation, equations and theories in design of canals, methods to reduce losses and deal with current issues to improve efficiency of irrigation. 2. The course will also teach the students about taking up the irrigation projects, their design and execution process. 3. The students will also learn basics of river training works and tube well irrigation which will increase their knowledge related to concepts of groundwater engineering. 4. Students will learn the design of canals using different theories. 5. Students will learn about the various types of methods used in the irrigation.			
4.	**Examination pattern (End Term Examination)**	The examiner will set total seven questions. First Question is compulsory covering whole syllabus (ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part.			
5	**Outline Syllabus: 45 lectures**				
		Section A			
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Methods of Irrigation	1	Advantages and disadvantages of irrigation, Water requirements of crops, Factors affecting water requirement, Consumptive use of water, water depth or delta and crop relation, Duty of water, relation between delta, duty and base period, Soil crop relation-ship and soil fertility, Sprinkler irrigation advantages & limitations. Planning and design of sprinkler irrigation, Drip irrigation advantages & limitations, suitability.		8
6.02	Unit 2 Canal Irrigation	2,4	Classifications of canals, canal alignment, Inundation canals, Bandhara irrigation, advantages and disadvantages, Silt theories-Kennedy's theory, Lacey's theory, Drawbacks in Kennedy's & Lacey's theories, comparison of Lacey's and Kennedy's theories, Design of unlined canals based on Kennedy & Lacey's theories, suspended and bed loads.		5
6.03	Unit 3 Lined Canals	1,2	Types of lining, selection of type of lining, Economics of lining, Maintenance of lined canals, Silt removal, Strengthening of channel banks, Measurement of discharge in channels, Design of lined canals, Methods of providing drainage behind lining.		6
6.04	Unit 4 Losses in Canals, Water Logging and Drainage	1	Losses in canals-Evaporation and seepage, Water logging, causes and ill effects of water logging-anti water logging measures. Drainage of land Classification of drains - surface and subsurface drains Design considerations for surface drains, Advantages and maintenance of tile drains.		6
		Section B			
6.05	Unit 5 Investigation and preparation of Irrigation Projects	4	Classification of project, Project preparation-investigations, Design of works and drawings, concept of multi - purpose projects, Major, Medium and miner projects, Planning of an irrigation project, Economics & financing of irrigation works. Documentation of project report.		**5**
6.06	Unit 6 Tubewell Irrigation	5	Force exerted by fluid jet on stationary flat plate, Force exerted by fluid jet on moving flat plate, Force exerted by fluid jet on stationary curved vane, Force exerted by fluid jet on moving curved vane. Types		6

			of tube - wells - strainer type, cavity type and slotted type. Type of strainers, Aquifer, porosity, uniformity coefficient, specific yield & specific retention, coefficients of permeability, transmissibility and storage. Yield or discharge of a tube well, Assumptions, Theim & Duputi's formulae. Interference of tube wells with canal or adjoining tube-wells, optimum capacity, Duty and delta of a tube well. Rehabilitation of tube well.	
6.07	Unit 7 River Training Work	3	Objectives, classification of river-training works, Design of Guide Banks. Groynes or spurs - Their design and classification ISI. Recommendations of Approach embankments and afflux embankments, pitched Islands, Artificial cut-off objects and Design Considerations River control - objectives and methods.	4

	Evaluation/Assessment	
7.1	**Internal Assessment**	**50** (Class Teacher)
7.1.1	Assignments / Quizzes/ Class Test	15 (Minimum two Mandatory Assignments
7.1.2	Attendance	5 (Depends upon Percentage of attendance in Class)
7.1.8	Sessional	30 (One best of 2)
7.2	**External Assessment (End Term Exam)**	**50**
	Text books	
8.1	Principles & practice of Irrigation Engg. S.K..Sharma, S. Chand.	
8.2	Irrigation & Water Power Engg. B.C. Punmia, Pande B.B.Lal, Laxmi Publications.	
8.3	Irrigation Engg. & Hydraulic Structure Varshney, Gupta & Gupta	
8.4	Irrigation Engg. & Hydraulic Structure Santosh Kumar Garg, Khanna Publishers.	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Group Discussion and Task

Course Title:		Estimation and Rate Analysis		
Course Code:		CIV-603	Classification:	Compulsory Core
Credits:		4	Contact Hours per week	4
1	Pre-requisites :	Knowledge of Building Materials & Construction Techniques		
2	Course Objective(s)	1. To acquaint the students of the methods of preparing preliminary estimate for buildings, RCC works and Roads from the available plans. 2. To analyze the rates of various items of work from the quantity of various materials in a building and its probable cost. 3. To study the specifications for the various items of work. 4. To develop an awareness of those factors that affect the cost of construction work and to analyze the influences that effect change in these factors. 5. To learn about P.W.D accounts and procedures of work.		
3	Course Outcome(s)	On successful completion of this course, students will be able to: 1. Estimate the materials and cost of a Civil Engineering work and assist in determining the feasibility of projects. 2. Prepare documentation for competitive tendering. 3. Specify the requirements of various resources for a given Civil Engineering project. 4. Manage and exercise financial control over contracts to ensure cash flow and the profitability of projects. 5. Managing sub-contractors and suppliers. 6. Finalising financial aspects of contracts upon completion of projects.		
4	Examination Pattern [End Term Exam]	Examiner will set 7 questions of 10 marks each. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and will be compulsory. Rest of the question paper will be divided into two parts having 3 questions each from Sections -A and -B, and the candidate is required to attempt at least 2 questions from each part.		
5	Outline Syllabus:	45 Lecture Hours		

Section A				
6.00	Units	Course Outcomes covered	Content	Lecture Hours
6.01	Unit 1: Estimates	1, 2	Method of building estimates, types, site plan index plan, layout plan, plinth area, floor area, Technical sanction, administrative approval, estimate of buildings, roads, earthwork, R.C.C. works, sloped roof, roof truss, masonry platform, masonry water tank, sanitary and water supply work, complete set of estimate.	16 hours
6.02	Unit 2: Specifications	3	Specifications for different classes of building and Civil engineering works.	6 hours
Section B				
6.05	Unit 5 Analysis of Rates	1,2	For earthwork, brickwork, concrete work, D.P.C., stone masonry, plastering, pointing, roadwork, Door and windows, whitewashing, painting, Varnishing, Centering and shuttering.	12 hours
6.06	Unit 6 Contracts, Works AND Tender	1,2,3,6	Tenders, tender form, submission and opening of tenders, Classification of contracts, Classification of works, Different type and methods of work types of measurement book, muster roll , piecework agreement and work order.	4 hours
6.07	Unit 7 Accounts	4,5	P.W.D. accounts, cash, receipt of money, cash book, temporary advance, imprest, accounting procedure, arbitration, arbitration act.	3 hours

6.08	Unit 8 Building Bye Laws	5,6	Building Byelaws, Definitions, Procedure for submission of building application and execution of works, Siting, Planning and Architectural control.	4 hours
Evaluation/Assessment				
7.1	**Internal Assessment**		**50 (Class Teacher)**	
7.1.1	Assignments/ Quizzes/ Class Test		15 (Minimum 2 Mandatory Assignments)	
7.1.2	Attendance		5 (Depends upon Percentage of Attendance in Class)	
7.1.3	Mid Term Exam		30 (Best of two MTEs)	
7.2	**External Assessment (End Term Exam)**		**50**	
Text Books				
8.1	B.N. Dutta , "Estimating and Costing", UBS Publishers & Distributors Ltd.			
8.2	D.C. Mahajan , "Estimating and Costing in Civil Engg.", Rainbow Book Company.			
8.3	Rangwala SC , "Estimating &Costing", Charotar Publishing House, Anand			
8.4	Kohli & Kohli , "Atext book on estimating &costing (Civil) with drawings", Ramesh Publications.			
8.5	P.W.D. Accounts,Chief Engineer, B & R, Punjab.			
9	Software Required		None	
10	Pedagogical Methods		White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task	

