Program: B. Tech. Civil Sem: VII (CBCS 2021 course)

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1.		Foundation Engineering	4	-	-	60	40	-	-	-	100	4	-	-	4
2.		Elective-I	3	2	-	60	40	25	25	-	150	3	1	-	4
3.		Waste Water Treatment and Management**	4	2	-	60	40	25	25	-	150	4	1	-	5
4.		Advanced Design of Structures*	4	2	-	60	40	25	25	-	150	4	1	-	5
5.		Project Stage-I	-	2	-	-	-	50	50	-	100	-	3	-	3
6.		Civil Engineering Software – III (Auto Scan and Auto Steel)	-	2	-	-	-	25	25	-	50	-	1	-	1
7.		Internship #	-	-	-	-	-	25	25	-	50	--	3	-	3
	Total		**15**	**10**	**-**	**240**	**160**	**175**	**175**	**-**	**750**	**15**	**10**	**-**	**25**

*Theory paper of 4 hours duration
**Industry Taught Course – V
Period- 60 days

Program: B. Tech. Civil Sem: VIII(CBCS 2021 course)

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1.		Seismic Design of Structures	4	2	--	60	40	25	--	-	125	4	1	-	5
2.		Hydraulic Structures	3	2	1	60	40	25	25	-	150	3	1	1	5
3.		Elective-II	4	-	-	60	40	-	-	-	100	4	-	-	4
4.		Construction Quality Control and Safety*	3	2	-	60	40	25	25	-	150	3	1	-	4
5.		Project Stage-II	-	4	-	--	-	100	100	-	200	--	6	-	6
6.		Civil Engineering Software – IV (E TABS)	-	2	-	--	-	25	-	-	25	--	1	-	1
	Total		**14**	**12**	**1**	**240**	**160**	**200**	**150**	**-**	**750**	**14**	**10**	**1**	**25**
	Research Paper Publication**		-	-	-	-	-	-	-	-	-	-	-	-	2

*Industry Taught Course – VI
** Add on course

List of Elective Courses:

Sr. No.	Elective –I B. Tech (Civil)Sem-VII	Elective –II B. Tech (Civil) Sem-VIII
1	Advanced Concrete Technology	Advanced Steel Design
2	Urban Water Management	Geo-synthetics and application
3	Human Resource Management	Urban Planning
4	Environmental Impact Assessment	Rural Sanitation
5	Green Construction Practices	Advanced Engineering Geology with Rock Mechanics
6	Docks,Ports and Harbours	Design of Foundations
7	Ground Water Hydrology	Metro Systems and Engineering
8	Ethics for Civil Engineers	Bridge Engineering
9	Air & Noise Pollution	Solid Waste Management
10	Planning of Smart Cities	Advance Geotechnical Engineering
11	Construction Management	

List Vocational Courses

Sr. No.	Name of Course	Semester
1	Auto CADD 3 D	III
2	Plumbing Engineering	IV
3	1. Structural Assessment and Retrofitting 2. Industrial Orientation for Civil Engineers-I	V
4	1. Contracts and E-Tendering 2. . Industrial Orientation for Civil Engineers-II	VI

List of Industry Taught Courses

Sr. No.	Name of Course	Semester
1	Concrete Technology	III
2	Planning and Management of Construction Projects	IV
3	Advanced Surveying with Geomatics	V
4	Design and Detailing of Reinforced Concrete Structures	VI
5	Waste Water Treatment and Management	VII
6	Construction Quality Control and Safety	VIII

Programme: B. Tech. (Civil) Sem – VII

COURSE: FOUNDATION ENGINEERING		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hours / Week	End Semester Examination: 60 Marks Internal Assessment: 40 Marks	Theory:04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Statics and Dynamics
2	Geomechanics
3	Fluid Mechanics
4	Construction and Material
Course Objective: On completion of the course -	
	Students can apply the knowledge about the analysis and design of different types of foundations.
Course Outcomes: On completion of the course, the students will be able to:	
1	summarize the principles and methods of subsurface exploration.
2	evaluate the bearing capacity of shallow foundation.
3	identify the concept of settlement and consolidation in soils.
4	compute the capacity of pile and pile group.
5	analyse problems related to black cotton soil and use design principle and construction techniques in black cotton soil to solve them.
6	choose the appropriate soil stabilisation technique based on site conditions.

Course Content:

Unit-I	**Subsurface Investigation:** Purpose and necessity of soil exploration, reconnaissance, methods of soil exploration – open excavation, auger boring, wash boring, percussion drilling, depth and number of explorations, soil sampling: types of samples, types of sampler, area ratio, inside and outside clearance, recovery ratio, geophysical method :-seismic reflection method and electrical resistivity method, field testing:- SPT, DCPT, SCPT and its correlation is code provisions, bore logs and preparation of soil investigation report.	**(06 Hrs)**
Unit-II	**Bearing Capacity:** Introduction and Definitions, different types of shear failure, Terzaghi's bearing capacity theory, Meyerhof's bearing capacity: - rectangular, square and circular,Effect of factors on bearing capacity:- Size and Shape, depth and Water table,Guidelines of BIS (IS 6403) for estimation of bearing capacity, Field tests for bearing capacity calculation:- Plate load test, SPT.	**(06 Hrs)**
Unit-III	**Settlement and Consolidation:** **Settlement:** Introduction, causes of settlement, Uniform and Non-Uniform settlement, significant depth of foundation, Pressure bulb, Contact pressure distribution diagram, Permissible limit of settlement **Consolidation:** Introduction and Basic Definitions, Spring analogy, Terzaghi's 1-D consolidation theory, Laboratory consolidation test, Determination of coefficient	**(06 Hrs)**

	of consolidation by square root of time fitting method and Logarithm of time fitting method.	
Unit-IV	**Pile Foundation:** Classification of pile, Pile Installation method, Load carrying capacity of piles: - Statics and Dynamic method, Engineering News formula, Modified ENR formula. . Pile load test, Static and Cyclic pile load test. Group action-Feld rule, Rigid block method. Settlement of pile group in cohesive soil by approximate method. Micro piles.	**(06 Hrs)**
Unit-V	**Shallow Foundation & Foundation on Black Cotton Soils** **Shallow Foundation:** types and applications, Principles of design of footing, steps involved in proportioning of footing, proportioning of combined footing- rectangular and trapezoidal footing, raft foundation- types. **Foundation on Black cotton Soils: -**Characteristics of black cotton soil, swelling potential and its evaluation methods, engineering problems, foundations on black cotton soil: design principles, construction techniques, under reamed piles: design principles and its construction techniques.	**(06 Hrs)**
Unit-VI	**Ground Improvement Techniques-** Soil Stabilization: Introduction, Objectives, Method of Soil Stabilisation, Cement Stabilization, Lime Stabilisation, Bitumen Stabilisation, Chemical Stabilisation, Injection stabilisation: Grouting, Use of Geosynthetic material in ground improvement.	**(06 Hrs)**

Internal Assessment:

Unit Test -1	Unit No: - I, II, III
Unit Test -2	Unit No: - IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it

1	To prepare of a brief report on standard Penetration test of soil as per IS code IS2131- 1981
2	To prepare of a brief report on soil investigation report.
3	To prepare chart on geophysical method of soil investigation.
4	To prepare demonstrate model of mode of shear failure.
5	To Prepare chart on derivation of Terzaghi's Bearing Capacity equation.
6	To prepare of a brief report on plate load test for determination of bearing capacity of soil
7	To prepare demonstrate model of spring analogy of consolidation.
8	To Prepare chart on derivation of Terzaghi's 1-D Consolidation equation.
9	To prepare chart on square root of time fitting method and Logarithm of time fitting method
10	To prepare PPT on classification of Pile foundation.
11	Compare the different methods of load carrying capacity of pile foundation.
12	To prepare demonstrate model of well foundation.
13	To prepare demonstrate model of under reamed pile foundation.
14	To prepare chart on different types of geosynthetics.
15	To prepare PPT on different method of soil stabilization.
16	Application of python for calculation of bearing capacity of soil.
17	Application of python for calculation of load carrying capacity of pile foundation.

Reference Books:	
1	A.K.Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers.
2	B.C. Punmia, "Soil Mechanics and Foundation Engineering", Laxmi Publication.
3	Dr. P.N. Modi, " Soil Mechanics and Foundation Engineering" Rajsons Publications Pvt. Ltd.
4	Gopal Ranjan, A.S.R., "Basic and Applied soil mechanics", New Age International Publishers
5	N.V. Nayak, "Foundation Design Manual", Dhanpat Rai and Sons
6	Braja M. Das, "fundamentals of Geotechnical Engineering"
7	V.N.S. Murthy, "Advanced Foundation Engineering", CBS Publishers and distributors.
Codes:	
1	IS2131- "Method for Standard Penetration Test for Soils", Bureau of Indian Standards.
2	IS 8403 "Code of Practice for Determination of Breaking Capacity of Shallow Foundations", Bureau of Indian Standards.
3	IS1888:"Methods of load test on soils", Bureau of Indian Standards.

COURSE: ELECTIVE I -ADVANCED CONCRETE TECHNOLOGY		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 03 Hours / Week Practical: 02 Hours / Week	End Semester Examination: 60 Marks Internal Assessment: 40 Marks Term work: 25 Marks Oral: 25 Marks	Theory: 03 Practical: 01
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Concrete Technology
Course Objective: On completion of the course -	
	The students should be able to understand advanced applications of composite materials.
Course Outcomes: On completion of the course, the students will be able to -	
1	design the concrete mix using fiber reinforced composites.
2	design the self compacting concrete.
3	identify the possible use of ferro-cement concrete in construction industry.
4	describe the benefits of use of silica fume in concrete.
5	identify and use the polymer and light weight concrete for different constructions.
6	Estimate cost of different types of concrete.

Course Content:

Unit-I	**Fiber Reinforced Composites:** Introduction to Fiber Reinforced Concrete, Types of fibers, Properties of fibers. Properties of constituent materials. Mix proportion, Mixing, Casting methods.	**(06 Hrs)**
Unit-II	**Self-Compacting Concrete:** Design and manufacture of Self compacting concrete, High performance concrete, Very High Strength Concrete, High Density Concrete, Fresh properties of self-compacting concrete.	**(06 Hrs)**
Unit-III	**Ferro-Cement:** Introduction, Materials used, Mechanical properties, Construction techniques, Applications, and Merits as structural materials.	**(06 Hrs)**
Unit-IV	**Silica Fume Concrete:** Introduction, Physical and chemical properties of silica fume, Reaction mechanism of silica fume, Properties of silica fume concrete in fresh state.	**(06 Hrs)**
Unit-V	**Polymer and Light Weight Concrete:** Introduction, Classification, Properties of Polymer and lightweight concrete.	**(06 Hrs)**
Unit-VI	**Economical Aspect:** Cost analysis of different types of concrete, Selection of suitable type of concrete.	**(06 Hrs)**

Internal Assessment:	
Unit Test -1	Units: I, II, III
Unit Test -2	Units: IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare the chart for various types and properties of fibers.
2	Develop of an excel sheet for calculation of mix design using fiber reinforced composites
3	Prepare the chart for design and manufacture of self-compacting concrete
4	Develop of an excel sheet for calculation of mix design for self-compacting concrete
5	Develop of an excel sheet for calculation of mix design for very high strength concrete
6	Develop of an excel sheet for calculation of mix design for high density concrete
7	Prepare the chart for various types of meshes used for construction of ferro-cement
8	Prepare the chart for various applications of ferro-cement
9	Prepare the chart for physical and chemical properties of silica fume
10	Prepare the chart for reaction mechanism of silica fume
11	Prepare the chart for properties of silica fume concrete in fresh state
12	Develop of an excel sheet for calculation of mix design for silica fume concrete
13	Develop of an excel sheet for calculation of mix design for polymer concrete
14	Prepare the chart for classification of light weight concrete
15	Develop of an excel sheet for calculation of mix design for light weight concrete
16	Compare Cost of different types of concrete
17	Suggest suitable type of concrete as per site requirements
18	Case study of economical aspect of a typical project.
Term work: (Any four)	
1	Mix design and testing of fiber reinforced composites concrete for split-tension and flexure.
2	Mix design and testing of fresh properties of Self Compacting Concrete
3	Mix design and testing of panels of ferro-cement
4	Mix design and testing of cubes of silica fume concrete
5	Mix design and testing of cubes of polymer concrete
6	Mix design and testing of cubes of light weight concrete
7	Mix design and cost comparison of different types of concrete.
Oral:	
	The oral examination will be based on above term work and course content.
Reference Books:	
1	M. S. Shetty, "Concrete Technology", S.Chand Publication.
2	R. N. Swamy, "Concrete Technology & Design" Surrey University Press.
3	Rafal Siddique, "Special Structural Concretes", Galgotia Publication Pvt. Ltd. New Delhi
4	P. N. Balaguru, S. P. Shah, "Fiber Reinforced Cement Composites" McGraw Hill Publication.
5	D. J. Hannant, "Fiber Cement and Fiber Concrete" John Wiley and Sons Publication.
6	Bhusan L. Karihal, "Fracture Mechanics and Structural Concrete", John Wiley and Sons Publ.
Codes:	
1	IS 10262: Indian Standard code of practice for Guidelines for concrete mix proportioning, Bureau of Indian Standards, New Delhi.
2	ACI PRC-237-07 Self-Consolidating Concrete.
3	ACI 549.1R-18 Design Guide for Ferro-cement.

4	IS 15388: Specification for Silica Fume.
5	ACI PRC-548.1-09: Guide for the Use of Polymers in Concrete.
6	ACI 211.2-98 Standard Practice for Selecting Proportions for Structural Lightweight Concrete.

COURSE: ELECTIVE I : URBAN WATER MANAGEMENT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 3 Hours / Week Practical: 2 Hours / Week	End Semester Examination: 6Marks Internal Assessment: 40 Marks Term work:25 Marks Oral: 25 Marks	Theory: 03 Practical: 01
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Physics, Chemistry, Mathematics and Statistics
2	Ecology, Hydrology, Environment and Climate Change
3	Water Engineering and Management
Course Objective:	
	An urban water management is to provide safe drinking water, handling wastewater for the maintenance of public health, protect against floods, along with alleviating the effects of pollution.
Course Outcomes: The student will be able to	
1	Understand how cities are growing and changing which is leading to describing the promise of Integrated Urban Water Management (IUWM)
2	Focus on the implications of these changes for urban water resources: in the past, water security efforts focused on water quantity and understand how new concerns about water quality are now emerging.
3	Understand and design the new tools and strategies to shift from urban water management to IUWM.
4	Gain insight that how UWM can contribute to cities' resilience in the face of climate change and analyze changing climate demanding water management be approached in a different way
5	Understand, apply and develop an enabling environment for the change toward a framework for integrated urban water management.
6	Design, analyze and apply practical approaches for constructing and building GREEN and SMART cities.