Course Title:		Environmental Engineering II		
Course Code:		CIV-604	Classification:	Compulsory Course
Credits:		4	Contact Hours/week:	4
1	Pre-requisites :	Environmental Engineering I		
2	Course Objectives	5. To study various waste water characteristics and their significance on treatment. 6. To analyse waste water system and its design 7. To analyse and design sewage system 8. To analyse industrial waste management, landfills and leachate.		
3	Course Outcomes	After the completion of this course, the students will be able to know : 1. The concepts of waste water and sewage systems. 2. Design of waste water system. 3. Sewer Design. 4. Industrial /solid waste management. 5. Landfills and leachate management.		
4	Examination Pattern [End Term Exam]	Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus: 4**5 Hours			

Section A

6.00	Units	Course Outcome Covered	Content	L+T Hours
6.01	UNIT 1 Waste Water	1	Various Sources: Sewage, Industrial Waste. Terms & definitions, systems of sanitation and their merits and demerits, system of sewerage, choice of sewerage system and suitability to Indian conditions, Sewer appurtenances, Materials for sewers. Laying of sewers, joints in sewers, testing of sewers pipes. Maintenance, operation and precaution before entering a sewer. Quantity of sanitary and storm sewage flow, forms of sewers. Conditions of flow in Sewers, sewers of equivalent PART, self cleansing and limiting velocity, hydraulic formula for flow of sewerage in sewers and their design	5hrs
6.02	UNIT 2 Characteristics & Testing of Sewage	2,3	wastewater Sampling and sampling types, Composition of sewage, physical, chemical & biological analysis of sewage, biological decomposition of sewage, kinetics of organic waste stabilization.	6 hrs
6.03	UNIT 3 TREATMENT OF SEWAGE	2,3	Unit processes of waste water treatment, screens, grit-chambers, detritus tank, skimming tank, grease traps, sedimentation, chemical treatment, aerobic biological treatment, trickling filter (LRTF & HRTF), activated sludge processes, anaerobic treatment, units-sludge digesters and biogas plant	12 hrs
Section B				
6.04	UNIT 4 Construction, Maintenance and Design of Sewers	4	Nature and characteristics of industrial wastes; Control and removal of specific pollutants in industrial wastewaters, i.e., oil and grease, cyanide. Fluoride, toxic organics, heavy metals.	12 hrs
6.05	UNIT 5 Industrial waste treatment	4,5	Sources, Composition and Properties of Municipal solid waste, Handling and Separation of solid waste, Introduction to Municipal Waste [Management and Handling Rules, 2000], Disposal of Municipal Solid Wastes, Solid Waste Collection and Transportation	5 hrs
6.06	UNIT 6 Ground Water	4,5	Solid waste management : Reduce, reuse, recycle of waste, waste to energy, Compositing, Incineration, Design and Management of landfills, Generation and	5 hrs

	Contamination		Control of Landfill gases, environmental control through liners, covers, leachate management, control and remedial measures for contaminated sites; pollution control regulations.	

Evaluation/Assessment:		
7.1	**Internal Assessment**	**50** (Class Teacher)
7.1.1	Assignments/ Quizzes/ Class Test	15(Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**
7.2	**External Assessment (End Term Exam)**	**50**
Text Book		
8.1	Environmental Engineering :Baljeet S. Kapoor, New Age Publishers	
8.2	Water Supply Engineering :S. K. Garg, Khanna Publishers	
8.3	Environmental Engineering :P. Venugopala Rao, PHI	
8.4	Water Supply & Sanitation Engineering :Gurcharan Singh, Std. Publishers	
8.5	Environmental Engineering :Peavy and Rowe, McGraw Hill Publishers	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title:		**Foundation Engineering**			
Course Code:		CIV-605	**Classification:**	Compulsory Core	
Credits:		4	**Contact Hours:**	4	
1	**Pre-requisites :**	**Knowledge of courses of Geotechnical Engineering**			
2	**Course Objectives**	The objective of the subject is to expand the knowledge used to design the different foundations of the different structures to be safely resisted by the soil without considerable settlement.			
3	**Course Outcomes**	On successful completion of this course, students will be able to: **1.**To understand the failure of slope. **2.**To calculate the bearing capacity of the soil. **3.**To understand the behavior of soil and its settlement under foundation. **4.**To understand the behavior of soil under deep foundation. **5.**To calculate the capacity of soil to resist the shallow as well as deep foundations.			
4	**Examination Pattern [End Term Exam]**	Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			
5	**Outline Syllabus:** 45 Lecture Hours				
Section A					
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Stability of Slope	1,4	Necessity, causes of failure of slopes. Stability analysis of infinite and finite slopes in sand and clay. Taylor's stability number and its utility.		8 hrs
6.02	Unit 2 Shallow Foundation	1	Introduction to the type of shallow foundations, Factors causing failure of foundation, Definitions of bearing capacities, Factors affecting bearing capacity. Terzaghis analysis for bearing capacity of soil, Skemptions equation, B. I. S. recommendations for shape, depth and inclination factors. Plate Load Test and Standard Penetration Test. Contact pressure distribution. Causes of settlement of structures, comparison of immediate and consolidation settlement, Calculation of settlement by plate load test and Static Cone Penetration Test data, Allowable settlement of various structures according to IS Code. Situation most suitable for provision of rafts foundation, Proportioning of rafts in sand and clays, Various methods of designing raft, Floating foundation.		10 hrs
6.03	Unit 3 Stress behavior in soil	2,3,4	Boussinesq's equation for a point load, uniformly loaded circular and rectangular area, Pressure distribution diagrams. New marks chart and its construction. Two- to – one method of load distribution Comparison of Boussinesq and Westergaard analysis for a point load. Limitations of elastic formula.		5 hrs
Section B					
6.04	Unit 5 Pile Foundation Preliminary Design	2,3,4	Determination of point resistance and frictional resistance of a single pile by static formula, Piles in clay, safe load on a friction and point bearing pile. Pile in sand spacing of piles in a group, factors affecting capacity of a pile group. Efficiency of pile group bearing capacity of a pile group in clay, Settlement of pile groups in clay and sand Negative skin friction.		8 hrs
6.05	Unit 6 Pile Foundation Final Design	2,3	Necessity and uses of piles, classification of piles, Types of pile driving hammers & their comparison, Effect of pile driving on adjacent ground. Use of Engineering news formula and Hiley's formula for determination of allowable load, Pile Load Test, separation of skin friction and point resistance using cyclic pile load test data. Related Numerical problems.		8 hrs
6.06	Unit 7 Well Foundation	5	Major area of use of caissons, Advantages and disadvantages of open box and pneumatic caissons. Essential part of a pneumatic caisson. Components of a well. Calculation of allowable bearing pressure. Conditions for stability of a well. Terzaghi's analysis for Lateral stability of a well, embedded in sand. Forces acting on a well foundation. Computation of scour depth, Tilts & Shifts.		6 hrs
Evaluation/Assessment:					

7.1	**Internal Assessment**	**50** (Class Teacher)
7.1.1	Assignments/ Quizzes/ Class Test	15(Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**
7.2	**External Assessment (End Term Exam)**	**50**
Text Book		
8.1	Ranjan G and Rao A S R "Basic and Applied Soil Mechanics" New Age International, New Delhi, 2000	
8.2	Murthy V N S "A Text Book of Soil Mechanics of Foundation Engineering" Sai Kripa Technical Consultants, Bangalore, 1993	
8.3	Bowles J E "Foundation Analysis and Design" McGraw Hill, New York, 1988	
8.4	Teng W C "Foundation Design" Prentice Hall of India, New Delhi, 1988	
8.5	Peck R B, Hanson W B and Thorn burn T H "Foundation Engineering" Jonh Wiley and Sons Inc, New York. 1974	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title:		**Steel Drawing - I**		
Course Code:		CIV-653	**Classification:**	Compulsory Core
Credits:		1	**Contact Hours:**	2
	Outline Syllabus: 26 Lecture Hours			
Section A				
1.00	**Expt./Problem**	**Content**		
1.01	Lab Expt./Problem 01	Detailed working drawing for bolted & welded connections		
1.02	Lab Expt./Problem 02	Detailed working drawing for Stanchion beam connections.		
1.03	Lab Expt./Problem 03	Detailed working drawing for Builtup column with lacings		
1.04	Lab Expt./Problem 04	Detailed working drawing for Plate girder		
1.05	Lab Expt./Problem 05	Detailed working drawing for Column Bases		
1.06	Lab Expt./Problem 06	Detailed working drawing for Grillage foundation		
1.07	Lab Expt./Problem 07	Detailed working drawing for Steel roof truss		
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5(Depends upon Percentage of Attendance in Class)		
2.03	Mid Term Viva-Voce	**30 (Best of two)**		
3	Software Required	**AutoCAD**		
4	Pedagogical Methods	**White/Black Board/ PPT/ Video Lecture/ Lab Equipments/Computers/Printers**		