Course Content:		
Unit-I	**Introduction to Urban Water management**	**(6 hours)**
	Introduction to Urban Water Management (UWM): Concept, Need, The changing urban context, Expanding city limits, Consequences of globalization and Urbanization, Urban-Rural Conflicts, Special challenges for some cities	
Unit-II	**Water resources and urbanization**	**(6 hours)**
	Water: Sources, Quantity and Quality, Wastewater: Sources, Quality and Reuse , Effects on Water Demand due to Urbanization, Water Cess Act, Water(Prevention and Control) Act 1974	
Unit-III	**UWM tools and management strategies**	**(6 hours)**
	Storm water management, Water reclamation and reuse, Water audits and efficient use, Flexible and adaptable urban water systems, Tariffs, payments and other economic tools, Benefit Cost Ratio for Urban Water	

	Management	
Unit-IV	**Climate Change Challenge**	**(6 hours)**
	Climate Change: Introduction, Cause and Consequences, Climatic Variations in India in recent years, Effect of Climate change on Water Resources and Sanitation, Urban contributions to climate change, Response options , Resilience to climate change	
Unit-V	**Conventional and Integrated Urban Water management**	**(6 hours)**
	Conventional Urban Water Management: Introduction, Present Scenario, Advantages and Disadvantages, Integrated Urban Water Management (IUWM): Introduction, Need, Advantages, Urban water governance, Application of IUWM for SMART CITY	
Unit-VI	**framework for integrated urban water management**	**(6 hours)**
	Role of Central and Local governments, Involvement of Private sector, Business opportunities and Employment Enhancement, Participation of NGO's and Stakeholder, Sustainable Development and Practices	

Internal Assessment:	
Unit Test -1	I,II,III
Unit Test -2	IV,V,VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Design poster on - new concerns about water quality are now emerging.
2	Study and Write Report on water resources of city/town/villageyou belong to
3	Power Point Presentation on Case study of urban water management
4	Prepare model of IUWM for city/town/village
5	Design chart on comparison of IUWM with Conventional method
6	Carryout water audit of your house and write report with suggestions
7	Design model for rain harvesting for your home
8	Power Point Presentation on Tools of UWM

Practical:	
1	Collection of data how cities are growing and changing describing the promise of IUWM
2	Study of urban water resources: in the past and how new concerns about water quality are now emerging.
3	Design new tools and strategies to shift from Conventional urban water management to IUWM
4	Study and data collection of climate change and analyze changing climate demanding water management to be approached in a different way
5	Design framework for integrated urban water management for Existing and Futuristic SMART Cities
6	Design, analyze and apply practical approaches for constructing and building GREEN and SMART cities to foster a new culture of urban water management
7	Field Visit and Report on SMART City and/or Township in India and/or abroad
8	Suggest suitable plan for a city to be smarter with respect to UWM

Oral:	
	The oral examination will be based on above term work and course content.

Textbooks:	
1	Urban Water Engineering and Management by Mohammad Karamouz, Ali Moridi, Sara Nazif, January 20, 2010 by CRC Press Textbook, ISBN 9781439813102 - CAT# K10665
2	Municipal Stormwater Management, Second Edition by Thomas N.Debo, Andrew Reese, November 25, 2002 by CRC Press, Reference –1176, ISBN 9781566705844 - CAT# L1584
3	Integrated Urban Water Management: Humid Tropics: UNESCO-IHP by Jonathan N. Parkinson, Joel AvruchGoldenfum, Carlos Tucci, March 26, 2010 by CRC Press, Reference – 180, ISBN 9780415453523 - CAT# K10165, Series: Urban Water Series
4	The Economics of Sustainable Urban Water Management: the Case of Beijing: UNESCO-IHE PhD Thesis by Xiao Liang, September 28, 2011 by CRC Press, Reference – 200, ISBN 9780415691734 - CAT# K13927
5	Climate Change Effects on Groundwater Resources: A Global Synthesis of Findings and Recommendations by HolgerTreidel, Jose Luis Martin- Bordes, Jason J. Gurdak, December 2, 2011 by CRC Press, Reference – 414, ISBN 9780415689366 - CAT# K13833, Series: IAH – International Contributions to Hydrogeology
6	Metropolitan Sustainability: Understanding and Improving the Urban Environment Edited by F Zeman, Royal Military College of Canada,
7	Integrated Urban Water Management By AkiçaBahri, Global Water Partnership Technical Committee (TEC), TEC BACKGROUND PAPERS, NO. 16, ISBN: 978-91-85321-87-2
8	Good Practices in urban water management: Decoding good practices for a successful future edited by Chiplunkar, Anand, KallidaikurichiSeetharam, and CheonKheong Tan, Mandaluyong City, Philippines: Asian Development Bank, 2012, ISBN 978-92-9092-740-2 (Print), 978-92-9092-741-9 (PDF)
9	Integrated Urban Water Management for Planners By John Y. Whitler and Jennifer Warner, Water Research Foundation, PAS Memo —September/October 2014, American Planning Association, 205 N.Michigan Ave., Ste. 1200, Chicago, IL 6060

COURSE: ELECTIVE I- HUMAN RESOURCES MANAGEMENT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 03 Hrs. / Week Practical :02 Hrs./Week	End Semester Examination: 60 Marks Internal Assessment: 40Marks TW: 25 Marks Oral : 25 Marks	Theory : 03 Practical: 01
		Total : 04 Credits

Course Pre-requisites: The students should have knowledge of	
1	Project Management
2	Engineering Economics Management
Course Objective: On completion of the course -	
	To develop the skill of human resource management in construction industry.
Course Outcomes: On completion of the course, the students will be able to -	
1	appraise the significance of human resources in construction industry.
2	arrange human resources.
3	identify the recruitment and selection process.
4	discuss the significance of training and development of employees.
5	analyze the employee benefits and incentives.
6	describe employee management relations.

Course Content:

Unit-I	**Introduction** History of HRD, Objectives, Functions, HRD in Construction Industry, Status of Construction Labour.	**(06 Hrs)**
Unit-II	**Human Resource Planning** Formulating Human Resource Plans, Various Methods, Job Analysis, Job Specifications and Job Design in Construction Projects, Forecasting Personal Needs and Supply in Construction Sector.	**(06 Hrs)**
Unit-III	**Recruitment & selection** Selecting Project Manager & Project Team, External & Internal Recruitment. Data Gathering Methods, Skill Requirement of Construction Personnel.	**(06 Hrs)**
Unit-IV	**Training & Development** The Training Process, Individual and Organizational Development, Change Management, Performance Appraisal, Use of Performance Appraisal Information, Establishing The Evaluation System, Performance Management / Encouragement, Rewarding Employees	**(06 Hrs)**
Unit-V	**Employee Benefits** Employee Health and Safety, Wage and Salary Administration, Incentive System, Wages of Construction Industry, Retirement and Pensions.	**(06 Hrs)**
Unit-VI	**Employee Management Relations** Collective Bargaining, Effective Ways of Working, Trade Unions Act, Labour Welfare Act, Payment Of Wages Act ,Workers Compensation Act ,Contract Labour Act, Management Of Conflicts.	**(06 Hrs)**

Internal Assessment:

	Unit Test -1	UNIT – I, II, III
	Unit Test -2	UNIT – IV,V,VI
Project Based Learning: Any ONE based on following topics but not limited to it		
1.	Prepare chart / presentation on functions of human resource development in construction industry.	
2.	Prepare chart / presentation on various methods for formulating human resource plans	
3.	Prepare chart / presentation on selection of project manager and project team.	
4.	Prepare chart / presentation on skill requirement of construction personnel.	
5.	Prepare chart / presentation on performance appraisal in construction industry.	
6.	Prepare chart / presentation on employee health and safety issues : Management Policy	
7.	Prepare chart / presentation on benefits of incentive systems to employees.	
8.	Prepare chart / presentation on different laws for employee management relations	
Term work:- Assignments based on Case studies of following but not limited to		
1.	Case study of HRD in construction industry	
2.	Formulating human resource plan	
3.	Case study of external and internal recruitment	
4.	Report on establishing evaluation system for performance appraisal	
5.	Importance on Employee benefits	
6.	Report on conversation with HR of any construction industry	
Oral:-		
	The oral examination will be based on above term work and course contents	
Reference Books:		
1	Biswanath Ghosh, "Human Resource Development and Management" Vikas Publishing House Pvt. Ltd	
2	S.C. Agarwal, "Human Resource Management" Dhanpat Rai Publications	
3	C.B. Mamoria, "Personnel & Human resource Management" , Himalaya Publishing House	
4	Subbarao," Human resource management", Himalaya Publishing House	
5	K. Aswathappa, "Human Resource Management" , TMH Pvt. Ltd	
IS Codes		
	Code of ETHICS by Society of Human Resources Management	

COURSE: ELECTIVE I-ENVIRONMENTAL IMPACT ASSESSMENT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 3 Hours / Week Practical: 2Hours / Week	End Semester Examination: 60Marks Internal Assessment: 40Marks Term work:25 Marks Oral: 25Marks	Theory: 03 Practical: 01
		Total: 04

Course Pre-requisites: The students should have knowledge of

1.	Basic Knowledge of Physics, Chemistry and Mathematics
2.	Basic Knowledge of Environmental Science
3.	Basic Knowledge of Statistics and Computers

Course Objective:

To learn the purpose and aims of EIA as well as EIA administration and practice thereby undertaking an EIA projects by understanding of the strengths and limitations of EIA with the costs and benefits of undertaking EIA

Course Outcomes: The student will be able to

1.	Appreciate the purpose and role of EIA in the decision-making process and understand the strengths of EIA in regard to environmental management;
2.	Understand the technical and social/political limitations of EIA
3.	Understand the screening process and the scoping process and how it is applied
4.	Know the options for estimating environmental and social impacts and the format of an EIA Report (Environmental Impact Statement, or Environmental Statement);
5.	Appreciate the factors that assist, and detract, from the usefulness of the EIA Report
6.	Understand the purpose of developing follow-up procedures, and the options for designing these procedures.

Course Content:

Unit-I	**Environmental Impact Assessment EIA**	**(6Hours)**
	EIA: Background, Introduction, Purpose and aims of EIA, Nature and Scope of environmental issues and impacts, Principles of EIA administration and practice, Key elements of the EIA process, Costs and benefits of EIA, EIA Policy and Legislation, EIA Requirements of International Organizations, Principles for a Functional EIA System	
Unit-II	**Screening and Scoping**	**(6Hours)**
	Screening: Introduction, Screening procedure, Project lists for screening, Preliminary EIA, Screening Basics, Other types of Screening, Criteria for the determination of the need for, and level of, EIAScreening Exercise, **Scoping**: Introduction, Purpose of scoping, Approaches to scoping, Scoping methods, Scoping Basics, Alternatives and tiering, Scoping in Practice	
Unit-III	**Impact analysis and EIA Methods**	**(6Hours)**
	Implications of the widening environment and sustainability agenda, Impact Identification, Impact Analysis/Prediction, Impact Analysis Basics, Characteristics of environmental impacts, Impact	

	Characterization, Social Impact Assessment, Evaluation of impact significance, Significance Criteria, Impact Significance Assessment, Interaction Matrix and Simple Checklist Methods, Development of a Simple Matrix, Observations on Simple Matrices, Simple Checklists	
Unit-IV	**Mitigation and Impact Management**	**(6Hours)**
	Link between EIA process and Mitigation, Main Elements of Mitigation, Mitigation Basics, Approaches to Mitigation, Mitigation of Specific Impacts, Environmental Management Plan and Mitigation Measures, Impact Assessment and Mitigation, Public involvement: Introduction, Principles of public involvement, Scope of involvement, Planning a public involvement programme, Public involvement techniques, Arguments for and against public involvement, Stakeholders involved	
Unit-V	**EIA Reporting and Review of EIA Quality**	**(6Hours)**
	EIA Report, Typical Elements of an EIA Report, EIA Reporting Basics, Shortcomings encountered in Preparing EIA Reports, Guidelines for effective EIA report preparation and production, The Non-Technical Summary/Executive Summary, EIA Reporting Practice, Role and Purpose of the EIA Review Process, Need for a Systematic Approach, Procedural Aspects, Main Steps in the EIA Review, EIA Quality Basics, Carrying out the review, EIA Report Quality Assessment Exercise, Procedures for Evaluating EIA Reports	
Unit-VI	**Decision-making, Implementation and Follow-up**	**(6 Hours)**
	Role of the Decision-makers, EIA as part of the Decision-making Process, Decision-making: Procedural Considerations, Responsibility of the Decision-Makers, Key Objectives of EIA implementation and follow up, Tools for Environmental Management and Performance Review, Monitoring, Implementation Management Planning, Environmental Auditing, EMP and Audit Programme, Evaluation of EIA Effectiveness and Performance, Introduction to ISO 14000 Series.	

Internal Assessment:	
Unit Test -1	I.II,III
Unit Test -2	IV,V,VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Draw flow chart of EIA for Road Project
2	Draw flow chart of EIA for Industrial Project
3	Draw flow chart of EIA for Township Project
4	Design Chart on Mitigation measures for Sugar industry
5	Design Chart on Mitigation measures for Dairy industry
6	Design Chart on Mitigation measures for Pulp and Paper industry
7	Write Executive Summery for Road Project
8	Write Executive Summery for Township Project
9	Power Point Presentation on Environmental Audit

10	Power Point Presentation on Case Study
11	Small Report on Case Study
Practical:	
1	The ways that a project might be modified through the EIA process
2	Legislative protections on a proposed development site in India
3	Some of the problems and advantages having the developer responsible for preparing the EIA documents
4	EIA Challenges especially in developing countries
5	Project of State Significance in India and what role does it play in the Indian system
6	Inventorisation of the natural resources available in India
7	Power Point Presentation on Case study undergone EIA
8	Site visit
Oral:	
	The oral examination will be based on above term work and course content.
Textbooks:	
1	Environmental Impact Assessment: A Practical Guide, Betty Marriott - 1997
2	Environmental impact assessment, Larry W. Canter - 1977
3	Introduction to Environmental Impact Assessment, John Glasson, RikiTherivel, Andrew Chadwick - 2013
4	Environmental Impact Assessment, Stephen Tromans - 2012
5	Environmental Impact Assessment: Practice and Participation, Kevin Hanna - 2015
6	Environmental Impact Assessment: A Methodological Approach, Richard K. Morgan - 1999
7	Methods of Environmental Impact Assessment, Peter Morris, RikiTherivel – 2001
8	Environmental Impact Assessment: A Guide to Best Professional Practices, Charles H. Eccleston - 2011
9	Introduction to Environmental Impact Assessment, John Glasson, RikiTherivel, Andrew Chadwick – 2005
Reference Books:	
1	Ackland A, Hyam P and Ingram H (1999) *Guidelines for Stakeholder Dialogue â€“ A Joint Venture*. The Environment Council, London.
2	*African High-Level Ministerial Meeting on Environmental Impact Assessment (EIA) Durban, South Africa*. Communique (1995) issued by UNEP, Nairobi.
3	Ashe J and Sadler B (1997) Conclusions and Recommendations. In *Report of the EIA Process Strengthening Workshop*. (pp.109-118). Environment Protection Agency, Canberra.
4	Au E and Sanvicens G (1997) *EIA Follow up and Monitoring in Report of the EIA Process Strengthening Workshop* (pp. 91-107). Environment Protection Agency, Canberra
5	Australian and New Zealand Environmental and Conservation Council (ANZECC) (1996) *Guidelines and Criteria for Determining the Need for and Level of Environmental Impact Assessment in Australia*. Working Group on National Environmental Impact Assessment,

	ANZECC, Canberra
6	Bass S, Dalal-Clayton B and Pretty J (1995) *Participation Strategies for Sustainable Development*. IIED, London.
7	Boyle J and Mubvami T (1995) *Training Manual for Environmental Impact Assessment in Zimbabwe*. Department of Natural Resources, Ministry of Environment and Tourism, Zimbabwe.
8	Brown A (1998) The Environmental Overview as a Realistic Approach to Strategic Environmental Assessment in Developing Countries. In Porter A and Fittipaldi J (eds) *Environmental Methods Review: Retooling Impact Assessment for the New Century*, pp. 127-134. The Press Club, Fargo, USA
9	International Association for Impact Assessment (IAIA) and the Institute of Environmental Management and Assessment (IEMA) (1999) *Principles of EIA Best Practice*. IAIA, Fargo, North Dakota. (http:/www.iaia.org/publications)
10	Institute of Environmental Management & Assessment (1999), *Draft Guidelines on Public Participation in Environmental Decision Making*. Institute of Environmental Management & Assessment, Lincoln, UK

COURSE: ELECTIVE –I GREEN CONSTRUCTION PRACTICES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 03Hours / Week Practical: 02Hours / Week	End Semester Examination: 60Marks Internal Assessment: 40Marks Term work: 25Marks Oral: 25Marks	Theory: 03 Practical: 01
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Environmental engineering
2	Sustainable energy sources & their applications
3	Building construction & materials
Course Objective: On completion of the course -	
	The students will be able to realize the importance of implementation of green construction in construction industry because in green construction practices mainly the emphasis is given on optimum use of natural resources along with its today's need & requirement.
Course Outcomes: On completion of the course, the students will be able to -	
1	describe the Definition, Concept & importance of green building, along with their benefits & techniques used.
2	Enumerate & apply conceptual knowledge about green design & summarize the rating system of green building
3	apply construction techniques in Green Building construction.
4	get the knowledge about material conservation and the role of air quality in green construction practice.
5	Summarize the need & demand of sustainable energy, and its importance in application of solar energy utilization in green construction practices.
6	Summarize the need & importance of water energy in green construction.