Course Title:		**Environmental Engineering Lab.**		
Course Code:		CIV-654	**Classification:**	Compulsory Course
Credits:		1	**Contact Hours:**	2
5	**Outline Syllabus: 26** Lecture Hours			
		Section A		
1.00	**Expt./Problem**	**Content**		
1.01	Lab Expt./Problem 01	Determination of Colour & Turbidity		
1.02	Lab Expt./Problem 02	Determination of Solids: Total, Dissolved and Suspended solids.		
1.03	Lab Expt./Problem 03	Determination of Alkalinity, pH, and Acidity		
1.04	Lab Expt./Problem 04	Determination of Hardness (different types)		
1.05	Lab Expt./Problem 05	Determination of Chlorides.		
1.06	Lab Expt./Problem 06	Jar test for optimum coagulant dose estimation.		
1.07	Lab Expt./Problem 07	Determination of residual chlorine and chlorine dose.		
1.08	Lab Expt./Problem 08	Determination of DO.		
1.09	Lab Expt./Problem 09	Determination of BOD.		
1.10	Lab Expt./Problem 10	Determination of COD.		
1.11	Lab Expt./Problem 11	Determination of Sulphates.		
1.12	Field Visit	Field visit of water/sewage treatment plant		
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5(Depends upon Percentage of Attendance in Class)		
2.03	Mid Term Viva-Voce	**30 (Best of two)**		
3	Software Required	**NA**		
4	Pedagogical Methods	**White/Black Board/ PPT/ Video Lecture/ Lab Equipments/Computers/Printers**		

Course Title:		**Foundation Engineering Lab**		
Course Code:		CIV-655	**Classification:**	Compulsory Core (P)
Credits:		1	**Contact Hours:**	2
0.00	**Outline Syllabus: 30** Lab Hours			
1.00	**Experiment/Problem**	**Content**		
1.01	Lab Expt./Problem 01	Determination of Unconfined Compressive Strength of soil.		
1.02	Lab Expt./Problem 02	Determination of shear parameters by Direct Shear Test.		
1.03	Lab Expt./Problem 03	Determination of shear parameters by Triaxial Test.		
1.04	Lab Expt./Problem 04	Determination of undrained shear strength of cohesive soils by Vane Shear Test.		
1.05	Lab Expt./Problem 05	Determination of void ratio of cohesionless soil in loosest & densest state by Relative Density apparatus.		
1.06	Lab Expt./Problem 06	Determination of bearing capacity of soil by Standard Penetration Test.		
1.07	Lab Expt./Problem 07	To collect data about bearing capacity and frictional resistance of soil by Static Cone Penetration Test.		
1.08	Lab Expt./Problem 08	Determination of Consolidation parameters.		
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5 (Depends upon percentage of attendance in class)		
2.03	Mid Term Viva-Voce	**30 (Best of two)**		
3.00	**Text Books/Manuals**			
3.01	IS codes as recommended by BIS			
3.02	Engineering Soil Testing by Shamsher Prakash & P.K.Jain, Nem Chand & Bros, Roorkee			
4.00	Software Required	AutoCAD.		
5.00	Pedagogical Methods	White/Black Board/PPT/Video Lectures/ Lab Work using equipments/Computers/Printers.		

Course Title:		**Design of Steel Structures - II**			
Course Code:		CIV-701		**Classification:**	Compulsory Core
Credits:		4		**Contact Hours:**	4
1	**Pre-requisites :**	**Design of Steel Structures I and Structural Analysis I**			
2	**Course Objectives**	The course content should be taught and learning imparted with the aim to develop theoretical knowledge and skills so that they are able to:- 1. Make the students well acquainted with the advancement in the design of Steel structural elements 2. Study design procedures of various components used in fabrication of Steel bridges. 3. Use of concepts learnt in Design of steel structures –I.			
3	**Course Outcomes**	1. Understanding the advanced structures in steel design. 2. Visualise the different joints in steel structures. 3. Understanding the design of tubular structures and steel foot bridges. 4. Understanding the complete design of an industrial building. 5. Understanding the analysis and design of various components of Railway Bridge.			
4	**Examination Pattern [End Term Exam]**	The examiner shall set total seven questions. First Question is compulsory covering whole syllabus(ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part. Use of IS-800-2007 & Steel Tables is allowed.			
5	**Outline Syllabus: 4**5 Lecture Hours				
		Section A			
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	Unit 1 Design of tubular sections	1,3	Introduction, round tubular sections, permissible stresses, tube columns and compression members, tube tension members, tubular roof trusses, Design of tubular beams, Design of tubular purlins.		7 hours
6.02	Unit 2 Design of footbridge	1,2,3	Introduction, design of flooring, cross girders, analysis of N- type truss, design of various members of truss, design of joints, design of bearings.		8 hours
6.03	Unit 3 Design of Industrial Building	1,2,4	Gantry Girder, Column bracket, Mill bent and built-up bents with constant moment of inertia, Lateral and longitudinal bracing for column bent.		15 hours
		Section B			
6.04	Unit 4 Design of Steel bridge	1,2,5	Design of stringers, cross girders, connection between stringer and cross girder		5 hours
6.05	Unit 5 Design of bridge crossection	1,5	Design of main lattice girder and welded plate girders		5 hours
6.06	Unit 6 Design of bracing	1,5	Design of bottom lateral bracing and top lateral bracing, bearings		5 hours
Evaluation/Assessment:			50 [Internal]	50 [External]	
7.1	**Internal Assessment**		**50** (Class Teacher)		
7.1.1	Assignments/ Quizzes/ Class Test		15(Minimum 2 Mandatory Assignments)		
7.1.2	Attendance		5(Depends upon Percentage of Attendance in Class)		
7.1.3	Mid Term Exam		**30 (Best of two MTEs)**		
7.2	**External Assessment (End Term Exam)**		**50**		
		Text Book			
8.1	Arya A S and Ajmani J L “Design of Steel Structures” Nem Chand & Bros, Roorkee,1996				

8.2	Design of steel structures S, K, Duggal Tata McGraw hill	
8.3	Design of Steel Structures, N Subramanian Oxford Higher Education	
8.4	Dayaratnam P "Design of Steel Structures" Wheeler Publishers, New Delhi, 2000	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

	Course Title	**Design of Hydraulic Structures**		
	Course Code	**CIV – 702**	**Classification:**	**Compulsory Core**
	Credits	**4**	**Contact Hours**	**4**
1	**Pre- requisites**	**Irrigation Engineering**		
2	**Course Objectives**	1. The objective of this course is to introduce the students with various theories of seepage and design of various important irrigation based structures.		
3	**Course Outcomes**	On successful completion of this course, students will be able to 1. The student would be able to learn various theories of seepage, requirements of various structures at various locations within the overall layout of irrigation system and their differences and importance in irrigation engineering. 2. The course will also teach the design of various important irrigation based structures such as distributary regulators, weirs, barrages, sloping glacis weir, canal falls, aqueducts etc. 3. Student will also learn about various design of energy dissipaters 4. Students will learn about the design of non-modular, semi-modular and modular outlets.		
4.	**Examination pattern (End Term Examination)**	The examiner will set total seven questions. First Question is compulsory covering whole syllabus (ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part.		
5	**Outline Syllabus: 45 lectures**			
	Section A			
6.00	**Units**	**Course Outcome Covered**	**Content**	**Lecture Hours**
6.01	Unit 1 Theory of Seepage	1	Seepage force and exit gradient, Salient features of Bligh's Creep theory, Lane's weighted Creep theory and Khosla's theory, Determination of uplift. Pressures and floor thickness.	5
6.02	Unit 2 Design of Weirs	1,2	Weirs versus barrage, Design considerations with respect to surface flow, hydraulic jump and seepage flow. Design of barrage or weir	3
6.03	Unit 3 Energy Dissipation Devices	3	Use of hydraulic jump in energy dissipation, Factors affecting design, Types of energy dissipators and their hydraulic design.	6
6.04	Unit 4 Diversion Headworks	2	Functions and investigations: component parts of a diversion head work and their design considerations, Silt control devices.	7
	Section B			
6.05	Unit 5 Distributory regulators	2	Offtake alignment, Cross-regulators – their functions and design, Distributory head regulators, their design, Canal escape.	7
6.06	Unit 6 Canal Falls	2	Necessity and location, types of falls and their description, selection of type of falls, Principles of design, Design of Sarda type, straight glacis and Inglis or baffle wall falls.	5
6.07	Unit 7 Cross Drainage Works	1,3	Definitions, choice of type, Hydraulic design consideration, Aqueducts their types and design, siphon aqueducts their types and design considerations, super passages, canal siphons and level crossing.	6
6.08	Unit 8 Canal Outlets	4	Essential requirements, classifications, criteria for outlet behaviours, flexibility, proportionality, sensitivity, sensitiveness, etc. Details and design of non-modular, semi-modular and modular outlets.	6
	Evaluation/Assessment			
7.1	**Internal Assessment**		**50** (Class Teacher)	
7.1.1	Assignments / Quizzes/ Class Test		15 (Minimum two Mandatory Assignments	
7.1.2	Attendance		5 (Depends upon Percentage of attendance in Class)	
7.1.8	Sessional		30 (One best of 2)	
7.2	**External Assessment (End Term Exam)**		**50**	
	Text books			
8.1	Design of Irrigation Structures by S.K. Sharma. S.Chand.			

8.2	Irrigation and Water Power Engg. By B.C. Punmia & Pande B.B. Lal.,Luxmi Publuications.	
8.3	Irrigation Engg. by S.K. Garg, Khanna Publishers.	
8.4	I.S..Codes.	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Group Discussion and Task

Course Title		Hydrology & Dams		
Course Code		CIV-703	**Classification**	Compulsory Core
Credits		4	**Contact Hours**	4
1	**Pre-Requisites**	**Irrigation Engg.**		
2	**Course Objectives**	**1.** To Study basics of science of hydrology **2.** To study various types of dams and spillways **3**. Dams & spillways design considerations		
3	**Course Outcomes**	On successful completion of this course, students will be able to Demonstrate and Apply the use of 1. The student would be able to learn the basic concepts related to hydrology and dams. 2. The course will also detail about the hydrological parameters such as interception, evaporation etc and know their importance in design of various hydraulic structures. The various designs of irrigation structures to be learnt are based on the basics studied in this class. 3. Apart from study of basics of hydrology, the students will also learn about the dams and their types and apply this information on the topics of gravity, arch and buttress dams. 4. Overall, this course will give a general overview of hydrological processes taking place within our environment and will be helpful to apply in other courses of Civil engineering.		
4	**Examination Pattern**	Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each snd the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus:** 45 Lecture Hours			
	SECTION A			
6.00	**Units**	**Outcome Covered**	**Contents**	**Lecture Hours**
6.01	**Unit 1 Precipitation**	2	Importance of hydrological data in water resource planning, The hydrologic Cycle, Mechanics of precipitation, types and causes, Hyetograph, Averaging depth of precipitation over the basin, Mass-rainfall Curves, Intensity-duration frequency curves, Depth-area duration curves	**06 hours**
6.02	**Unit 2 Interception, Evapo-transpiration and filtration**	2,3	Factors effecting interception, Evaporation from free water surfaces and from land surfaces, Transpiration, Evapo-transpiration, factors effecting Infiltration rate, Infiltration capacity and its determination	04 hours
6.03	**Unit 3 Runoff**	2,3	Factors effecting run-off, Runoff hydrograph, S-curve hydrograph, Synder's Synthetic unit hydrograph, principles of flood -routing through a reservoir by ISD method	**06 hours**
6.04	**Unit 4 Peak Flows**	2,3	Estimation of peak flow by rational formulae, By use of hydrograph, Frequency analysis,Gumble's method, Design flood and its hydrograph	**04 hours**
	SECTION B			
6.05	**Unit 5 Introduction to Dams**	1,4	Choice of type of dam, Site selection, Investigation, Foundation treatment	**05 hours**
6.06	**Unit 6 Gravity dams**	1,4	No-overflow and over flow section of dams, Forces acting on dams, stability factors, stresses on the faces of dams, Design of profile by method of zoning, elementary profile of a dam, upstream lip ad approach ramp, discharge characteristics of spillways, General principles of design of spillways-ogee, chute, side channel and siphon	**07 hours**
6.07	**Unit 7**	1,4	Components of earthen dams and their functions,	**06 hours**

	Earthen dams		Phreatic line determination by analytical method, phreatic line determination y graphical method, seepage determination and control	
6.08	**Unit 8 Arch & Buttress dams**	1,4	**C**lassification of Arch dams, Constant radius, constant angle and various radius types, Cylinder theory, Expression relating central angle and cross-sectional area of arch, types of buttress dams, Advantages of buttress dam**s**	**07 hours**

Evaluation/Assessment		
7.1	Internal Assessment	50(Subject Incharge)
7.1.1	Assignments/Quizzes/Class Test	15(Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	30 (Best of two MTEs)
7.2	External Assessment	50(Subject Incharge)

TEXTBOOK	
8.1	Engineering Hydrology, By K. Subramanya, Tata Mc Graw Hill and Company, New Delhi.
8.2	Design of Small Dams, USBR Publication Oxford and IBH Publishing.
8.3	Design of Gravity dams, By Varshney, Gupta & Gupta; Earth dams By Bharat Singh, Nem Chand & Bros.
9	**Software Required** — None
10	**Pedagogical Methods** — White/Black Board/ PPT/ Live Examples/ Group Discussion/study Tours and Task

Course Title:		Bridge Engineering		
Course Code:		CIV-704	Classification:	Core Elective
Credits:		4	Contact Hours:	4
1	Pre-requisites :	Knowledge of Basics of Structural Analysis and RCC.		
2	Course Objectives	1. To discuss basic definitions, types, and components of bridges, and sub-surface investigations required for bridge construction. 2. To understand the hydraulic aspects of bridge design and standard specification for bridge design. 3. To perform design of slab type reinforced concrete bridge. 4. To perform design of bridges sub-structures, bearings and joints. 5. To have knowledge of quality control and maintenance aspect.		
3	Course Outcomes	On successful completion of this course, students will be able to: 1. Relate different design philosophies of the bridges. 2. Decide on the span and hydraulic parameters of a bridge as well as specify the design parameters of bridges. 3. Understand the structural behaviour of different components of a reinforced concrete bridges. 4. Analyze and design different components of highway bridges to meet desired needs within realistic constraints such as economy, environment friendly, safety, viable construction and its sustainability under loads standardized by Indian Road Congress (IRC). 5. Prepare and submit the designs in complete and concise manner.		
4	Examination Pattern [End Term Exam]	Examiner will set 7 questions of 10 marks each. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part. Use of IRC: 21:2014, IS 456-2000, and Pigeaud's curves is allowed.		
5	**Outline Syllabus: 45** Lecture Hours			
		Section A		
6.00	**Units**	**Course Outcomes Covered**	**Content**	**Lecture Hours**
6.01	UNIT 1 Introduction	1, 2	Definition, Investigation of Bridges: Need for investigations, selection of bridge site, choice of bridge type, preliminary data to be collected, design discharge and its determination , linear waterway, choice of span ,economical span, vertical clearance above HFL, afflux,. Scour depth.	8 hours
6.02	UNIT 2 Standard Specifications	2	I.R.C. loadings for road bridges, Codal provisions on width of carriage way, clearances, loads considered etc.	8 hours
6.03	UNIT 3 Reinforced Concrete Bridges	3,4	Classification of bridges, Pre-stressed concrete bridges, Balanced cantilever bridges, Design of R.C.C. Solid Slab bridge, Courbon's theory for load distribution.	8 hours
		Section B		
6.04	UNIT 4 Sub Structure	4	Types of piers and abutments, design forces, design of piers and abutments.	9 hours
6.05	UNIT 5 Bearing and Joints	4	Various types of expansion bearing and fixed bearings, elastomeric bearings, joints and their types.	4 hours
6.06	UNIT 6 Lessons from Bridge Failures	1,4	Major causes, Flood and scour failures, Brittle failures, erection errors, design deficiencies, earthquake effects, failures due to wind, fatigue, corrosion.	4 hours
6.07	UNIT 7 Recent Trends in Bridge Engineering	4,5	Urban flyovers and elevated roads, High performance concrete and steel, Durability considerations.	4 hours
Evaluation/Assessment:			50 [Internal]	50 [External]