Course Content:		
Unit-I	**Introduction to Green Building:** Definition of Green Building, Importance of Green Building, Characteristics of Green Building, Principles of Green Building, Benefits of Green Building, Techniques to be applied in Green Building, Scope of Green Buildings in India, Zero Energy Building (ZEB)	**(06 Hrs)**
Unit-II	**Green Design & Rating System:** **Design:** 3 Pillars of Sustainability - (Environmental, Economical & Social), Principles Of Sustainable Development In Building Design, Characteristics of Sustainable Buildings, Sustainably managed Materials, Integrated Lifecycle design of Materials and Structures (Concepts only), **Rating System:** Launch of Green Building Rating Systems, BREEAM, LEED, GREEN STAR, GRIHA (Green Rating for Integrated Habitat Assessment) for new buildings, Purpose, Key highlights, Point System with Differential weightage, Benefits given by Municipal Corporation to Green Building.	**(06 Hrs)**
Unit-III	**Green Building Construction Techniques:** Features of Green Building, key Requisites for Constructing a Green	**(06 Hrs)**

	Building, Building Simulation Analysis: - four 'R's & Green Techniques, Structural Techniques, Electrical Techniques, Special Techniques, Water Efficiency, Optimum Energy Efficiency, Typical Energy Saving Approach in Buildings, Green Composites for Buildings Concepts of Green Composites, Non Mechanized Practices & Importance.	
Unit-IV	**Material Conservation & Air Quality:** **Material Conservation:** Handling of Non-Process Waste, Waste Reduction During Construction, Materials With Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture. **Air Quality:** Indoor Environment Quality and Occupational Health, Air conditioning, Indore air quality, Sick building syndrome, Minimum fresh air requirements avoid use of asbestos in the building, Improved Fresh Air Ventilation, Measure of IAQ, IAQ depend on factors: List of Materials, their impacts & preventive measures and or alternate options to reduce the impacts.	**(06 Hrs)**
Unit-V	**Sustainable Energy Utilization Practice :** Need of Energy, Reduction in Energy Demand, Onsite Sources and Sinks, Maximise System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources. Utility of Solar Energy in Buildings Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling.	**(06 Hrs)**
Unit-VI	**Water Efficiency:** Need of Water Efficiency, Importance of EP-Act of 1992, Low Energy Approaches to Water Management. Flush and flow fixture water usage measurement, Importance Of Reducing Indoor, Outdoor and Process Water Use, strategies to reduce indoor & Outdoor water use, Means & Strategies of use of water.	**(06 Hrs)**

Internal Assessment:

Unit Test -1	Unit No. I,II,III
Unit Test -2	Unit No. IV,V,VI

Project Based Learning: Any ONE based on following topics but not limited to it

1	Prepare a informative chart of green building.
2	Prepare a building model showing the concept utilization of green construction.
3	Prepare a report on sustainable building.
4	Prepare a chart showing the information about Building Simulation Analysis.
5	Prepare a model on water harvesting system.
6	Prepare a model on solar energy /lighting system.
7	Prepare a chart showing colorful pictures of various green construction materials.
8	Prepare a model on grey water management System.
9	Case studies of Solar Passive Cooled and Heated Buildings.
10	Prepare model on soil erosion control techniques.
11	Collect the samples of various natural and renewable materials, materials with recycled content, waste and salvaged materials etc.

Term work: The term work shall consist of **ANY SIX** following practical-	
1	Design water harvesting system for institution / a building.
2	Design waste water reuse system for institution.
3	Design Solar Energy conservation system for institution.
4	Design green waste treatment system for the institution.
5	Planning & Design the energy Conservation for the building or institution
6	Application of Green Roof System design to the building.
7	Rules & Regulation of Green Building at national level.
8	Rules & Regulation of Green Building at international level
Oral:	
	The oral examination will be based on above term work and course content.
Reference Books:	
1	Harhara Iyer G, "Green Building Fundamentals", Notion Press.
2	Dr. Adv. Harshul Savla, Green Building: Principles & Practices
	Tomwoolley and Samkimings "Green Building Handbook".
3	"Handbook on Green Practices" published by Indian Society of Heating Refrigerating and Air conditioning Engineers.
4	Trish Riley, "Complete Guide to Green Buildings".
5	Kent Peterson, "Standard for the design for High Performance Green Buildings".
6	D. R. Wulfinghoff "ENERGY EFFICIENCY MANUAL".
7	IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
8	GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
9	K.S. Jagadish, B.V. Venkatarama Reddy and K. S. Nanjunda Rao, "Alternative building materials and technologies"
10	G. D. Rai, "Non-Conventional Energy Resources", Khanna Publishers.
11	"Sustainable Building Design Manual", Vol.1 and 2, TERI, New Delhi.
12	Mike Montoya, "Green Building Fundamentals", Pearson, USA,.
13	Charles J. Kibert, "Sustainable Construction – Green Building Design and Delivery", John Wiley& Sons, NewYork,.
14	Regina Leffers, "Sustainable Construction and Design", Pearson / Prentice Hall, USA.
Reference Codes:	
1.	Delaware's Code for Energy Conservation
2.	National Model Energy Codes
3.	International Energy Conservation Code (IECC)
4.	International Green Construction Code (IGCC)

COURSE:ELECTIVE I- DOCKS, PORTS & HARBOURS		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 03 Hrs. / Week Practical :02 Hrs./Week	End Semester Examination: 60 Marks Internal Assessment: 40Marks TW: 25 Marks Oral : 25 Marks	Theory : 03 Practical: 01
		Total : 04 Credits

Course Pre-requisites: The students should have knowledge of	
1	Fluid Mechanics
2	Advanced Surveying (Hydrographic Survey)
Course Objective: On completion of the course	
	The student will demonstrate knowledge of different marine structures and their design considerations.
Course Outcomes: On completion of the course, the students will be able to -	
1	illustrate importance of Ports in Economy and International trade .
2	analyze the wave, tide and the phenomenon related to the same
3	explain the requirements of an ideal port & harbour
4	design the different harbour works.
5	explain the port planning process
6	analyze marine pollution.

Course Content:

Unit-I	**Introduction to Ports and Harbours:-** History, Development of Port and Ship Construction Technology along with International Trade, Port Development – Indian Scenario	**(06 Hrs)**
Unit-II	**Waves and Tides:-** Concept of Generation, Propagation and Form of Wave in Coastal Zone, Global Tide Phenomenon, Types of Tides, Concept of Wave Tranquillity, Resonance, Coastal Sediment Transport, Types of Ports	**(06 Hrs)**
Unit-III	**Ports and Harbours:-** **Harbour:** Classification, Facilities and Structures, Approach Channel, Marker Buoys, Breakwater Layout, Berth and Jetties, Bulk Oil Container **Ports**: Loading Unloading, Storage, Customs and Relevant Facilities, Security, Hospital Colony, Associated Services, Maintenance Facilities, Dry Docks, Slipway, Locks.	**(06 Hrs)**
Unit-IV	**Marine Structures:-** General Design Aspects, Breakwaters - Function, Types, General Design Principles, Wharves, Quays, Jetties, Piers, Pier Heads, Dolphin, Fenders, Mooring Accessories- Function, Types, Suitability, Design And Construction Features.	**(06 Hrs)**
Unit-V	**Port Planning:-** Modernization of Port, Lifting and Loading Unloading (RO-RO) Facilities, Computerization, Automation, Berth Occupancy, Port Cost Analysis, Dredging and Disposal Technology	**(06 Hrs)**
Unit-VI	**Port Development:-** Role of Port Development and National Policy, Public And Private	**(06 Hrs)**

	Sector, Marine Pollution and Environmental Aspects.	
Internal Assessment:		
	Unit Test -1	UNIT – I, II, III
	Unit Test -2	UNIT – IV, V, VI
Term Work		
1.	Assignment on Port Development An Indian Scenario	
2.	Assignment on types of tides and their generation.	
3.	Assignment on Environmental aspects of port development.	
4.	Assignment on port cost analysis.	
5.	Assignment on suitability of different marine structures.	
6.	Assignment on design of breakwaters.	
7.	Assignment on Coastal Sediment Transport.	
Oral:		
	The oral examination will be based on above term work and course content.	
Project Based Learning: Any ONE based on following topics but not limited to it		
1	Prepare chart / presentation on history of ports in India.	
2	Prepare chart / presentation on importance of ports in Indian Economy.	
3	Prepare chart / presentation on importance of ports in International Trade.	
4	Prepare chart / presentation on types of ports.	
5	Prepare chart / presentation on facilities and structures in harbour.	
6	Prepare chart / presentation on types of marine structures.	
7	Prepare chart / presentation on dredging in ports.	
8	Prepare chart / presentation on marine pollution.	
Reference Books:		
1	R.L.Wiegel, "Oceanographic Engineering" , Prentice –Hall	
2	R. Silvester, "Coastal Engineering" , Vols. 1 and 2 , Elsevier Scientific Publishing Co.	
3	R.M.Sorenson, "Basic Coastal Engineering", J.Wiley & Sons	
4	H.P.Oza and G.H.Oza, "Docks and Harbour Engineering" , Charotar Publishing	
5	S.P.Bindra, "A Course in Docks and Horbour Engineering" , Dhanpat rai Publications	
IS Codes:		
1	IS 9527: (Part 6)	
2	IS 10020: (Part 4)	

COURSE: ELECTIVE I- GROUND WATER HYDROLOGY		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 3 Hours / Week Practical: 2 Hours / Week Tutorial:-	End Semester Examination: 60 Marks Internal Assessment: 40 Marks Term work: 25 Marks Oral: 25 Marks	Theory: 3 Practical: 1 Tutorial:
		Total: 4

Course Pre-requisites: The students should have knowledge of	
1	Fluid Mechanics
2	Hydrology and Irrigation
Course Objective: on completion of the course	
	Course attempts to provide knowledge and skills for effective ground water management
Course Outcomes: The student will be able to	
1	Describe utilization of ground water, its origin and rock properties.
2	Derive ground water flow equations
3	Describe different types of flow in different aquifers and different yield tests.
4	Describe the sources and causes of ground water pollution.
5	Demonstrate various methods of Exploration of ground water.
6	Describe various methods of artificial ground water recharge and intrusion of saline water.

Course Content:		
Unit-I	**Ground water utilization**: Ground water utilization & historical background, ground water in hydrologic cycle, ground water budget, ground water level fluctuations & environmental influence, rock properties affecting groundwater, groundwater column, zones of aeration & saturation,	(06 Hours)
Unit-II	**Aquifers and their characteristics:** Aquifers and their characteristics/classification, groundwater basins & springs, Darcy's Law, permeability & its determination, Dupuit assumptions, heterogeneity &anisotropy, Ground water flow rates & flow directions, general flow equations through porous media.	(06 Hours)
Unit-III	**Ground Water Flow:** Steady, uniform, radial flow to a well in a confined, unconfined aquifer, well flow near aquifer boundaries/ for special conditions, partially penetrating, horizontal wells & multiple well systems, well completion, development, protection, rehabilitation, testing for yield.	(06 Hours)
Unit-IV	**Ground Water Pollution and Quality:** Municipal, industrial, agricultural ,miscellaneous sources & causes of pollution, , physical, chemical ,biological analysis of ground water quality, criteria & measures of ground water quality, ground water salinity & samples,	(06 Hours)
Unit-V	**Ground Water Exploration:** Geological, geophysical exploration, remote sensing , electric resistivity, seismic refraction based methods for surface investigation of ground water, test drilling & ground water level measurement, sub-surface ground	(06 Hours)

	water investigation through geophysical , resistivity	
Unit-VI	**Ground Water Recharge:** Concept & methods of artificial ground water recharge, recharge mounds & induced recharge, wastewater recharge for reuse, water spreading. Saline water interface, upcoming of saline water, saline water intrusion control.	(06 Hours)

Internal Assessment:	
Unit Test -1	UNIT – I, II, III
Unit Test -2	UNIT – IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare a report on Case studies with reference to rock properties affecting ground water.
2	Prepare a report on Case studies with reference to ground water fluctuations.
3	Prepare a report on different types of aquifer and their characteristics .
4	Prepare a report on well development and well protection.
5	Prepare a report on testing for yield of the wells.
6	Prepare a report on sources and causes of ground water pollution.
7	Prepare a report on physical, chemical and biological analysis of ground water quality .
8	Prepare a report on Case studies with reference ground water exploration using geophysical methods.
9	Prepare a report on Case studies with reference ground water exploration by remote sensing methods.
10	Prepare a report on Case studies with reference ground water exploration by using electrical resistivity method.
11	Prepare a report on Case studies with reference various methods of artificial recharge of ground water.
12	Prepare a report on Case studies with reference various sea water intrusion.
Practical will consist of following Assignments	
1	Determination of specific yield of an aquifer
2	Use of flow net for ground water studies
3	Problems on pumping test method.
4	Assignment on method of images
5	Assignment on different types of wells
6	Assignment on ground water quality for industrial use and domestic use.
7	Visit to nearby ground water harvesting structure and prepare a report.
8	Problems on well hydraulics
9	Assignment on ground water exploration techniques.
10	Assignment on Design of wells
Oral:	
	The oral examination will be based on above term work and course content.
Reference Books :	

1	Dr. P.N.Modi, Irrigation Water Resources and Water Power Engineering , Standard Book House 2012
2	H.M. Raghunath, Ground Water hydrology,
3	D.K. Todd and L. F. Mays,"Groundwater Hydrology", John Wiley and sons
4	Literature of Central Ground Water Board

COURSE:ELECTIVE-I: ETHICS FOR CIVIL ENGINEERS		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 03 Hours / Week Practical: 02 Hours/ Week	End Semester Examination: 60 Marks Internal Assessment: 40 Marks Term work: 25 Marks Oral: 25 Marks	Theory: 03 Practical: 01
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Construction Design & Drawing
2	Arbitration and Laws related to Construction Industry.
3	Quantitative Techniques, Communication and Values.
Course Objective: On completion of the course -	
	The students to imbibe and internalize the values and ethical behavior in the personal and professional lives.
Course Outcomes: On completion of the course, the students will be able to -	
1	comprehend the importance of values and ethics.
2	identify the principles of Engineering Ethics and Ethical terms.
3	analyze the Ethical Theories
4	apply the Professional Practices in Civil Engineering.
5	assess the Safety and Risk in Ethical terms
6	recognize the Global issues.

Course Content:

Unit-I	**Morals, Values, and Ethics:** Integrity, Work ethic, Service learning, Civic virtue, Respect for others, living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.	**(06 Hrs)**
Unit-II	**Code of Ethics for Engineers:** First principles of Engineering Ethics & Ethical terminology, Social Values, Character, considerations for general Individuals, Engineers & the Society, Recommendations of the Professional bodies (Code of Conduct).	**(06 Hrs)**
Unit-III	**Senses of 'Engineering Ethics':** Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories.	**(06 Hrs)**
Unit-IV	**Professional Practices in Engineering:** Profession: Definition and Characteristics, Relation of an Engineer with Client, Contractor and Fellow Engineers, Professional and Norms of Professional Conduct, Norms of Professional Conduct vs Profession; Responsibilities, Obligations and Moral values in Professional Ethics,Ethics inlimits of predictability and responsibilities of engineering profession.,	**(06 Hrs)**
Unit-V	**Safety and Risk:** Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk,	**(06 Hrs)**

	Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Introduction to Copyright, IPR (Intellectual Property Right), Plagiarism & Legal issues.	
Unit-VI	**Global Issues:** Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Corporate Social Responsibility.	**(06 Hrs)**

Internal Assessment:	
Unit Test -1	UNIT – I, II, III
Unit Test -2	UNIT – IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare a report on Morals, values, and Ethics.
2	Prepare a report on and PPT on Introduction to Yoga and meditation for professional excellence and stress management
3	Prepare a report on first principles of Engineering Ethics.
4	Prepare a report on Recommendations of the Professional bodies (Code of Conduct).
5	Prepare a detailed report on first principles of Engineering Ethics & Ethical terminology.
6	Prepare a detailed report and PPT on senses of 'Engineering Ethics'.
7	Prepare a detailed report and PPT on Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory.
8	Prepare a detailed report and PPT on uses of Ethical Theories.
9	Prepare a detailed report and PPT on responsibilities, Obligations and Moral values in Professional Ethics.
10	Prepare a detailed report and PPT on limits of predictability and responsibilities of engineering profession.
11	Prepare a detailed report and PPT on Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk.
12	Prepare a detailed report and PPT on Introduction to Copyright.
13	Prepare a detailed report and PPT on IPR (Intellectual Property Right).
14	Prepare a detailed report and PPT on Plagiarism & Legal issues.
15	Prepare a detailed report and PPT on Global Issues.

Term work: The term work shall consist of any EIGHT following practical-	
1	Study of various Work ethics and Commitment.
2	Write a report and PPT on Empathy and Self Confidence.
3	Write brief report on various Ethical terminology.
4	Write a report and PPT on Social Values in Code of Ethics.
5	Study of variousEthical theories about right action.
6	Study of variousProfessional Practices in Civil Engineering.
7	Write a report and PPT onRelation of an Engineer with Client, Contractor and Fellow Engineers

8	Write a report and PPT onProfessional Rights.
9	Write a report and PPT onenvironmental Ethics.
10	Write a report and PPT onCorporateSocial Responsibility.
Oral:	
	The oral examination will be based on above term work and course content.
Reference Books:	
1	R.Subramanian, "Professional Ethics" Oxford University Press.
2	Caroline Whitbeck, "Ethics in Engineering Practice & Research", Cambridge University Press.
3	Mike W. Martin and Roland Scherzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi.
4	Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi.
5	John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi.
6	Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi.

COURSE: ELECTIVE -I AIR & NOISE POLLUTION		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 03 Hours / Week Practical: 02Hours / Week	End Semester Examination: 60Marks Internal Assessment: 40Marks Term work: 25Marks Oral: 25Marks	Theory: 03 Practical: 01
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Environmental Engineering
Course Objective: On completion of the course -	
	The students will be able to impart knowledge on the sources, effect and control techniques of air pollutants and noise pollution.
Course Outcomes: On completion of the course, the students will be able to -	
1	acquire general understanding of quality of air and impact on local and global effects of air pollution on human, materials, properties and vegetation.
2	characterize the Scales & unit of air pollution, Air pollution episodes, Air quantity criteria and Air Quality standards, emission standards
3	know Meteorology, Meteorological parameters, meteorological data for atmospheric stability and air pollutant transport and dispersion
4	summarize sampling methods& the various types of air pollution control equipment
5	Get information about Air pollution monitoring systems, Legislation and enforcement, EIA, Air pollution control Act and strategy for effective control of air pollution.
6	Interpret the general of meaning, sources& effects of noise pollution also the acts of noise pollution

Course Content:

Unit-I	**Sources and effects of Air Pollution:** Definition, sources of air pollution- Natural and Artificial, types and classification of air pollutants, Primary and Secondary air pollutants and their importance, Effects of air pollution on –Human, Animals, Materials and Vegetation. Global Effects-Photochemical smog, heat island, ozone depletion, acid rain.	**(06 Hrs)**
Unit-II	**Air Pollution Measurement & Standards:** Scales of Air Pollution, Units of Measurement, Quantity and Composition of Gaseous and Particulate Pollutions, Air Pollution Episodes, Air quantity criteria and Air Quality standards, Ambient Air Quality standards and emission standards, .	**(06 Hrs)**
Unit-III	**Meteorology And Air Pollution:** Scales of Meteorology, Meteorological Parameters, Stability of Atmosphere & Temperature Lapse Rate, Plume Behaviour, Inversion Phenomena, Vertical Stability Of Atmosphere, Precipitation, Wind Patterns, Direction, Velocity and Fluctuations, Gaussian Diffusion Model for Finding Ground Level Concentration, Mixing Heights, Determination Of Stack Height.	**(06 Hrs)**
Unit-IV	**Air Pollution Sampling, Control Equipment and Methods :**	**(06 Hrs)**

	devices And Methods Used For Sampling Of Gases And Particulates, Ambient Air And Stack Sampling, Stack Emission Monitoring For Particulate And Gaseous Matter, Equipment For Ambient Air And Stack Sampling, Principles Of Particulate Removals, Removal Methods Of Particulate, Various Types of Particulate Control Equipment, Settling Chamber, Cyclone Separators, Scrubbers, Fabric Filters and Electrostatic precipitators. General Control of Gaseous Pollutants,	
Unit-V	**Air Pollution Acts & Monitoring Strategies :** Air Pollution Monitoring And Regularity Control, Ambient Air Quality Standards, Preventive Measures, Air Pollution Control Efforts, Zoning, Town Planning Regulation Of New Industries, Legalisation And Enforcement, Environmental Impact Assessment And Air Quality, Air Pollution Control Act And Strategy For Effective Control Of Air Pollution.	**(06 Hrs)**
Unit-VI	**Noise Pollution :** Sources Of Noise Pollution, Effects Of Noise Pollution, Human Diseases Caused By Noise Pollution, Control Of Noise Pollution, Units And Measurements Of Noise–Standard, Noise Pollution Act 2000.	**(06 Hrs)**

Internal Assessment:	
Unit Test -1	Unit No: I,II,III
Unit Test -2	Unit No: IV, V,VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare a chart / presentation on sources of air pollution & Effect of air pollution.
2	Prepare a chart / presentation on Classification of air pollutants.
3	Prepare PPT on concept of air pollution.
4	Prepare a chart / presentation on air quality standards and emission limits as per zones.
5	Collect the information of air pollution standards of your city.
6	Prepare the information chart on town planning regulation of new industries.
7	Prepare the information chart on Legislation (**Air Pollution Acts)** and enforcement of air Pollution.
8	Prepare a Model for any type of particulate control equipment.
9	Prepare a chart / presentation on new installations of pollution monitoring equipment.
10	Prepare chart on Sources, effect & control of noise pollution.
11	Prepare PPT on Noise pollution Act 2000.
Term work: The term work shall consist of **ANY SIX** following practical-	
1	Determination of particulate matter by PM 2.5 sampler.
2	Determination of NOx.
3	Determination of Sox.
4	Determination of noise level at certain location by using Digital Sound Level Meter.
5	Site visit specifically to 'Chimney' – Stack dispersion.
6	Site visit to industry to understand the working of control equipment of air pollution. (Electro-static precipitator).
7	Measurement of Construction site noise pollution by Digital Sound Level Meter.

8	Measurement of Construction site air pollution.
Oral:	
	The oral examination will be based on above term work and course content.
Reference Books:	
1.	C. S. Rao, "Environmental Pollution Control Engineering", Wiley Eastern Limited.
2.	Louis Theodore, Burley Intuscence "Air Pollution Control Equipment".
3.	CD Cooper and FC. Alley Wairland, "Air Pollution Control" Press III.
4.	Noel de Nevey, "Air Pollution Control Engineering", – McGraw Hill.
5.	M. N. Rao, H. V. N. Rao, "Air pollution", Tata McGraw Hill Pvt Ltd, New Delhi.
6.	Dr. Y. Anjaneyulu, "Air Pollution and Control Technologies", Allied publishers Pvt. Ltd.
7.	H.C Parkins, Air Pollution Mc Graw Hill Publication
8.	Wark Kenneth and Warner C.F, "Air pollution its origin and control". Harper and Row Publishers, New York,.
9.	Rao C.S., "Environmental pollution control engineering", New age international Ltd, New Delhi,.
10.	Peavy, H.S., Rowe, D.R., Tchobanoglous, G. "Environmental Engineering", McGraw Hills, New York.
11.	De Nevers, N., "Air Pollution Control Engineering", McGraw Hill, New Delhi.
12.	Rao M. N., "Air Pollution", Tata Mc-Graw Hill Publication
13.	H.S. Peavy, D.R. Row & G. Tchobanoglous, "Environmental Engineering", Mc Graw Hill International Edition.
14.	Martin Crawford, "Air Pollution Control Theory", TMH Publ.

COURSE: ELECTIVE I – PLANNING OF SMART CITIES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 03Hrs / Week Practical: 02Hrs / Week	End Semester Examination: 60 Marks Internal Assessment: 40Marks Term Work: 25 Marks Oral: 25 Marks	Theory: 03 Practical: 01
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Construction Design and Drawing
2	Building Byelaws and Regulations
3	Urban Planning
Course Objective: On completion of the course -	
	The students will study the concept and process of smart city planning
Course Outcomes: On completion of the course, the students will be able to -	
1	understand concept and necessity of smart city planning.
2	examine the core challenges due to urbanization.
3	learn models of 21st century green and smart cities.
4	understand current international strategies relating to the foundation of sustainable smart cities.
5	develop knowledge, understanding and application of smart city planning.
6	develop the critical thinking related to smart, sustainable urban development.

Course Content:		
Unit-I	Introduction, Concept of Smart City, Components of Smart Cities, Initiative by the government of India, Need of today, Benefits of Smart Cities	**(06 Hrs)**
Unit-II	Evolution of cities up to the present day: social, political and spatial planning models, Urbanization and its impacts on cities, Urban evolution in India, Changing patterns of urban growth, Quality of life in the city.	**(06 Hrs)**
Unit-III	Efficiencies and inefficiencies in cities; challenges and opportunities, Eco challenges in the contemporary cities; Principles of green and smart cities; International initiatives including UN and EU level; Corporate social and environmental strategies in cities;	**(06 Hrs)**
Unit-IV	Fundaments of sustainable development; Sustainability and "sustainable development, Climate change indicators and their meaning for cities; Mobility and transportation within urban areas; Green technologies in cities; Green buildings and ecological footprint, Green Infrastructure, Urban sustainability foundations, models, & theories	**(06 Hrs)**
Unit-V	Role of local authorities and public participation in shaping the cities; Liveability, place making and Walk-ability; City services: utilities (water, energy and communications), public street lighting, roadways and traffic, public transport, signage, environmental quality, waste and sewage management, maintenance.	**(06 Hrs)**
Unit-VI	Study of the existing cities, finding problems and how far they are solvable, Designing for Smart cities, Design, development and exhibition of a feasible innovation project which will enrich citizens and the city through all its phases: determining the scope, defining the idea, establishing objectives,	**(06 Hrs)**

	identifying partners, selecting and acquiring tools and knowledge, planning and presentation, beginning to put the project into practice, Budgetary allocation.	

Internal Assessment:	
Unit Test -1	Units: I, II, III
Unit Test -2	Units: IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare a poster on 'Components of smart Cities'.
2	Prepare a power point presentation on 'Need of Smart City Planning in India'.
3	Prepare a poster on 'Impact of Urbanization on Cities'.
4	Prepare a power point presentation on 'Quality of life in cities'.
5	Prepare a power point presentation on international initiatives for challenges in cities.
6	Prepare a model of green city.
7	Prepare a poster on 'Sustainable Development' in cities.
8	Prepare a model of 'Waste Management' in Smart Cities.
9	Prepare a power point presentation on 'Need for public participation in shaping the cities'.
10	Case study of 'Smart City' and prepare a power point presentation on it.

Term work: The term work shall consist of **any SIX** following practical-	
1	Case study of 'Smart City Planning' in detail and prepare the report
2	To study and prepare report on smart materials for smart buildings
3	Case study of 'Green Building' in detail and prepare the report
4	To study the problems urbanization and its impact on quality of life
5	Case study of 'e – governance' in detail and prepare the report
6	To study the traffic problems in metro cities and address the solutions
7	To study and prepare a report on 'Smart Transport systems for Smart Cities'
8	Site visit of Smart City and prepare a report
9	Model preparation on Smart City

Oral:	
	The oral examination will be based on above term work and course content.

Reference Books:	
1	Annapurna Shaw ," Indian cities " Oxford India ,2012
2	B. Gallion, S. Eisner , "The Urban Pattern", Van Nostrand Reinhold Company,2003
3	ITPI, " City and Metropolitan Planning & Design" ITPI, New Delhi
4	How Green is Cities? By Dimitri Devuyst, Colombia University Press, New York
5	Sustainability Science and Engineering Vol 1, By Martin A. Abraham (editor) Elsevier Publication
6	www.smartcitiescouncil.com
7	City Region 2020, by Joe Ravetz, Earthscan Publication Ltd, London, 2000.

COURSE: INDUSTRY TAUGHT COURSE – V-WASTE WATER TREATMENT AND MANAGEMENT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 4 Hours / Week Practical: 2 Hours / Week	End Semester Examination: 60Marks Internal Assessment: 20 Marks Term work: 25 Marks Oral: 25 Marks	Theory: 04 Practical: 01
		Total: 05

Course Pre-requisites: The students should have knowledge of	
1.	Engineering Chemistry
2.	Engineering Mathematics
3.	Microbiology
4.	Mechanics of fluids
Course Objective:	
1	To understand the basics of waste water treatment
2	To gain thorough knowledge on primary, secondary and Advanced treatment of waste water treatment
3	To get employability in ETP and STP
Course Outcomes: The student will be able to	
1.	Use the concept related to sewage, sewer, storm water, etc in its hydraulic design
2.	Study of Primary Treatment and Secondary Treatment
3.	Take-up functional planning, layout and design of sewage treatment plant components.
4.	Study of Advanced Waste water treatment.
5.	Analyze the industrial waste water for understanding its characterization.
6.	Plan for Waste Water reclamation and reuse

Course Content:		
UNIT - I	**General Aspects of Environmental Engineering**	**(8 Hours)**
	General Aspects of Environmental Engineering – Study of waste water, black water & grey water. System of collection and conveyance of sewage- separate and combined systems, patterns of sewage collection systems. Quantity of storm water and sanitary waste water Sewer: Types, Shapes, Hydraulic Design (Capacity, Size, Grade)	
UNIT - II	**Primary Treatment**	**(8 Hours)**
	Characteristics of sewage – Physical, Chemical, Biological. Introduction to unit operations and unit processes. Primary Treatment –Preliminary and Primary treatment- screen, grit chamber, oil & grease removal, Primary settling tank.	
UNIT - III	**Secondary Treatment**	**8 Hours)**
	Activated sludge process: Theory and design of ASP, sludge volume index, sludge bulking & control, modifications in ASP. Trickling filter: Biological principle, different T.F media & their characteristics, design of standard rate and high rate filters , single stage & two stage filters, recirculation, ventilation, operational trouble, control measures, process of sequencing batch reactor(SBR) and membrane bioreactor (MBR).	