7.1	**Internal Assessment**	**50** (Class Teacher)
7.1.1	Assignments/ Quizzes/ Class Test	15 (Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5 (Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	**30 (Best of two MTEs)**
7.2	**External Assessment (End Term Exam)**	**50**
Text Book(s)		
8.1	Victor D .J, "Essentials of Bridge Engineering", Oxford and IBH Publishers, New Delhi, 2012.	
8.2	Jagadeesh T.R. and Jayaram M.A., "Design of Bridges",PHI, New Delhi , 2012.	
8.3	Krishnaraju N. ''Design of bridges", Oxford and IBH Publishers, New Delhi.	
8.4	Codes: IRC 21:2014, IRC 6:2000, IS 456:2000	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title:		Hydropower Engineering		
Course Code:		CIV-705	Classification:	Core Elective
Credits:		4	Contact Hours:	4
1	Pre-requisites :	Knowledge of Irrigation Engineering and Hydrology and dam4		
2	Course Objectives	1. To study the features of hydropower engineering and water power potential in India. 2. To impart the knowledge of hydrology used for hydropower and discuss the types of hydropower plants. 3. To study the major components of a dam including water conveyance and their design aspects. 4. To understand the working and design principles of intakes, tunnels and surge tanks. 5. To study the power generation using different types of turbines and systems used for onward transmission of electricity.		
3	Course Outcomes	Upon successful completion of this course, it is expected that students will be able to: 1. Describe various aspects of hydro-electric power potential, and identify suitable type of hydropower plant for given site conditions. 2. Use hydrology principles to estimate capacity of reservoirs and decide on other factors. 3. Analyze and present design overview of different types of water conveyance systems as well as spillways and tunnels. 4. Describe the fundamentals of working of surge tank and power house. 5. Give overview of power transmission and discuss about the financial aspects.		
4	Examination Pattern [End Term Exam]	Examiner will set 7 questions of 10 marks each. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.		
5	**Outline Syllabus: 45** Lecture Hours			
	Section A			
6.00	**Units**	**Course Outcomes Covered**	**Content**	**Lecture Hours**
6.01	UNIT 1 Introduction	1	Waterpower Development – its types, distribution and use World's largest hydropower generating plants, Potential of hydropower in India- its development and future prospect.	4 hours
6.02	UNIT 2 Analysis of Stream Flow and Demand	1,2	Flow duration curve, firm power, Secondary power, Load factor and Load duration curves, firm capacity, reservoir capacity, capacity factor etc.	4 hours
6.03	UNIT 3 Types of Hydro Power Plants	1,2,3	Classification of hydro power plants, Run-of-river plants, Valley dam plants, High head diversion plants, Diversion Canal Plants, Pumped storage plants, Tidal power plants.	5 hours
6.04	UNIT 4 Water Conveyance System	3	Power Canals, Alignment, Design of Power canals, Flumes, Covered conduits and Tunnels. Penstocks- Alignment, types of penstocks, Economic Diameter of penstocks, Anchor blocks.	5 hours
6.05	UNIT 5 Spillways	3	Selection of site, Preliminary Investigations, Final Investigations, Spillway capacity, classification of Spillways, Design of Ogee Spillway, Stilling Basins, Spillways crest gates.	5 hours
	Section B			
6.06	UNIT 6 Intake Structures	3	functions, location, intake type, trash rack, dimension, design, spacing of bars, method of cleaning, shape of inlet, power canal, location, site, forebay, size, capacity, gates and valves.	5 hours
6.07	UNIT 7 Tunnels	3	Geometric and hydraulic design, penstock, location, type, Economical diameter of penstock.	5 hours
6.08	UNIT 8	4	Functions, type, Design of Surge tank, methods of surge	4 hours

	Surge Tank		analysis, restricted orifice and differential surge tanks, downstream surge tanks.	
6.09	UNIT 9 Power House Details	1,4	Location, site and general arrangements, draft tubes, tail trace and their hydraulic design, turbines, number, make, size, type, characteristics and efficiency, pumps, Generators, exciters, switchboard, transformers and other accessories.	6 hours
6.10	UNIT 10 Transmission Systems	5	General introduction, financial implications of Hydro Power plants	3 hours
Evaluation/Assessment:			50 [Internal] 50 [External]	
7.1	**Internal Assessment**		**50** (Class Teacher)	
7.1.1	Assignments/ Quizzes/ Class Test		15 (Minimum 2 Mandatory Assignments)	
7.1.2	Attendance		5 (Depends upon Percentage of Attendance in Class)	
7.1.3	Mid Term Exam		**30 (Best of two MTEs)**	
7.2	**External Assessment (End Term Exam)**		**50**	
Text Book(s)				
8.1	Barrows H K "Water Power Engineering" Tata McGraw Hill Publishing Company Ltd. New Delhi, 1999.			
8.2	Varshney R S "Hydro Power Structures" Nem Chand & Bros., Roorkee, 2000.			
8.3	Garg S K "Irrigation Engineering and Hydraulic Structures" Khanna Publishers, New Delhi, 1998.			
8.4	Galce A A "Handbook of Dam Engineering" Van Nostrang Rheinhold Co., New York, 2000.			
8.5	Justin J D and Creager W P "Engineering for Dams" Vols. 1 to 3, John Wiley & Sons, New York, 1998.			
8.6	Hydro Power an Indian Perspective, Author-Cum-Editor Dr. B.S.K. Naidu, Director General, NPTI.			
9	**Software Required**	None		
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task		

Course Title:		**Dynamics of Structures**		
Course Code:		CIV-706	**Classification:**	Compulsory Core
Credits:		4	**Contact Hours:**	4
1	**Pre-requisites :**	**Design of RCC structures-I**		
2	**Course Objectives**	1. To understand dynamic behavior of structures 2. To study SDOF and MDOF systems 3. To know various mode shapes and frequencies		
3	**Course Outcomes**	1. To know various dynamic loadings 2. To be able to understand various degrees of freedom systems 3. To be able to find out mode shapes and natural frequencies 4. To be able to find out fundamental frequency 5. To be able to find out dynamic response 6. To be able to construct response spectra		
4	**Examination Pattern [End Term Exam]**	The examiner shall set total seven questions. First Question is compulsory covering whole syllabus(ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part. Use of IS-800-2007 & Steel Tables is allowed.		
5	**Outline Syllabus:** 45 Lecture Hours			

Section A

6.00	**Units**	**Course Outcome Covered**	**Content**	**Lecture Hours**
6.01	UNIT 1 Introduction	1,3,4	Nature of dynamic loading: Harmonic, Earthquake and blast loading, Single degree of freedom systems, Free vibrations and Forced vibrations: Harmonic force, Periodic force, Impulse, and General type of loading	8 hours
6.02	UNIT 2 Multi Degree of freedom system	2,3, 4	Multi-degree of freedom system: Free and Forced vibrations of lumped MDOF Systems,	8 hours
6.03	UNIT 3 Mode shapes	2,3	Numerical techniques for finding natural frequencies and mode shapes, orthogonality	8 hours
		Section B		
6.04	UNIT 4 Principal modes	2,3,4	Relationships of principal modes, Rayleighs Principle and its application for determination of fundamental frequency.	8 hours
6.05	UNIT 5 Mode superposition method	5	Evaluation of dynamic response by mode superposition method.	5 hours
6.06	UNIT 6 Response spectra	6	Construction of Response spectra. Response spectra for elastic design	8 hours