UNIT - IV	**Advanced Waste water and Sludge treatment**	**(8 Hours)**
	Methods, principles and process description. Membrane filtration, Gas stripping, lon exchange, Advanced Oxidation Process (AOP): Sewage water treatments systems-STP-principle and unit process. Principles of anaerobic digestion, stages of digestion, bio-gas production its characteristics and application, factors governing anaerobic digestion, Theory, Process and design of sludge drying bed. Advances in sludge treatment and disposal and nutrient removal.	
UNIT - V	**Industrial waste water treatment and Management**	**(8 Hours)**
	Methods of sampling. Equalization and neutralization. Application of preliminary, primary and secondary treatment for industrial wastewater as per the CPCB norms. Sources of waste water generation from manufacturing process, characteristics of effluent, different methods of treatment & disposal of effluent for the following industries: Sugar, dairy and Pulp and Paper. Discharge standards as per CPCB norms.	
UNIT - VI	**Water reclamation and reuse**	**(8 Hours)**
	Water reclamation technologies – process flow diagrams; Agricultural and landscape irrigation; ground water recharge with reclaimed water – ground water recharge guidelines; Risk assessment for water reuse, Industrial water reuse: Cooling tower makeup water, zero discharge, Case study of waste water management.	

Internal Assessment:	
Unit Test -1	Unit I,II,III
Unit Test -2	Unit IV,V,VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Hydraulic Design of Sewers
2	Characterization of sewage sample collected by the students.
3	Power Point Presentation on Working of Sewage treatment Plants
4	Collection of information - Advances in sludge treatment and disposal.
5	Layout of ETP of Sugar, Pulp and Paper, Dairy Industries (Case studies)
6	Design and drawing of septic tank for hostel
7	Prepare chart on useful micro-organisms in waste water treatment
8	Case studies – Recycle and reuse of treated waste water and write report
9	Power Point Presentation Water reclamation and reuse
10	Prepare model of single Pipe system
11	Prepare model of double Pipe system
12	Prepare model of Sewage Treatment Plant
13	Prepare model of Effluent Treatment Plant
14	Collect information of River Pollution of your city/town/village
15	Write a report on the manner waste water handled in your city/town/village
Practical (Any Eight)	
1	Determination of Solids –Total solids, suspended solids, volatile solids, settleable solids &non

	settleable solids
2	Determination of Dissolved oxygen
3	Determination of Bio-Chemical Oxygen Demand
4	Determination of Chemical Oxygen Demand
5	Determination of Electrical Conductivity
6	Determination of Phosphates by spectrophotometer
7	Determination of Nitrates by spectrophotometer
8	Visit to domestic / Industrial wastewater treatment plant & its detailed reports
9	Application of Arc Gis in Environmental Engineering
10	Selection of Site for sewage treatment plant by using Arc Gis
11	Determination of Sludge Volume Index
12	Design of ETP/STP using software
Oral:	
	The oral examination will be based on above term work and course content.
Textbooks:	
1	Waste Water Treatment & Disposal – Metcalf & Eddy - TMH publication
2	Environmental Engg. - Peavy, Rowe - McGraw Hill Publication.
3	Waste Water Treatment – Rao & Dutta
4	Environmental studies by Rajgopalan- Oxford University Press
5	Waste Water Engg. – B.C. Punmia& Ashok Jain - Arihant Publications
6	Sewage Disposal & Air Pollution Engg. – S. K. Garg – Khanna Publication
7	Industrial Waste Water Treatment- A.D.Patwardhan Publication – PHL Learning Private Limited.
8	Water Supply And Wastewater Engineering – B S N Raju- McGraw Hill Publication.
9	Waste Treatment Plants-C.A.Sastry Narosa Publication
Reference Books:	
1	Environmental Engg. – Davis - McGraw Hill Publication
2	Water Supply & Waste Water Engg.- B.S.N. Raju – TMH publication
3	Resources i) http://nptel.iitm.ac.in/courses-contents/IIT Kanpur and IIT Madras. ii) http://cpcb.nic .in iii) http://moef.nic .in
4	P.N.Modi,Sewage Treatment & Disposal & Waste Water Engineering, Rajsons Publications,2015

COURSE: ADVANCED DESIGN OF STRUCTURES

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS:
Theory: 04 Hours / Week Practical: 02 Hours / Week	End Semester Examination: 60 Marks Internal Assessment: 40 Marks Term work: 25 Marks Oral: 25 Marks	Theory: 04 Practical: 01
		Total: 05

Course Pre-requisites: The students should have knowledge of

1	Design and Detailing of Reinforced Concrete Structures
2	Analysis of Determinate and Indeterminate Structures
3	Mechanics of Solids

Course Objective: On completion of the course -

	The students should be able to design advanced structures in Reinforced Cement Concrete and Prestressed Concrete.

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

1	calculate stresses in prestressed girder in flexure.
2	design a prestressed girder.
3	design the flat slab using I.S. code method.
4	design T and L shaped cantilever retaining wall.
5	design rectangular combined footing.
6	design circular and rectangular water tank resting on ground using I.S. code method.

Course Content:

Unit-I	**Introduction to Prestressed Concrete Structures:** Introduction to prestressing, Basic definitions and terms related to pre stressing, Concepts of prestressing, Materials used, Various methods of prestressing, analysis of P.S.C. beam for flexure.	**(06 Hrs)**
Unit-II	**Losses and Design of P.S.C. Beam:** Concept of losses, Calculation of various losses. Design of Prestressed simply supported beams of rectangular and flanged cross sections, design for flexure and shear only, check for deflection, Design should confirm to the latest version of I.S. 1343.	**(06 Hrs)**
Unit-III	**Design of Flat Slabs:** Concept of flat slabs, Design of flat slabs using latest I.S. Codes.	**(06 Hrs)**
Unit-IV	**Design of Retaining Walls:** Design of cantilever retaining walls- T and L shaped, for all loading conditions as per latest I.S. codes.	**(06 Hrs)**
Unit-V	**Design of Combined Footing:** Design of slab type rectangular combined footing for two columns only. Concept of beam- slab type footing.	**(06 Hrs)**
Unit-VI	**Design of Water Tanks:** Design of circular water tank resting on ground using latest version of I.S. 3370.	**(06 Hrs)**

Internal Assessment:	
Unit Test -1	Units: I, II, III
Unit Test -2	Units: IV, V, VI
Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare the chart for difference in pre tensioning and post tensioning.
2	Prepare the chart for various methods of prestressing.
3	Prepare the chart for various types of losses.
4	Develop of an excel sheet for calculation of design of types of stresses induced in member due to initial loading of prestressing.
5	Develop of an excel sheet for calculation of design of types of stresses induced in member due to final loading of prestressing.
6	Prepare the chart for concept, types, advantages and disadvantages of flat slabs.
7	Develop of an excel sheet for calculation of design of a flat slab.
8	Prepare the chart for concept, types, and advantages of different types of retaining walls.
9	Develop of an excel sheet for calculation of design of T shaped cantilever retaining wall.
10	Develop of an excel sheet for calculation of design of L shaped cantilever retaining wall.
11	Prepare the chart for concept, types, and advantages of different types of combined footings.
12	Develop of an excel sheet for calculation of design of slab type rectangular combined footing.
13	Prepare the chart for different types of water tanks depending on design and location.
14	Develop of an excel sheet for calculation of design of circular water tank resting on ground.
Term work: A) Term work shall consist of **Any TWO** projects from following- Minimum three full imperial sheets based on above projects to be drawn with the help of any drafting software.	
1	Design of post-tensioned simply supported beams flexure and shear with check for deflection.
2	Design of flat slab.
3	Design of retaining walls (T or L).
4	Design of slab type rectangular combined footing.
5	Design of Circular water tank.
B)	Visit to construction site and prepare report on it.
Oral:	
	The oral examination will be based on above term work and course content.
Reference Books:	
1	Dr .H. J. Shah, "Reinforced Concrete design, Vol I and II", Charotar Publishing house.
2	Punmia, Jain and Jain, "Comprehensive Design of R. C. Structures", Standard Book House.
3	Sinha R.C., "RCC Analysis and Design- Vol. I, II", Chand and Co, New Delhi.
4	Ramamrutham, "Design of R. C. Structures", Dhanpat Rai Publications.
5	N. Krishna Raju, "Advanced Reinforced Concrete Design", CBS Publishers and Distributors.
6	T. Y. Lin and N. H. Burns, "Design of P.S.C structures", John Wiley and Sons, New York.
7	S. S. Bhavikatti, "Advanced R.C.C. Design", New Age International Ltd.
8	N. Subramanian, "Design of Reinforced Concrete Structures", Oxford University Press.
9	S. Unnikrishnan Pillai, and Devidas Menon, "Reinforced Concrete Design", Tata McGraw Hill

	Publications.
10	N. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill Publications.
11	Edward Nawy, "Prestressed Concrete: A Fundamental Approach", PHI.
Codes:	
1	IS 3370: Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi.
2	IS 1343: Prestressed Concrete - Code of Practice.
3	IS 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
4	IS 13920: Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision), Bureau of Indian Standards, New Delhi.
5	SP 16: Design Aids for Reinforced Concrete to IS 456.

COURSE: PROJECT STAGE-I		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical: 02 Hrs / Week	Term work: 50Marks Oral: 50Marks	Practical: 03 Credits
		Total: 03 Credits

Course Pre-requisites: The students should have knowledge of	
1	Core Civil Engineering Courses
2	Analytical skills
3	Soft and Computing Skill
Course Objective : On completion of the course -	
	The student shall be able to identify the problem and suitable solution for the same.
Course Outcomes: On completion of the course, the students will be able to -	
1	identify the grey areas of present condition by literature review
2	define the objective of the project and scope of the project
3	decide the methodology to achieve objective of the project
4	estimate resources and cost of project
5	do planning and coordination of project work
6	arrangement for collection of data / resource required.

Course Content:		
Unit-I	**Literature Review:** Discuss and identify thrust areas, Conduct Literature review	**(04 Hrs)**
Unit-II	**Define Objective and Scope:** Identify grey areas and decide objective of project work, check feasibility, limitations and define scope of work.	**(04 Hrs)**
Unit-III	**Methodology:** Work out methodology to address grey areas and to achieve objective of project work	**(04 Hrs)**
Unit-IV	**Cost Estimate:** Predict resources required for the work, Evaluate quantity and cost of resources, Estimate overall cost of project	**(04 Hrs)**
Unit-V	**Project Planning:** Prepare weekly plan of project work, distribute responsibilities and coordination	**(04 Hrs)**
Unit-VI	**Resources provision:** Collect data required, arrange resources and material required.	**(04 Hrs)**

Term work: The project work shall consist of any project pertaining to Civil Engineering field or interdisciplinary field. The students should submit and present Project Stage-I Report which includes consists of above topics. (Maximum Five Students per Project Group)

Oral:	
	The oral examination will be based on above term work and presentation with reference to course content.

COURSE: CIVIL ENGINEERING SOFTWARE – III (Auto Scan and Auto Steel)		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical: 02 Hrs / Week	Term work: 25 Marks Oral: 25 Marks	Practical: 01
		Total: 01

Course Pre-requisites: The students should have knowledge of	
1	Civil Engineering Software – I (Autocad)
2	Construction Design & Drawing
3	Project Estimation and Valuation
Course Objective: On completion of the course -	
	The students will be able to use modern tool of Auto scan and Auto steel for estimation of project
Course Outcomes: On completion of the course, the students will be able to -	
1	use the Auto Cad drawings for estimating the quantities
2	estimate the quantities with better accuracy and speed
3	present both measurement sheets and Abstracts / summary reports in a systematic way

Course Content:		
Unit-I	**Introduction of Software Auto scan** Introduction of software, Applications of the Software In Civil industry, Preparation Of Drawing (Burst Or Explode the block references and schedule formation if required).	**(06 Hrs)**
Unit-II	**Working Process Of Auto scan** Setting up project, Read Room Process- Scan the drawing and get the reports of floor Finishing items like- Tiles, Paints, Plaster, brickwork, No Door Windows, Waterproofing, Staircase etc	**(06 Hrs)**
Unit-III	**Introduction of Software Auto steel** Introduction of software, applications of the software In Civil industry, preparation of drawing (Burst Or Explode the block references and schedule formation if required).	**(06 Hrs)**
Unit-IV	**Working Process Of Auto steel** Setting up project, Working of All type of footing, column, beam, slab. Working of shear wall, retaining wall, staircase etc	**(06 Hrs)**

Term work: The term work shall consist of consists **Any FOUR** out of following –	
1	Assignment on different toolbars and menu bars used in Auto Scan
2	Assignment on flowchart of steps for working process of Auto Scan
3	Practice problems on Auto Scan
4	Assignment on different toolbars and menu bars used in Auto Steel
5	Assignment on flowchart of steps for working process of Auto Steel
6	Practice problems on Auto Steel
Oral:	

	The oral examination will be based on above term work and course content.
Reference Books:	
1	Auto Steel Manual
2	Auto Scan Manual
3	Manual estimation books for subject knowledge

COURSE: INTERNSHIP		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Duration: 60 days	Term work: 25 Marks Oral: 25 Marks	Term work: 03 Credits
		Total: 03 Credits

Course Pre-requisites: The students should have knowledge of	
1	Core Civil Engineering Courses
2	Analytical skills
3	Soft and Computing Skill
Course Objective: On completion of the course -	
	The student shall be able to work effectively on civil engineering project.
Course Outcomes: On completion of the course, the students will be able to -	
1	learn work process, behave responsibly, and follow rules of organization
2	co-relate and apply knowledge of courses learnt on real life project
3	work individually and in team.
4	plan, estimate, communicate and coordinate to complete the work in scheduled time
5	Learn solution to the problems in context of social, environmental, and legal context.
6	use and adopt to modern tools and techniques

Course Content:

Internship: A student has to undergo the inplant training for 8 weeks / 60 days for exposure to industry / site / design office, in one of the Civil Engineering areas. The training may consist of any one or more of the following:

1) Working on any construction site with substantial work related to Civil Engineering
2) Working in any engineering planning / design office with work related to Civil Engineering Design
3) Working in any Civil Engineering industry / Government organisation / research organisation

Term work: Term work consist of an inplant training for 8 weeks / 60 days. Daily work report on above training in logbook duly certified by officer incharge for the training. The report to be submitted within fifteen days from the date of completion of the training.

Oral:

The oral examination will be based on above term work and internship experience.

SEMESTER VIII

COURSE: SEISMIC DESIGN OF STRUCTURES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04Hrs / Week Practical: 02Hrs / Week	End Semester Examination: 60 Marks Internal Assessment: 40Marks Term work: 25Marks	Theory: 04 Practical: 01
		Total: 05

Course Pre-requisites: The students should have knowledge of	
1	Design and Detailing of Reinforced Concrete Structures
2	Advanced Design of Structures
3	Limit State Design of Steel Structures
Course Objective: On completion of the course -	
	The students will be able to design the building super structures to resist earthquake forces.
Course Outcomes: On completion of the course, the students will be able to -	
1	apply seismic zones factors for earthquake resistant design.
2	predict nature of vibration of structure.
3	estimate seismic forces on structure using equivalent static method
4	estimate seismic forces on structure using dynamic method
5	design shear wall for seismic forces
6	detailing of reinforcement for ductile performance of structure.