	Evaluation/Assessment:	
7.1	**Internal Assessment**	50 (Class Teacher)
7.1.1	Assignments/ Quizzes/ Class Test	15(Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	30 (Best of two MTEs)
7.2	**External Assessment (End Term Exam)**	50
	Text Books	
8.1	Dynamics of Structures by Chopra ,Anil K	
8.2	Structural Dynamics by Paz, Mario,	
8.3	Dynamics of Structures by Clough and Penzien	
9	Software Required	None
10	Pedagogical Methods	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

Course Title:		**Steel Drawing II**		
Course Code:		CIV-751	**Classification:**	Compulsory Core
Credits:		1	**Contact Hours:**	2
5	**Outline Syllabus: 26** Lecture Hours			
1.00	**Expt./Problem**	**Content**		
1.01	Lab Expt./Problem 01	Detailing of industrial building		
1.02	Lab Expt./Problem 02	Detailing of tubular roof truss		
1.03	Lab Expt./Problem 03	Detailing of the gantry girder		
1.04	Lab Expt./Problem 04	Detailing of footbridge		
1.05	Lab Expt./Problem 05	Detailing of the through type railway bridge		
Evaluation/Assessment:		**50 [Internal]**		
2.00	**Internal Assessment**	**50** (Class Teacher)		
2.01	Lab Performance	15		
2.02	Attendance	5(Depends upon Percentage of Attendance in Class)		
2.03	Mid Term Viva-Voce	**30 (Best of two)**		
3	Software Required	**AutoCAD**		
4	Pedagogical Methods	**White/Black Board/ PPT/ Video Lecture/ Lab Equipments/Computers/Printers**		

Course Title		Advanced Environmental Engineering			
Course Code		CIV-801	Classification	Compulsory core	
Credits		4	Contact Hours	4	
1	Pre-requisites	Knowledge Of Environmental Issues In India, Biological Environment, Soil & Agricultural Pollution, Global Issues, Eia & Environmental Audit, Industrial Pollution, Waste Water From Industries , Solid Waste Management, Legal Requirements			
2	Course Objectives	**1.** To Study recent environmental trends **2.** To study global environmental issues across domestic and industrial life.			
3	Course Outcomes	On successful completion of this course, students will be able to Demonstrate and Apply the use of 1. Students will be able to apply the knowledge and understanding gained through the course to the practical projects 2. Students will be able to analyze & audit environmental issue like biological, soil & agricultural etc.			
4	Examination Pattern(End Term Exam)	Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each snd the candidate is required to attempt at least two questions from each part.			
5	**Outline Syllabus:** 45 Lecture Hours				
	SECTION A				
6.00	**Units**	**Course Outcome Covered**	**Contents**		**Lecture Hours**
6.01	Unit1 Environmental Issues in India	1	Forest and agricultural degradation of land, Resource depletion, Environmental degradation, Public Health, Loss of biodiversity, Loss of Resilience in ecosystems, Land pollution, Green house emissions, Environmental issues and Indian Law, Conservation, Specific issues		06 hours
6.02	Unit 2 Biological Environment	1	Community health-Significance, Disease Transmission, Health Education, Occupational Health, Hazards, Plan prevention and control, Water borne diseases		06 hours
6.03	Unit 3 Soil & Agricultural pollution	1	Top soil Pollution, Parameter of soil analysis, Remedial measures, Related disease, Green construction & Eco renovation,CO2 pollution and global warming, Compact fluorescent lights, Radiation/Nuclear/ radioactive pollution		07 hours
6.04	Unit 4 EIA & Environmental Audit	1,2	Environmental impact, Social and economic aspects, Brief study of environmental audit, Audit items, Audit procedure, Safety Audit		05 hours
SECTION B					
6.05	Unit 5 Industrial Pollution	1,2	Paper and a pulp, Cane sugar and distilleries, Dairy plant, Petrochemical & refineries, Other industrial units		05 hours
6.06	Unit 6 Waste water from Industries	1,2	Waste characteristics, harmful effects, Pre treatment of industrial waste, reduction of waste strength and volume equalization and neutralization.		05 hours
6.07	Unit 7	1,2	Municipal Solid Waste rules, Hazardous waste rules,		06 hours

	Legal Requirements		Biomedical waste rules, Rules related to recycled plastics, Used batteries, flyash etc., Function of pollution control board & legal aspect	
6.08	Unit 8 Solid Waste Management	1,2	Properties of solid waste, Management of solid waste in India, Disposal of solid waste, Sanitary land filling including leachate collection and treatment, Recovery of methane from landfill sites for power generation	05 hours

Evaluation/ Assessment		
7.1	**Internal Assessment**	50(Subject Incharge)
7.1.1	Assignments/Quizzes/Class Test	15(Minimum 2 Mandatory Assignments)
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	30 (Best of two MTEs)
7.2	**External Assessment**	50(Subject Incharge)

Text Book	
8.1	Waste Water Engg. By Metcalf and Eddy Inc. TMH.
8.2	Elements of Public Health Engg. By K.N.Duggal

9	**Software required**	None
10	**Pedagogical Methods**	White/Black Board/ PPT/ Live Examples/ Group Discussion/Study Tours and Task

Course Title:		**Computational Methods**			
Course Code:		CIV-802		**Classification:**	Elective
Credits:		4		**Contact Hours:**	4
1	**Pre-requisites :**	**Knowledge of Basics of Matrices, Algebra and Differential equations.**			
2	**Course Objectives**	The development of fast, efficient and inexpensive computers has significantly increased the range of engineering problems that can be solved reliably. The course aims at: 1. Use computers to solve problems by step-wise, repeated and iterative solution methods, which would otherwise be tedious or unsolvable by hand-calculations. 2. To formulate engineering problems using systems approach and optimization, develop awareness of the shortcomings, approximations and uncertainties associated with numerical methods and modeling. 3. To give an overview of computational techniques of interest to process engineer. The focus being on the techniques themselves, rather than specific applications			
3	**Course Outcomes**	The theory should be taught along with examples in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes: 1. Students can able to solve problem sets relevant to civil engineering through problem formulation, solution algorithm design and programming application. 2. To improve computational skills and be proficient in programming language required to solve engineering problems and recognize the need for life-long learning, and advancement of computational skills for solving complex civil engineering problems.			
4	**Examination Pattern [End Term Exam]**	The examiner shall set total seven questions. First Question is compulsory covering whole syllabus(ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part.			
5	**Outline Syllabus: 45**Lecture Hours				
Section A					
6.00	**Units**	**Course Outcome Covered**	**Content**		**Lecture Hours**
6.01	UNIT 1 matrices & linear system of equations	1,2	Linear dependence of vectors, relation between rank of a matrix and linear independent vectors of matrix, similar matrices, characteristic vector and characteristic roots of a matrix, Cauley- Hamilton Theorem, Consistency of a linear system of a equations, solution of linear systems, direct method, matrix inversion, Gaussian elimination, method of factorization, iterative methods—Jacobi's method, Gauss- Siedal method, solution of tridiagonal systems.		15 hours
6.02	UNIT 2 sequences & series	1,2	Sequences, limits of sequences, infinite series, series of positive terms, integral test, comparison test, ratio test, root test, Alternating series, Absolute and conditional Convergence, Leibnitz test, Power series: radius of convergence of power series, Taylor's and Maclaurin's series, Formulae for remainder term in Taylor and Maclaurin series, Formulae for remainder term in taylor and Maclaurin series, Error estimates.		12 hours
Section B					
6.03	UNIT 3 numerical method	1,2	Numerical differentiation using finite differences, numerical integration using Trapezoidal rule, Simpson's one third rule, Simpson's Three-eight rule, numerical solution of first order ordinary differential equation using Taylor's series method, Picard's method, Euler's method, Modified Euler's method, Range Kutta method and Predictor-Corrector method,(Adam methods and Milne's method) Simultaneous equations of first order, higher order ordinary differential equations reducible to simultaneous differential equations of first order, ordinary linear differential equations, boundary value problem using finite difference method.		18 hours
Evaluation/Assessment:					
7.1	**Internal Assessment**		**50** (Class Teacher)		
7.1.1	Assignments/ Quizzes/ Class Test		15(Minimum 2 Mandatory Assignments)		
7.1.2	Attendance		5(Depends upon Percentage of Attendance in Class)		
7.1.3	Mid Term Exam		**30 (Best of two MTEs)**		