Course Content:

Unit-I	**Earthquake and its Effects:** Causes of Earthquakes, Plate Tectonic, Measurements of Earthquakes, Seismic Zoning, Effects of earthquakes, Earthquakes resistant design philosophy	**(08 Hrs)**
Unit-II	**Theory of Vibrations:** Vibrations - definition, terminologies, (SDOF) - Free, Forced, Damped, Un-damped vibrations with basic examples. Introduction to Multi-degrees of Freedom systems (MDOF), Different types of irregularities in structures.	**(08 Hrs)**
Unit-III	**Determination of Earthquake Forces-Static Method:** Basic definitions, Concept of OMRF &SMRF frames, Seismic coefficient method as per I.S. 1893, Determination of base shear, Lateral force, Storey shear diagram, Application to cantilevers	**(08 Hrs)**
Unit-IV	**Determination of Earthquake Forces- Dynamic Method:** Dynamic Methods, Modes of Vibration, Response Spectra Method as per I.S. 1893,Choice of Method	**(08 Hrs)**
Unit-V	**Design of Shear Wall:** Types and Concept of Shear Wall in earthquake resistance, Design of Shear wall as per 13920	**(08 Hrs)**
Unit-VI	**Ductile Detailing of Earthquake Resistant Design:** General Provisions and rules to be followed for buildings in seismic areas, Ductile detailing of beams, columns, joints and footing for earthquake resistant design as per IS 13920	**(08 Hrs)**

Internal Assessment:

Unit Test -1	Units: I, II, III
Unit Test -2	Units: IV, V, VI
Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare chart / presentation on causes and effect of earthquakes
2	Prepare chart / presentation on various irregularities in buildings.
3	Prepare chart / presentation on different types of vibrations.
4	Prepare model of SDOF and MDOF System
5	Prepare model of Modes shapes
6	Develop an excel sheet on equivalent static method for calculation of EQ forces
7	Develop an excel sheet on dynamic method for calculation of EQ forces
8	Prepare model of Shear wall reinforcement
9	Prepare model showing ductile detailing in beams
10	Prepare model showing ductile detailing in columns
11	Prepare model showing ductile detailing in foundation
12	Prepare model of earthquake resistant building construction
Term work: The term work shall consist of **all THREE** following practical-	
1	Design of RC Earthquake resistant building using Equivalent Static Method
2	Design of RC Earthquake resistant building using dynamic Response Spectrum Method
3	Design of Shear wall for earthquake resistant
Reference Books:	
1	B.N.Duggal, "Earthquake Resistance Design of Structure", Oxford University Press
2	Pankaj Agarwal, Manish Shrikhande, "Earthquake Resistant Design of Structures" PHI Learning Pvt Ltd
3	Dr. Vinod Hosur "Earthquake Resistant Design of Building Structures"- Wiley India
4	National Information Centre of Earthquake Engineering, "IITK-BMTPC Earthquake Tips", NICEE Publication
5	Anil K Gupta, "Dynamics of Structure", Prentice Hall
6	N.Subramanian, "Design of Steel Structures", Oxford University Press
7	Mario Paz, "Dynamics of structure", CBSPD Publication
Reference Codes:	
1	IS1893-"Criteria for Earthquake Resistant Design of Structures", Bureau of Indian Standards.
2	IS13920- "Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces" Bureau of Indian Standards

COURSE: HYDRAULIC STRUCTURES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 3 Hours / Week Practical: 2 Hours / Week Tutorial: 1 Hour/Week	End Semester Examination: 60 Marks Internal Assessment: 40 Marks Term work: 25 Marks Oral: 25 Marks	Theory: 3 Practical: 1 Tutorial: 1
		Total: 5

Course Pre-requisites: The students should have knowledge of	
1	Fluid Mechanics
2	Hydrology and Irrigation
Course Objective: On completion of the course	
	The students will be able to design and plan Hydraulic Structures
Course Outcomes: On completion of the course the student will be able to	
1	calculate forces on gravity dam and perform stability analysis.
2	describe method of construction and perform stability of slopes of Earth dam.
3	hydraulic design of Ogee spillway and Energy dissipater.
4	analyze weirs on permeable foundations,
5	design stable channels and Cross drainage works
6	describe river training works and describe components of Hydropower plants

Course Content:

Unit-I	**Reservoir Planning and Gravity Dams:** Investigations for reservoir planning, various storage zones, estimation of reservoir capacity by mass curve method, Gravity dams forces acting and their combinations, criteria for structural stability, modes of failure, elementary profile of gravity dam, construction of gravity dam, Use of colgrout masonry ,foundation treatment.	(06 Hours)
Unit-II	**Earthen dams:** Classification of earth dams, method of construction ,basic design considerations in design of section, phreatic line and its location, stability of slopes ,design of filters ,rock toe and pitching, internal drainage arrangement, cut of trench. Causes of failure of earth dams.	(06 Hours)
Unit-III	**Spillways and Energy Dissipator:** Introduction , function , components, classification ,selection of type of spillway, spillway capacity, hydraulic design of ogee spillway, Energy dissipation below spillway- hydraulic jump type and bucket type, spillway gates.	(06 Hours)
Unit-IV	**Diversion Head Works and canals:** Diversion Head Works Selection of sites, layout of the work types of weirs and barrages, design of subsurface flow, safety against piping and uplift, Bligh, Lane, and Khosala‟s Theories, design of weirs on permeable foundations. Canal Irrigation, Types of canal, canal alignment, losses in irrigation channels. Design of lined channels, various types of canal lining, economics of lining.	(06 Hours)

Unit-V	**Stable Channels and Cross Drainage works:** Design of stable channels in alluvium, the regime method, Design of Channel using Lacey's and Kennedy's theory, cross-section of irrigation channels. Canal Masonry Works Cross drainage works, necessity types and selection, comparative merits and demerits, falls, types and design, head regulating works.	(06 Hours)
Unit-VI	**River Training works and Hydropower plants:** Classification of rivers, River training and its objectives, River Training Works- Levees, guide banks, groynes, bank pitching and launching aprons, and their design and construction principles. Hydro Power General features of Hydro-power plant, general layouts of different types, Assessment of power potential, Flow duration curve, main components of Hydro-power schemes, selection of suitable turbine.	(06 Hours)

Internal Assessment:	
Unit Test -1	UNIT – I, II, III
Unit Test -2	UNIT – IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Presentation on Case study of the gravity dam in the country with detail report.
2	Presentation on case study of colgroute masonry construction for gravity dam.
3	Presentation on Case study of Roller Compacted concrete dam construction.
4	A report on case studies of failure of earthen dams and their causes.
5	Presentation on construction of a major earthen dam in the country.
6	Prepare a report on location of Spillway for the earthen dams with case studies.
7	Presentation on Case study of the Ogee spillway with detail report.
8	Presentation on Case study of the side channel spillway with detail report.
9	Presentation on Case study of the stable channel in the country with detail report.
10	Prepare a report on channel losses and types of canal linings with case studies.
11	Prepare a report on different types of Cross drainage works with case studies.
12	Prepare a report on Case study of High head Hydropower plant.
13	Prepare a report on case studies of river training works like levees, guide banks.
14	Prepare a report on Case study of Pumped Storage Hydropower plant.
15	Prepare a report on Case study of Run off the river Hydropower plant.

Practical: Any eight of the following	
1	Estimation of reservoir capacity using mass inflow curve.
2	Stability analysis of Gravity dam.
3	Stability analysis of an Earth Dam
4	Hydraulic design of a ogee spillway and Energy dissipater.
5	Design of canals.
6	Analysis of a weir on permeable foundation using Khosla's curves.
7	Typical layout of High head hydropower plant.
8	Design of Guide banks.

9	Site visit report on Irrigation project.
Oral:	
	The oral examination will be based on above term work and course content.
Reference Books:	
1	Asawa G.L., Irrigation and Water Resources Engineering, New Age International (P) Ltd. Publishers, 2006
2	Garg, S. K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers Delhi, 2007.
3	Modi, P.N., Irrigation, Water Resource and Water Power Engineering, Standard Book House, Delhi, 2008.
4	Varshney R. S., Concrete Dams, Oxford and IBH Publishing Co.
5	Bharat Singh and R.S.Varshney Embankment dams , Oxford and IBH ,2000
Codes:	
1	I.S. 6512 Criteria for design of solid gravity dams, first revision, first reprint, September, 1998, B.I.S. New Delhi.
2	I.S. 11223 Guidelines for fixing spillway capacity, edition (1991-09), B.I.S. New Delhi.
3	I.S. 6934 ,Hydraulic design of high ogee overflow spillways – recommendations, first revision, B.I.S. New Delhi.
4	I.S. 10137Guidelines for selection of spillways and energy dissipaters, B.I.S. New Delhi.
5	I.S. 4997 – 1968 (Reaffirmed 1995) Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron, sixth reprint, January, 1998, B.I.S. New Delhi.
6	I.S. 7365-1985, Criteria for hydraulic design of bucket type energy dissipaters, first revision, B.I.S. New Delhi

COURSE: ELECTIVE –II- ADVANCED STEEL DESIGN		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04Hours / Week	End Semester Examination: 60Marks Internal Assessment:40Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Limit State Design of Steel Structures
2	Mechanics of Solids
3	Analysis of Structures
Course Objective: On completion of the course -	
	The students will be able to design different types of steel structures using limit state design.
Course Outcomes: On completion of the course, the students will be able to -	
1	design the member for different forces
2	design moment resisting connection.
3	design truss bridge
4	design of building Frame
5	design plate girder
6	evaluate design forces on gantry girder.

Course Content:		
Unit-I	**Design of Structural Elements:** Design of Members for Axial Tension, Axial Compression, Shear and Bending Moment. Check for deflection	**(08 Hrs)**
Unit-II	**Design of Moment Resisting Connection:** Design of bolted and welded connections for Moment, Design of connection for combined Shear and Moment.	**(08 Hrs)**
Unit-III	**Design Truss Bridge:** Components of truss bridge, Load calculation, Load combinations, Analysis and Design	**(08 Hrs)**
Unit-IV	**Design of Building Frame:** Load Calculation, Analysis of Frame, Design of Beams, Design of Columns, Design of Beam-to-Beam connection, Design of Beam to Column connection.	**(08 Hrs)**
Unit-V	**Design of Welded Plate Girder:** Design of Cross section, Design of connection between web and flange, Design of Load carrying and Load bearing Stiffeners, Design of Intermediate Stiffeners, Design of Horizontal Stiffeners, Design of connection between stiffeners and section.	**(08 Hrs)**
Unit-VI	**Design Philosophy for Gantry Girder:** Components and functioning of gantry girder, Design philosophy for Gantry Girder	**(08 Hrs)**

Internal Assessment:	
Unit Test -1	Units: I, II, III
Unit Test -2	Units: IV, V, VI

Project Based Learning: AnyONE based on following topics but not limited to it	
1	Prepare model of Rigid and Hinge connection
2	Prepare model of Truss Bridge
3	Prepare model of Plate Girder
4	Prepare model of Gantry Girder
5	Prepare model of Building Frame
6	Prepare Presentation on design of Rigid and Hinge connection
7	Prepare Presentation on design of Truss Bridge
8	Prepare Presentation on design of Plate Girder
9	Prepare Presentation on design of Gantry Girder
10	Prepare Presentation on design of Building Frame
Reference Books:	
1	S. K. Duggal, "Limit State Design of Steel Structures", Tata McGraw-Hill Education
2	S.S.Bhavikatti, "Design of Steel Structures: By Limit State Method", I K International Pub
3	M. R. Shiyekar, "Limit State Design in Structural Steel", Prentice-Hall of India
4	N. Subhramanian, "Design of Steel Structures", Oxford University Press
5	Ramchandra, "Limit State Design of Steel Structures", Scientific Publications
Reference Codes:	
1	IS:800-2007, "General Construction in Steel - Code of Practice", Bureau of Indian Standards
2	IS:875-1987, "Code of Practice for Design Loads for Buildings and Structures Part (1 to 5)" Bureau of Indian Standards
3	SP-6(6)- 1972, "Handbook for Structural Engineers" ,Bureau of Indian Standards

COURSE: ELECTIVE – II GEO-SYNTHETICS AND APPLICATION		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory:04 Hours / Week	End Semester Examination:60 Marks Internal Assessment: 40 Marks	Theory:04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Geomechanics
2	Foundation Engineering
Course Objective: On completion of the course -	
	To make student aware about manufacturing and performance of geo synthetics and its application in Civil Engineering construction project.
Course Outcomes: On completion of the course, the students will be able to -	
1	understand use of geosynthetic materials in the field of Civil Engineering construction works.
2	identify the various properties of Geosynthetics.
3	design the geo-synthetics for the various functions in Civil Engineering work.
4	investigate effect of geo-synthetics in design of retaining wall
5	investigate effect of geo-synthetics in design of flexible pavements
6	describe mechanism of soil reinforcement to improve bearing capacity of soil

Course Content:		
Unit-I	**Introduction to Geo-synthetics material:** Introduction, Historical Development, necessity of geosynthetics, Classification of Geosynthetics, manufacturing process, Functions, and applications.	**(08 Hrs)**
Unit-II	**Properties of Geosynthetics material:** material used in Geosynthetics, properties of Geosynthetics:- physical, mechanical , hydraulic & endurance, Nano material.	**(08 Hrs)**
Unit-III	**Geotextiles:** Design criteria for Separation, Reinforcement, Stabilization, Filtration, Drainage and Moisture barriers. Geogrids: Designing for Reinforcement, Stabilization, Designing Gabions Construction methods.	**(08 Hrs)**
Unit-IV	**Application of Geo-synthetics in reinforced soil retaining wall :** Types of the facing element, construction procedure, cost, design of geo-synthetics wrap around face wall, geo-grid reinforced soil wall, geo-cell wall and gabion wall.	**(08 Hrs)**
Unit-V	**Application of Geo-synthetics in Pavement**: Mechanism and concept of pavement, design of unpaved road using geo-synthetic material, giroud and Noiray method, airfield pavement design	**(08 Hrs)**
Unit-VI	**Application of Geo-synthetics in ground improvement:** Consolidation technique, prefabricated vertical drain, ground instrumentation and monitoring, design of encased stone column, bearing capacity of geo-synthetics reinforced soil system, mechanism of geo-cell reinforced sand overlaying soft clay.	**(08 Hrs)**

Internal Assessment:	
Unit Test -1	Unit No: - I, II, III
Unit Test -2	Unit No: - IV, V, VI
Project Based Learning: AnyONE based on following topics but not limited to it	
1	To prepare chart on Historical development of geosynthetics.
2	Study and prepare a presentation of classification geosynthetics.
3	To prepare a detailed report on properties of geosynthetics.
4	To prepare chart on use of various raw materials for manufacturing of geosynthetics.
5	To prepare a detailed report on design criteria of geotextile for various functions.
6	To prepare a detailed report on use of geosynthetics in soil retaining structures.
7	To prepare chart on giroud and Noiray method.
8	To prepare a detailed report on design of unpaved road using geo-synthetic material.
9	To prepare chart on consolidation technique.
10	To prepare a detailed report on use of geosynthetics in ground improvement.
Reference Books:	
1	G.L. Sivakumar Babu, "An Introduction to Soil Reinforcement and Geosynthetics", Universities Press,India,
2	Robert M. Koerner, "Designing with Geosynthetics" 6th editionXlibris Corporation, 2012
3	Sanjay kumar Shukla and Jijan-Hua Yin, "Fundamentals of Geosynthetics Engineering" CRC Press, 2017, Hyderabad.
4	G.V. Rao & G.V.S.S. Raju, "Engineering With Geosynthetics", Tata McGraw-Hill Publication Co Ltd, 1990.

COURSE: ELECTIVE II – URBAN PLANNING		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04Hrs / Week	End Semester Examination: 60 Marks Internal Assessment: 40Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Building Planning and Design
2	Building Byelaws and Development Control rules
3	Infrastructure Engineering
Course Objective: On completion of the course -	
	The students will understand the concept and study the process of urban planning
Course Outcomes: On completion of the course, the students will be able to -	
1	learn various definitions of planning, various sources of planning knowledge and various forms of planning knowledge.
2	understand importance of Urban and Regional Planning at various levels
3	learn about development plan and development control regulations also various guidelines and various land uses.
4	learn the concept and planning of smart cities
5	conduct the traffic planning surveys
6	learn basics of governance in planning and Global cities and its characters.

Course Content:		
Unit-I	**Definitions and Rationales of Planning** Various definitions of town and country planning; Goals and objectives of planning; Components of planning; Benefits of planning	**(08 Hrs)**
Unit-II	**Foundations of Planning** Sustainability and rationality in planning; Components of sustainable urban and regional development; Town & Country Planning at National, Regional and Local levels; The physical planning process; Land-use planning, determinants of land use, Zoning and density control; urban sprawl.	**(08 Hrs)**
Unit-III	**Development Plans and Development Regulations, Zoning Regulations** Definition of development plan; Types of development plans: master plan, city development plan, structure plan, district plan, action area plan, subject plan, town planning scheme, regional plan, sub-regional plan; Planning Advisory Group report and the URDPFI Guidelines; Defining development and development control regulations,	**(08 Hrs)**
Unit-IV	**Smart City Planning** Concept of Smart City; Urban renewal, retrofitting and redevelopment program. Smart city planning for solid waste management, rejuvenation of streams and rivers, affordable housing to poor ,housing and slum redevelopment, energy efficient and green buildings, Water supply and its management, Concept of intelligent transport network and green belts. E governance and citizen's participation.	**(08 Hrs)**
Unit-V	**Traffic Planning**	**(08 Hrs)**

	Concept of PCU and level of service, capacity of uninterrupted flow conditions, factors affecting; capacity and level of service; capacity of rural and urban roads, capacity at intersections. Traffic Volume Count, origin destination survey, speed and delay study, parking surveys, road network inventory, accident study, need of public transport.	
Unit-VI	**Governance of Planning** Local government in India; District Planning Committees and Metropolitan Planning Committees; Use of remote sensing and GIS in planning; Introduction to Internationalization and globalization of planning	**(08 Hrs)**

Internal Assessment:	
Unit Test -1	Units: I, II, III
Unit Test -2	Units: IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare the power point presentation on the definitions and components of planning
2	Prepare the poster on the benefits of planning
3	Prepare the model of planning at various levels
4	Prepare the conceptual model of land use zoning
5	Prepare the report on URDPFI guidelines
6	Prepare a poster on Comparative study of various types of plan
7	Prepare the poster on components of smart city
8	Case studies on urban renewal, retrofitting and redevelopment
9	Prepare the model on level of service
10	Prepare the survey format for parking surveys
11	Prepare the survey format for Traffic Volume Count
12	Prepare the survey format for Origin Destination Survey

Reference Books:	
1	L.R. Kadiyali, " Traffic Engineering and Transport Planning" Khanna Publishers, New Delhi, 2007
2	Annapurna Shaw ," Indian cities " Oxford India ,2012
3	B. Gallion, S. Eisner , "The Urban Pattern", Van Nostrand Reinhold Company,2003
4	ITPI, " City and Metropolitan Planning & Design" ITPI, New Delhi
5	Faludi, A. A Reader in Planning Theory - Pergamon Press, Oxford.
6	Faludi, A. Planning Theory - Pergamon Press, Oxford.
7	Keeble, L. Principles and Practice of Town - The Estate Gazette, London Town and Country Planning
8	McLoughlin, J.B. Urban and Regional Planning:- Faber and Faber, London. A System Approach
9	McLoughlin, J.B. Control and Urban Planning - Faber and Faber, London.
10	Hall, P. Urban and Regional Planning Fourth Routledge, London
11	Freidmann, J. Planning in the Public Domain - Princeton University Press, Princeton.
12	Fainstein, S.S. and Readings in Planning Theory - Mackwell. Campbell, S.
13	Smart City Guidelines, Ministry of Urban Development, Govt. of India. 2015

Reference Codes:	
1	Urban and Regional Development Plans Formulation and Implementation (URDPFI) guidelines by Ministry of Urban Development, Government of India.

COURSE: ELECTIVE II -RURAL SANITATION		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hours / Week	End Semester Examination: 60 Marks Internal Assessment: 40 Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Water Supply Engineering
2	wastewater Treatment Methods
Course Objective: On completion of the course	
	The students will be able to extrapolate the methods of rural water supply, treatment requirements and management of liquid waste.
Course Outcomes: On completion of the course, The student will be able to	
1	describe the concept of sanitation
2	elaborate the onsite rural sanitation concept
3	detailed about the management of night soil and liquid waste
4	identify the sources of rural water supply system, problem associated with it
5	decide the methods of treatment required for rural water supply
6	get familiar with govt. policies regarding rural sanitation

Course Content:

Unit-I	**Introduction To Sanitation:** Sanitation, Hygiene, Meaning of WASH, methods of sanitation, general concept and scope of sanitation in rural areas, importance of sanitation. Sanitation problems in rural areas, challenges of rural sanitation. Ecological sanitation.	**(08Hrs)**
Unit-II	**RURAL SANITATION** Introduction to rural sanitation; On site sanitation systems and community latrines, concept of Eco-sanitation, trenching and composting methods, two pit latrines, aqua privy, septic tank, soak pit. Disposal of Solid Wastes; Composting, land filling, incineration, Biogas plants, Rural health. WADEP.	**(08Hrs)**
Unit-III	**SMALL SCALE [RURAL] WATER SUPPLY** Introduction- Magnitude and problems of water supply and sanitation in rural areas in India, Relationship of environmental sanitation and health and its importance, Water and Health, Sources of water and characteristics , Diseases transmitted through water and channels of transmission of infection, Protected water supply ,Community wells - Study of various types of wells, Disinfection for Tank and well.	**(08Hrs)**
Unit-IV	**WATER SUPPLY SCHEMES IN RURAL AREAS** Individual village and group schemes, Source of water supply: Springs, wells, infiltration wells, radial wells, infiltration galleries and surface water intake, Treatment of water for rural water supply, Compact system: multi bottom settler, horizontal roughing filter, slow sand filter, cloth filter, chlorine diffuse cartridges, house-hold water treatment, pumps, pipe,	**(08Hrs)**

	materials, appurtenances & advancement in rural water supply schemes, Distribution system for rural water supply.	
Unit-V	**WATER QUALITY** Water sample collection for water quality test ,National Rural Drinking Water Programme, National Water supply and sanitation programme ,Water Quality Monitoring.	**(08Hrs)**
Unit-VI	**POLICIES AND PROGRAMMES RELATED TO WASH** Governmental Policies and Programmes - Central Rural Sanitation Programme (CRSP) 1986, Total Sanitation Campaign (TSC) Programme 1999, Nirmal Bharat Abhiyan 2012; Swachh Bharat Mission 2014, and Role of Local Bodies. Accelerated Rural Water Supply Programme (ARWSP), the Sector Reforms Project, Swajal Dhara, and the National Rural Drinking Water Programme (NRDWP).	**(08Hrs)**

Internal Assessment:

Unit Test -1	Unit No. I,II,III
Unit Test -2	Unit No. IV,V,VI

Project Based Learning:

1	Prepare the chart showing Sanitation problems in rural areas.
2	Prepare PPT on the overall concept of rural sanitation
3	Prepare the models of water supply system in rural area.
4	Prepare the chart showing the poor sanitation in rural area along with the remedies.
5	Prepare a model on Composting of solid waste; land filling, incineration; Biogas plants etc.
6	Prepare a model on Treatment of water for rural water supply.
7	Visit the rural area to understand the sanitation and give the practical remedies/improvements on the current system. / Visit to "APPA PATWARDHAN SAFAI WA PARYAWARAN TANTRANIKETAN", DHEHUGAON.
8	Prepare a data required for conduction of Campion/ program in rural area related to sanitation awareness.
9	Prepare a chart showing various govt. schemes, policies & strategies for rural sanitation.
10	Collect the water sample from rural area for testing the concerned water parameters.
11	Prepare a chart showing the effect of used water on the soil.

Reference Books:

1	Rural Sanitation Planning and appraisal W. Armstrong
2	Rural Water Supply and Sanitation South Asia rural development series South Asia rural development series: India water resources management DANIDA.
3	Basic Sanitation In Rural India by Sunder Ram (Ed), Shipra Publications
4	Preventive and Social Medicine by J.E Park and K. Park
5	Municipal and Rural Sanitation by Ehlers and Steel.
6	Public Health Engineering by GS Bajwa.
7	Wastewater engineering, treatment and reuse by Metcalf and Eddy, 5th Edition, Tata Mc Graw Hill

8	Environmental sanitation –Ehlers, V.M., add steel, E. W., Mc Graw-Hill Book Co.
9	Gupta, S., "Rural Water Supply and Sanitation", VAYU Education of India
10	Wright, F.B., "Rural Water Supply and sanitation", Kruger Publishing Company
11	Birdie, G.S., and Birdie, J.S., "Water Supply & Sanitary Engineering", Dhanpat Rai Publishing Co. Pvt Ltd.
12	Husain, S.K., "Textbook of Water Supply and Sanitary Engineering", Oxford & IBH Publishers
13	CPHEEO Manual.
14.	CPHO Manual

COURSE: ELECTIVE -II ADVANCED ENGINEERING GEOLOGY WITH ROCK MECHANICS		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04Hours / Week	End Semester Examination: 60Marks Internal Assessment: 40Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Basic Engineering sciences
2	Basic geology
3	Engineering Mechanics
Course Objective: On completion of the course -	
	The students will be able to intends to provide sound knowledge in applying the concepts of mechanics in analysing stability problems related to rocks. The course covers topics related to failure theories of rocks.
Course Outcomes: On completion of the course, the students will be able to -	
1	Know the geology, mineralogy & petrology
2	Informed about seismology , geo-hydrology
3	Know the Importance of geological investigation in engineering projects to carry out the site selection of various civil constructions like dam, tunnel etc.
4	Classify rocks and gain an understanding of the strength and stress-strain response of rocks
5	Analyze the effect of water and cracking on engineering property of rocks
6	Design structures in rocks and adjudge stability of rock slopes

Course Content:

Unit-I	**Physical Geology:** Weathering, Erosion, Transportation, Deposition, Geological Agents. Overall ideas about the work done by Geological Agents. The Earth- Origin, age, internal constitution. Mineralogy & Petrology, Importance of geology in civil engineering structures.	**(08Hrs)**
Unit-II	**Mineralogy & Petrology:** **Mineralogy**: Definition of Minerals, Non-crystalline, Crystalline matter and -Crystals. Physical Properties of Minerals in general. An Introduction to physical properties of Common Rock Forming Minerals and Economic Minerals **Petrology**: Definition of Rocks. Brief idea on different types of Rocks. Igneous Rocks-, forms, Structures and Textures. Sedimentary Rocks- Genesis, Texture, Classification. Metamorphic Rocks -Factors controlling Metamorphism, Textures and Structures of Metamorphic Rocks. Petrography of common Igneous, Sedimentary and Metamorphic rocks	**(08Hrs)**
Unit-III	**Structural Geology:** Brief idea about fold, fault, unconformity, lineation, foliation, Seismology: An introduction to Earthquake. Elastic Rebound Theory. Different types of seismic waves. Global distribution of seismic zones, Geohydrology - Sources of Ground water, Hydrological Zones below the surface, porosity,	**(08Hrs)**

	permeability, aquifer-confined and unconfined, engineering importance of ground water study Engineering Geology –Importance of geological investigation in engineering projects, site selection for dam, bridge, tunnel & reservoir, stability of hill slopes along road and railway cuttings	
Unit-IV	**Rock Classification and Coring:** Composition of rocks, engineering, classification of rocks and limitation, rock structures and pore space inrock, rock coring methods.	**(08Hrs)**
Unit-V	**Rock Strength and Failure Theories:** Elastic properties of rock, stress-strain relations, application of elastic theory to rock design, uni-axial and tri-axial strength of rocks, failure theories of rocks and propagation of cracks.	**(08Hrs)**
Unit-VI	**Design Theories and Measurement Methods:** Griffith Crack Theory, water in rock, structural feature of massive rocks and their effects on engineering properties, measurement of stresses in rock mass, various measuring devices, evaluation of properties of rocks in field.	**(08Hrs)**

Internal Assessment:

Unit Test -1	Unit No. I,II,III
Unit Test -2	Unit No. IV,V,VI

Project Based Learning: Any ONE based on following topics but not limited to it

1	Collection of different types of rocks.
2	Prepare a chart showing different types of texture, folds & failure in rocks.
3	Structural interpretation & mineral potential using remote sensing data & GIS tool.
4	Determination of rock parameters, specific gravity, density & compressive strength of different types of rock.
5	Geophysical investigation using seismic refraction method to determine causes of real failure.
6	Resistivity methods used in horizontal & vertical discontinuities in electrical properties of the ground water.
7	Application of electrical resistivity methos in ground water exploration.
8	Calculate uniaxial and triaxial strength of rocks samples.
9	Collection of various core samples of the rocks.

Reference Books:

1.	S. P. Bindra S.P.Arora "Building Construction", Laxmi publications.
2.	Gupta R.B. A textbook of engineering Geology, P.V.G. Publications, Pune.
3.	John Hudson, John Harrison, Engineering Rock Mechanics an Introduction to the Principles1st Edition.
4.	Rock mass classification, by Bhawani singh and R.K. Goel
5.	Engineering rock mechanics: part 1, by john a. Hudson and john p. Harrison
6.	Engineering rock mechanics: part 2, by john a. Hudson and john p. Harrison
7.	Fundamentals of rock mechanics by j. C. Jaeger, n. G. W. Cook, andr. W. Zimmerman
8.	Rock mechanics for underground mining by b. H. G. Brady and e. T. Brown

9.	Introduction to rock mechanics by richard e. Goodman
10.	Understanding earth by Press, Frank, Raymond Siever, John Grotzinger, and Thomas H. Jordan. Macmillan
11.	P. K. Mukherjee, A Textbook of Geology, compiled by and published by World Press
12.	GB Mahapatra, A Textbook of Geology, published by CBS Publishers & Distributors
13.	Holmes' Principles of Physical Geology edited by Peter MacLaren Donald Duff, Donald Duff publishedby Taylor & Francis.
14.	Hudson J.A. and J.P. Harrison, "Engineering Rock Mechanics: An Introduction to the Principles",Elsevier, Oxford.
15.	Goodman, R.E. "Introduction to Rock Mechanics", John Wiley & Sons.
16.	Ramamurthy, T. (editor) "Engineering in Rocks for Slopes, Foundation and Tunnels", Prentice HallIndiaPvt. Ltd.
17.	Related codes and manuals from International Society of Rock Mechanics, ASTM and Bureau of Indian Standards.

COURSE: ELECTIVE – II DESIGN OF FOUNDATION		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hours / Week	End Semester Examination: 60 Marks Internal Assessment: 40Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of

1	Statics and Dynamics
2	Geomechanics
3	Fluid Mechanics
4	Foundation Engineering

Course Objective: On completion of the course -

	To familiarize the students for the design of different type of foundations.

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

1	identify various types of foundations and its necessities.
2	design of raft foundation.
3	understand concept of Pier and Cassion.
4	design of well foundation.
5	analyse the sheet pile foundation.
6	summarizing the concept of machine foundation.

Course Content:

Unit-I	**Introduction: -** Introduction: Basic concept of foundation design, Function of Foundation, General requirements, causes of foundation failure, types of shallow and deep foundations and their use, performance of various types of foundations during past earthquakes, Various IS codes for design of foundations.	**(08 Hrs)**
Unit-II	**Raft Foundation: -** Introduction, types, floating raft, design of raft foundation- conventional and elastic method, principles of design of buoyancy raft and basement, concept of modulus of sub-grade reactions.	**(08 Hrs)**
Unit-III	**Raft, Pier and Cassion Foundation: -** **Pier and Caisson:** Introduction, design of piers, construction of piers, design of open caissons, construction of open caissons, pneumatic caissons, construction of pneumatic caissons, advantages and disadvantages of pneumatic caissons.	**(08 Hrs)**
Unit-IV	**Well Foundation:** Introduction, depth of well foundation and bearing capacity, forces acting on a well foundation, analysis of well foundation, design of individual components of well, Floating Foundation	**(08 Hrs)**
Unit-V	**Sheet pile:** Introduction, Sheet piles and Braced cuts: Cantilever sheet piles including	**(08 Hrs)**

	anchored sheet piles in cohesion-less and cohesive soils: lateral earth pressure diagram, computation of embedment depth. Design of anchored bulkhead:- Free earth support and fixed earth method.	
Unit-VI	**Machine Foundation: -** Introduction, types of machine foundation, dynamic loads, Dynamic soil testing techniques: block vibration test, shear modulus test, Resonance-column test, Two & three borehole techniques, Vibration isolation, General requirements and design criteria, analysis, and design steps involved in Barkans method.	**(08 Hrs)**

Internal Assessment:	
Unit Test -1	Unit No: I, II, III
Unit Test -2	Unit No:IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	To prepare demonstrate models of different types of foundations.
2	To prepare detailed report on performance of various types of foundations during past earthquakes.
3	To prepare chart on computation of design load of shallow foundation.
4	To prepare chart on design steps of raft foundation.
5	To prepare detailed report on construction open and pneumatic caisson.
6	To prepare chart on forces acting on a well foundation.
7	To prepare detailed report construction of well foundation.
8	To prepare chart on cantilever sheet pile in cohesive and non-cohesive soil.
9	To prepare detailed report on types of machine foundation.
10	To prepare detailed report on Dynamic soil testing techniques.