7.2	**External Assessment (End Term Exam)**	**50**
Text Book		
8.1	S.S. Sastry, “Introductory methods of Numerical Analysis”,PHI Learning Pvt. Ltd.	
8.2	B.S.Grewal,“Higher Engg. Mathematics”,Khanna Publishers, New Delhi.	
8.3	E Balagurusamy, “Numerical Methods”,Tata Mc-Graw Hill Education.	
9	**Software Required**	Excel or equivalent
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task

	Course Title	Maintenance of Building		
	Course Code	**CIV - 803**	**Classification:**	**Compulsory Core**
	Credits	**4**	**Contact Hours**	**4**
1	**Pre- requisites**	**Learning the objectives and methods for maintenance of buildings**		
2	**Course Objectives**	1.Importance of maintenance 2. Maintenance management 3. Repair materials 4. Investigation and diagnosis for repair of structures 5. Problems and root causes and remedial measure		
3	**Course Outcomes**	On successful completion of this course, students will be able to 1. To understand the importance of maintenance 2. Learning the methods for maintenance management 3. Introduction to repair materials 4. Investigation and diagnosis for repair of structures 5. Understanding the problems and root causes and remedial measure of various building defects		
4.	**Examination pattern (End Term Examination)**	The examiner will set total seven questions. First Question is compulsory covering whole syllabus (ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part.		
5	**Outline Syllabus: 45 lectures**			

Section A

6.00	**Units**	**Course Outcome Covered**	**Content**	**Lecture Hours**
6.01	Unit 1 Principles of Maintenance	1,4	Importance of maintenance, deterioration and durability, factors affecting decision to carryout maintenance, maintenance and GNP, agencies causing deterioration, effect of deterioration agencies on materials**.**	6
6.02	Unit 2 Design and Economic Consideration in Maintenance	2,4	Factors to reduce maintenance at design stage, consideration lf maintenance aspects in preparing tender document and specifications, sources of error in design which enhances maintenance and its importance at design stage. Economic consideration in maintenance: physical life, functional life, economic life of different types of buildings, discounting technique for assessment of economic life**.**	6
6.03	Unit 3 Maintenance Management	2	Definition, organization structure, work force for maintenance, communication needs, building inspections, maintenance budget and estimates, property inspections and reports, specification for maintenance jobs, health and safety in maintenance, quality in maintenance, maintenance manual and their importance**.**	8
6.04	Unit 4 Material for maintenance	3	Compatibility of repair materials, durability and maintenance, types of materials, their specification and application, criteria for selection of material, use of commercial available materials in maintenance.	6
Section B				
6.05	Unit 5 Investigation and diagnosis for repair of structures	4,5	Basic approach to investigations, physical inspection, material tests, non-destructive testing for diagnosis, estimation of actual loads and environmental effects, study of design and construction practices used in original construction, retrospective analysis, and confirmation and repair steps	**5**
6.06	Unit 6 Maintenance problems and Root Causes	4	Classification of defects, need for diagnosis, type of defects in building elements and building materials defect location, symptoms and causes.	6
6.07	Unit 7 Remedial	4,5	Preventive maintenance and special precautions – considerations, preventive maintenance for floors, joints, wet areas, water supply and sanitary systems,	4

	Measures for Building Defects		termite control, common repair techniques, common methods of crack repair, Repair of existing damp proofing systems in roofs, floors and wet areas, Protection, repair and maintenance of RCC elements, Repair of finishes, Repair of building joints, Repair of water supply and sanitary systems, underground and over head tanks, Common strengthening techniques.	
6.08	Unit 8 Maintenance of Multi-storey Buildings	2,5	Specials features for maintenance of multi-storeyed buildings, including fire protection system, elevators, booster pumps, generator sets.	2
6.09	Unit 9: Maintenance of Services	5	Leakage detection techniques in pipes, cleaning of pipes, replacement of pipes, clogging of sewer pipes, cleaning and their repairs, special precaution required in sewer pipe maintenance, maintenance of septic tanks, maintenance of AC and electrical system in buildings.	2

7	**Evaluation/Assessment:**	
7.1	**Internal Assessment**	**50** (Class Teacher)
7.1.1	Assignments / Quizzes/ Class Test	15 (Minimum two Mandatory Assignments)
7.1.2	Attendance	5 (Depends upon Percentage of attendance in Class)
7.1.8	Sessional	30 (One best of 2)
7.2	**External Assessment (End Term Exam)**	**50**

	Text books
8.1	Concrete Repairs & Maintenance by Peter H. Emmons & Gajanan M. Subnis.R.S.Means Company.
8.2	Repair and Rehabilitation of Concrete Structures, ACI Compilation 10.
8.3	Building Repair and maintenance management, Gahlot & Sharma, CBS, Publications
8.4	Maintenance of Buildings, A.C. Panchdari, New Age International (P) Limited Publishers
8.5	G. Szechy, D.Sc: Foundation Failures, Concrete Publications Limited 14 Dartmouth Street, London.
8.6	H.J Eidridge, Common Defects in Buildings, Her Majesty's Stationery Office, London
8.7	Concrete Repair: Vol. I, II & II published by the Aberdeen Group.
8.8	W.H. Ransom; Building Failures: Diagnosis and Avoidance, New Age Publications (P) Limited

9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Group Discussion and Task

Course Title		Advanced Transportation Engineering			
Course Code		CIV-804	**Classification**	Compulsory Core	
Credits		**4**	**Contact Hour**s	4	
1	**Pre-requisite**	**Transportation Engineering I & II**			
2	**Course Objectives**	1. To give knowledge about different components of rigid pavements 2. Knowledge about design of flexible & rigid pavements 3. To give them knowledge about various methods of design of bituminous mix 4. Marshall method bituminous mix design 5. To give basic knowledge about harbours, docks and tunnels			
3	**Course Outcomes**	On successfulll completion of this course, students will be able to Demonstrate and Apply the use of **1.**Learn principles and design elements of pavements **2.** Various bituminous mix design methods 3. Various water transportation measures and facilities available with them 4. Construction and design of tunnels 5.Safety measures in tunnels			
4	**Examination Pattern(End Term Exam)**	Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 5 conceptual questions of 2 marks each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			
5	**Outline Syllabus:**45 Lecture Hours				
	SECTION A				
6.00	**Units**	**Course Outcome covered**	**Contents**		**Lecture Hours**
6.01	Unit 1 Introduction	1	Types of pavements, Importance and functions of various components of pavement structure, Design factors: design wheel load, Equivalent single wheel load, Repetition of loads, Climatic variations		04
6.02	Unit 2 Design of flexible pavements	**1**	CBR method of flexible pavement Design, Group index method of pavement Design, IRC method of design of flexible pavements		04
6.03	Unit 3 Design Of Rigid pavements	**1**	General Design considerations, Wheel load stresses, Westergaaard's stress equation for wheel load, Temperature stresses, Design of joints, Evaluation of wheel load stresses, Design of dowel and tie bars, IRC method of design of rigid pavements		05
6.04	Unit 4 Bituminous Mix Design	2	Requirement of bituminous mixes, Marshall method of bituminous mix design		04
	SECTION B				
6.05	Unit 5 Harbours	**3**	Harbours and ports, Natural Phenomenon: Tides, wind and Waves, Classification of harbours, Facilities at a major port, Protection facilities: wall type and special breakwater, Planning & layout of ports		04
6.06	Unit 6 Docks	3	General classification of Docks, Various docking facilities, Repairing facilities: Fixed form & movable form, Approach facilities, Loading & unloading facilities, Guiding facilities: storing facilities, Lighthouse & signals		05
6.07	Unit 7 Tunnels	4	General, Basic definitions, Advantages and disadvantages of tunnels and open cut**s**, Classificaation of tunnels, tunnel approaches		02
6.08	Unit 8 Problems in Tunnelling	4,5	Introduction to various stages in tunnel construction, Methods of tunnelling in soft soils and rocks, Tunnel lining; necessity and materials used, Drainage in tunnel, Health protection in tunnels		02
	Evaluation/ Assessment				
7.1	**Internal Assessment**	50(Subject Incharge)			
7.1.1	Assignments/Quizzes/Clas	15(Minimum 2 Mandatory Assignments)			

	s Test	
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)
7.1.3	Mid Term Exam	30 (Best of two MTEs)
7.2	**External Assessment**	50(Subject Incharge)
Text-Book		
9.1	Khanna S.K.,and Justo,C.E.G. " Highway Engineering", Nem Chand and Brothers,Roorkee,2014. Bindra, S.P." Docks & harbour engineering", Dhanpat Rai Publications.2002.	
9.2	IRC-37:2002(Design of Rigid pavements), IRC-58:2002(Design ofvFlexible pavements)	
	Software required	None
10	**Pedagogical Methods**	White/Black Board/ PPT/ Live Examples/ Group Discussion/study Tours and Task

	Course Title	**Prestressed Concrete Design**		
	Course Code	**CIV - 805**	**Classification:**	**Elective**
	Credits	**4**	**Contact Hours**	**4**
1	**Pre- requisites**	**Knowledge of Basics of Structural Analysis and RCC**		
2	**Course Objectives**	1. To learn the principles, materials, methods and systems of prestressing. 2. To know the different types of losses and deflection of prestressed members. 3. To learn the design of prestressed concrete beams for flexural, shear and tension. 4. To calculate ultimate flexural strength of beam. 5. To learn the design of anchorage zones.		
3	**Course Outcomes**	On successful completion of this course, students will be able to 1. To differentiate between Reinforced Concrete and Prestressed Concrete. 2. To design a prestressed concrete beam for flexural, shear and torsion after accounting for losses. 3. To design the anchorage zone for post tensioned members. 4. To explain the systems of pre tensioning and post tensioning. 5. To explain the losses in prestress.		
4.	**Examination pattern (End Term Examination)**	The examiner will set total seven questions. First Question is compulsory covering whole syllabus (ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part.		
5	**Outline Syllabus: 45 lectures**			
	Section A			
6.00	**Units**	**Course Outcome Covered**	**Content**	**Lecture Hours**
6.01	Unit 1 Introduction	1	Basis concepts, Materials used, advantages of prestressed Concrete, Applications of prestressed concrete.	5
6.02	Unit 2 Materials for Prestressed Concrete	1,4	High strength concrete, strength requirements permissible stresses in concrete, creep & shrinkage, deformation characteristics, high strength steel, strength requirements, permissible stress in steel.	5
6.03	Unit 3 Prestressing Systems	4	Introduction, pre-tensioning systems, post-tensioning systems, chemical prestressing.	5
6.04	Unit 4 Loss of Prestress	5	Nature of losses, different types of losses and their assessment.	5
	Section B			
6.05	Unit 5 Analysis of prestress and bending stress	1,2	Basic assumptions, Resistant stresses at a section, pressure line, and concept of land balancing, stresses in grading moment.	5
6.06	Unit 6 Flexural Shear strength of prestressed Concrete sections	2,3	Types of flexural failure, strain compatibility method, code procedures, shear and principal stresses, ultimate shear resistance of pressed concrete members, prestressed concrete members in torsion.	8
6.07	Unit 7 Transfers of prestress in Pre –tensioned and post-tensioned members	2,3	Transmission Length, bond structures, Transverse tensile stress End-zone reinforcement, stress distribution in end block.	6
6.08	Unit 8 Design Prestressed concrete sections	3	Design of section for flexure, Axial tension compression & bending, shear, bond and torsion.	6
7	**Evaluation/Assessment:**	**50 (Internal)**	**50 (External)**	
7.1	**Internal Assessment**	**50** (Class Teacher)		
7.1.1	Assignments / Quizzes/ Class Test	15 (Minimum two Mandatory Assignments)		
7.1.2	Attendance	5 (Depends upon Percentage of attendance in Class)		
7.1.8	Sessional	30 (One best of 2)		

7.2	**External Assessment (End Term Exam)**	**50**
	Text books	
8.1	Raju N K, “Prestressed Concrete” Tata McGraw Hill, New Delhi, 2001.	
8.2	Rajagopalan N, “Prestressed Concrete” Narosa, New Delhi, 2001.	
8.3	Dayaratnam P, “Prestressed Concrete” Oxford & IBH, New Delhi, 1999.	
8.4	Lin T Y, “Prestressed Concrete” McGraw Hill, New York, 1985.	
8.5	Edward G. Navy, “Prestressed Concrete-A Fundamental Approach” Prentice Hall Publishers, NY,2000	
9	**Software Required**	None
10	**Pedagogical Methods**	White/Black Board/ Scenarios/ PPT/ Video Lecture/ Group Discussion and Task

Course Title:		**Earthquake Resistant Design of structures**		
Course Code:		CIV-806	Classification:	Compulsory Core
Credits:		4	Contact Hours:	4
1	Pre-requisites :	Design of RCC structures		
2	Course Objectives	1. To study concept of earthquake resistant design 2. To study various IS codes related to earthquake resistant design		
3	Course Outcomes	1. To be able to design RCC structures according to 1893 2. To be able to do ductile detailing of RCC structures according to IS:13920 3. To apply IS : 4326 to masonry structures 4. To be able to apply IS: 13928 to structures .		
4	Examination Pattern [End Term Exam]	The examiner shall set total seven questions. First Question is compulsory covering whole syllabus(ten questions carrying one mark each). Three questions will be set from Part A and three questions from Part B (carrying 10 marks each) and students are required to attempt 2 questions from each part. Use of IS-800-2007 & Steel Tables is allowed.		
5	Outline Syllabus: 45 Lecture Hours			

Section A				
6.00	Units	Course Outcome Covered	Content	Lecture Hours
6.01	Unit I	1	Introduction to Seismicity, Earthquake Motion and Response, Response Spectra, Philosophy of Capacity Design.	8 hours
6.02	Unit II	1	Concepts of seismic design: Earthquake resistant design of R.C.C Structures and IS:1893.	8 hours
6.03	Unit III	2	Earthquake resistant construction of R.C.C. Elements: Detailing aspects and IS:13920	8 hours
Section B				
6.04	Unit IV	1,3,4,5	Introduction to Indian Standards, related to Earthquake Engineering	8 hours
6.05	Unit V	4	Earthquake resistant design according to IS:13928	5 hours
6.06	Unit VI	3	Earthquake resistant design of Brick Masonry Structures and IS: 4326	8 hours

Evaluation/Assessment:		50 [Internal]	50 [External]
7.1	Internal Assessment	50 (Class Teacher)	
7.1.1	Assignments/ Quizzes/ Class Test	15(Minimum 2 Mandatory Assignments)	
7.1.2	Attendance	5(Depends upon Percentage of Attendance in Class)	
7.1.3	Mid Term Exam	30 (Best of two MTEs)	
7.2	External Assessment (End Term Exam)	50	

Text Book	
8.1	Earthquake Resistant design of structures by Pankaj Aggarwal
8.2	Earthquake Resistant design of structures by S.K. Duggal
8.3	IS 1893:2002
8.4	IS 13920:1993
8.5	IS :4326:1993
8.6	IS:13928:1993
9	Software Required: None
10	Pedagogical Methods: White/Black Board/ Scenarios/ PPT/ Video Lecture/ Role Play/ Group Discussion and Task