Reference Books:	
1	A.K.Arora, “Soil Mechanics and Foundation Engineering”, Standard Publishers.
2	B.C. Punmia, “Soil Mechanics and Foundation Engineering”, Laxmi Publication.
3	Dr. P.N. Modi, “ Soil Mechanics and Foundation Engineering” Rajsons Publications Pvt. Ltd.
4	Murthy V. N. S, “Advanced Foundation Engineering”, C.B.S. Publishers.
5	N.V. Nayak, “Foundation Design Manual”, Dhanpat Rai and Sons.

COURSE: ELECTIVE II – METRO SYSTEMS AND ENGINEERING		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04Hrs / Week	End Semester Examination: 60 Marks Internal Assessment: 40Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Construction Techniques
2	Infrastructure and Transportation Systems
3	Urban Planning
Course Objective: On completion of the course -	
	The students will understand the construction, implementation and operation of Metro Systems.
Course Outcomes: On completion of the course, the students will be able to -	
1	explain the basics of metro systems
2	appreciate the importance of different modes of transportation and characterize the rail transportation
3	discuss construction methods for elevated and underground section
4	explain the construction quality and safety
5	apply electronic signaling systems and automatic fare collection
6	understand the importance of railway infrastructure planning and design at global level

Course Content:

Unit-I	**General** Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials, Origin of railways and metro, Introduction to Transit Oriented Development	**(08 Hrs)**
Unit-II	**Basics of Metro development in India and at global level** Development of metro in Indian metropolitan cities Rail transit development in foreign countries Various organizations working for the development of metro rail transit system and vision of the governing bodies behind the development	**(08 Hrs)**
Unit-III	**Construction Methods** Civil Engineering- Overview and construction methods for elevated and underground stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations	**(08 Hrs)**
Unit-IV	**Quality & Safety Systems** Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management	**(08 Hrs)**
Unit-V	**Operation Control Centre** Electronics and Communication Engineering- Signalling systems; Automatic fare collection; Intelligent Transport System; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.	**(08 Hrs)**

Unit-VI	**Technology enhancement for Metro construction at global level** Case studies for the development done in metros, rail transit operation (Light rail transit, Metro, Mono rail, urban rails) at global and Indian level Similar technology development (alternatives)-TRAM, Sky bus, Electric Bus, Subways etc.	**(08 Hrs)**

Internal Assessment:	
Unit Test -1	Units: I, II, III
Unit Test -2	Units: IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare a poster on 'Advantages of Metro Systems'.
2	Study the detailed Project Report of Metro and prepare a power point presentation.
3	Prepare the power point presentation on 'Need of Metro Systems in India'.
4	Prepare a poster on various organizations working on Metro Rail Transit Systems.
5	Prepare a model for underground metro station.
6	Prepare a model for elevated metro station.
7	Prepare a power point presentation on Initial Surveys and Investigations for Metro Systems.
8	Prepare a poster on Metro Safety Systems.
9	Prepare a model for multi modal transfers at Metro Station.
10	Prepare a model on Signaling System of Metro
11	Prepare a power point presentation on Automatic fare collection system.
12	Case study of Metro System and prepare a report based on it.

Reference Books:	
1	Satish Chandra and M.M. Agrawal, Railway Engineering, Oxford University Press, New Delhi
2	S.C. Saxena and S. P. Arora, A Text Book of Railway Engineering, Dhanpat Rai & Sons, New Delhi
3	S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, Principles of Railway Engineering, Charotar Publishing House, Anand
4	General & Technical information of Hyderabad Metro
5	General & Technical information of Delhi Metro
6	Metro Rail Projects in India: A Study in Project Planning Book by M. Ramachandran
7	Urban rail transit construction technology demonstration project: Guangzhou Metro Line Paperback – January 1, 2000 by Lu Guang Lin. Chen Shao Zhang (Author)
8	The Metro Railway Corporation and Maintenance ACT 2002 PART A – Act Indian Railway Board Act, 1905
9	Paul Garbutt, World Metro Systems, Capital Transport Pub; 2nd Edition, 1997.

Reference Codes:	
1	IS1893-"Criteria for Earthquake Resistant Design of Structures", Bureau of Indian Standards.
2	IS13920- "Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces" Bureau of Indian Standards

COURSE:ELECTIVE-II BRIDGE ENGINEERING		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hours / Week	End Semester Examination: 60 Marks Internal Assessment: 40 Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1	Analysis of Determinate and Indeterminate Structures
2	Design of Steel Structures
3	Design of RCC Structures
4	Analysis and Design of Prestressed Concrete
5	Transportation and Geotechnical Engineering
Course Objective: On completion of the course -	
	The students should be able to select and design appropriate bridge structures for given site conditions.
Course Outcomes: On completion of the course, the students will be able to -	
1	classify different types of bridges
2	calculate the stresses on bridges as per IRC
3	differentiate different types of bridges
4	design of RC slab bridge deck for highways
5	design the components of railway plate girder bridge
6	design the bridge bearings

Course Content:

Unit-I	**Introduction to Bridge Engineering:** Classification of bridges, Components of Bridges, Preliminary data to be collected during investigation of site for bridges, Economical span, Afflux, HFL, Scour depth and Clearance, Locations of piers and abutments, Factors influencing the choice of bridge super structure, Approach roads.	**(08 Hrs)**
Unit-II	**Superstructure and Substructure:** Components of Superstructure, loads on bridges: Brief specifications of different loads, Forces and stresses coming on bridges as per IRC, Substructure: Abutment, Piers, and Wing walls with their types.	**(08 Hrs)**
Unit-III	**Types of Bridges:** Culvert: Definition, Location, Waterway of culvert and types. Temporary bridges: Definition, Materials used, Brief general ideas about timber, Floating- pontoon bridges. Movable bridges: Bascule, Cut boat, Flying, Swing, Lift, Transporter and Transverse bridges, their requirement and suitability. Fixed span bridges: Simple, Continuous, Cantilever, Arch, Suspension, bowstring girder type and Rigid frame and Cable stayed bridges, Materials for super structure.	**(08 Hrs)**
Unit-IV	**Design of RC Slab Bridge Deck for Highways:** Analysis of slab decks considering cases solid slab spanning in one direction, solid slabs in spanning two direction and solid cantilever slab,	**(08 Hrs)**

	design. Aids and Tables of RC deck bridge slab as per Pigeaud's method, design of slab culvert, Design of RC slabs supported on all sides for T-beam and slab deck.	
Unit-V	**Plate Girder Bridges:** Railroad bridge philosophy, Railroad bridge types, Elements of plate girder and their design such as web, flange, vertical stiffeners, end bearing stiffeners, intermediate stiffeners, and lateral bracing for plate girders.	**(08 Hrs)**
Unit-VI	**Bridge Bearings:** General features and function of bearings, Types of bearings, Design of steel rocker and roller bearings, Design of elastomeric pad bearing, Concept of fatigue.	**(08 Hrs)**

Internal Assessment:	
Unit Test -1	Unit: I, II, III
Unit Test -2	Unit: IV, V, VI

Project Based Learning: Any ONE based on following topics but not limited to it	
1	Prepare the chart for different classification of bridges
2	Prepare the chart for different components of bridges
3	Prepare the chart for site investigations of bridges
4	Prepare the chart for different components of substructure of bridges
5	Prepare the chart for different components of superstructure of bridges
6	Prepare the chart for different types of bridges
7	Develop of an excel sheet for calculation of design of a slab deck spanning in one direction
8	Develop of an excel sheet for calculation of design of a slab deck spanning in two directions
9	Develop of an excel sheet for calculation of design of a solid cantilever slab
10	Develop of an excel sheet for calculation of design of a RC slabs supported on all sides for T-beam.
11	Prepare the chart for different types of railway bridges
12	Prepare the chart for different components of railway bridges
13	Prepare the chart for general features, function, and types of bearings
14	Develop of an excel sheet for calculation of design of a steel rocker and roller bearings
15	Develop of an excel sheet for calculation of design of an elastomeric pad bearing

Reference Books:	
1	B. L. Gupta and Amit Gupta, "Highway and Bridge Engineering", Standard publishers Distributors.
2	Rangwala, "Bridge Engineering", Charotar Publication.
3	N. Krishna Raju, "Design of Bridges", Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.
4	D. Johnson and Victor, "Essentials of Bridge Engineering", Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
5	Wai-Fah Chen and Lian Duan, "Bridge Engineering Handbook", CRC Press Pvt. Ltd.
6	Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill, New Delhi.
7	Ramachandra, "Design of Steel Structures", Standard Publications, New-Delhi.

8	Jain and Jaikrishna, “Plain and Reinforced Concrete”, Vol.2., NemChand Brothers, New Delhi
Codes:	
1	Standard specifications and code of practice for road bridges, IRC section I, II, III, V, VI, VII, and IX.
2	IS 456: Code of practice for Plain and Reinforced Concrete, BIS, Bureau of Indian Standards, New Delhi
3	Indian Railway Standard Code of practice for the design of steel and wrought iron bridges carrying rail, Govt of India, Ministry of Railways.
4	American Association of State Highway and Transportation Officials (AASHTO).
5	Ministry of Road Transport and Highways, India.

COURSE: ELECTIVE-II SOLID WASTE MANAGEMENT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hours / Week	End Semester Examination: 60Marks Internal Assessment:40 Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of	
1.	Basic Knowledge of Physics, Chemistry and Mathematics
2.	Basic Knowledge of Environmental Science
3.	Basic Knowledge of Statistics and Computers
Course Objective:	
	To learn the mode of Solid Waste Generation and understand its need and importance to Reuse, Recycle, Refuse and thereby, effectively manage the problem of Solid Waste generated as well as mitigation and combating the issue of land pollution
Course Outcomes: The student will be able to	
1.	Understand the generation, sources and characteristics of Solid Waste
2.	Learn Segregation, Collection and Transportation of Municipal Solid Waste(MSW)
3.	Describe the different steps of executing the relevant methods of solid waste disposal
4.	Implement the relevant methods for disposal of Bio-medical waste
5.	Familiarize with latest Emerging Processing Technologies for Solid Waste for Treatment and Recovery of useful Products
6.	Implement the relevant laws related to solid waste management

Course Content:		
Unit-I	**Solid Waste Management**	**(8Hours)**
	Definition of solid waste, Meaning of different solid wastes, Domestic waste, commercial waste, industrial waste, market waste, agricultural waste, biomedical waste, E-waste, hazardous waste, institutional waste, **Sources of solid waste and classification** of solid waste, Physical and chemical characteristics of municipal solid waste. Impact of solid waste on environment, Solid waste management techniques, Factors affecting solid waste generation.	
Unit-II	**Segregation, Storage, Collection and Transportation of MSW Waste**	**(8Hours)**
	Segregation: at source, household level, at transfer station/central sorting facility, Reuse, Recovery and Recycling of solid waste. **Storage:** container categories, Communal containers, Location of Communal Container, Storage of recyclable waste, **Transfer station:** Selection of location, operation and maintenance; options under Indian conditions – Field problems- solving. **Collection:** methods, Tools and Equipments **Transportation**: Transportation vehicles with their capacity.	
Unit-III	**Disposal of Solid Waste**	**(8Hours)**
	Methods of disposal, **Composting:** Principles, factor affecting Composting process, Methods	

	of Composting, Land filling: techniques, factors considered in site selection, methods, Incineration of solid waste	
Unit-IV	**Biomedical Waste and Health Aspects**	**(8 Hours)**
	Definition, Sources and Generation, Classification and Management technologies, Health problems during segregation, recovery , recycling and reuse, public involvement in Biomedical Waste management.	
Unit-V	**Solid Waste Processing Technologies**	**(8 Hours)**
	Introduction, Vermi-composting, Bio-methanation, Pyrolysis, Plasma Arc Technology/Plasma Pyrolysis Vitrification, Refuse Derived Fuel, Hydro pulping, Slurry Carb Process, Treatment For Recovery Of Useful Products, E waste management, Integrated solid waste management	
Unit-VI	**Legal Aspects of Solid waste Management**	**(8 Hours)**
	Legal Aspects- present scenario Muncipal Solid Waste Management Rules-2016, E-Waste Management Rules,2016, Construction and demolition Waste Management Rules 2016, Plastic Waste Management Rules 2016, Role of Central Pollution Control Board and Maharashtra Pollution Control Board in management of solid waste.	

Internal Assessment:

Unit Test -1	I,II,III
Unit Test -2	IV,V,VI

Project Based Learning: Any ONE based on following topics but not limited to it

1	Write a report on Segregation and Storage of Waste at your home
2	Visit nearby slums and write report on Provision of SWM Services in slums
3	Clean My institute
4	Zero Waste Initiative
5	Waste Management Program for institute
6	Model of land fill
7	Visit nearby Transfer station and write report
8	Audit of E-waste of institute
9	Case study on Industrial Solid Waste Management
10	Power Point Presentation on Industrial Solid Waste Management
11	Selection of solid waste management site through Arc Gis

Reference Books:

1	Handbook of Solid Waste Management, George Tchobanoglous and Frank Kreith, Second Edition, McGRAW-HILL
2	Solid Waste Management, K. Sasikumar, Sanoop Gopi Krishna, PHI Learning, 2009
3	Solid Waste: Engineering Principles and Management Issues, , George Tchobanoglous, 1st Edition, Mc GRAW-HILL
4	Solid Waste Technology and Management Vol. 1 and 2, Thomas Christensen, Wiley Publishing, 2010

5	Solid Waste Management, Stefen Burnley, Wiley Publishing, 2014
6	Assessment of the Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities and Class II Towns in India: An Insight .Sunil Kumar, J.K. Bhattacharya, A.N. Vaidya, Tapan Chakrabarti, Sukumar Devotta, A.B. Akolkar. Kolkatta : Central Pollution Control Board (CPCB), National Environmental Engineering Research Institute (NEERI), 2008.
7	Ministry of New and Renewable Energy, MNRE. National Master Plan for Development of Waste-to-Energy in India. Ministry of Environment and Forests. [Online] 2003.
8	Census of India, 2011. Census of India. [Online] 2011
9	National Environmental Engineering Research Institute, NEERI. Air Quality Assessment, Emissions Inventory and Source Apportionment Studies: Mumbai. New Delhi : Central Pollution Control Board (CPCB), 2010
10	Department of Economic Affairs, Ministry of Finance, Government of India. Position Paper on the Solid Waste Management Sector in India. Public Private Partnerships in India. [Online] November 2009.
11	Ministry of Urban Development, Government of India. Guidance Note: Municipal Solid Waste Management on a Regional Basis. Ministry of Urban Development, Government of India. [Online].
Codes:	
1	IS 12647: Solid Waste Management Systems--Collection Equipment--Guidelines Bureau of Indian Standards (BIS)
2	CPHEEO MANUAL

COURSE: ELECTIVE – II ADVANCE GEOTECHNICAL ENGINEERING		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 04 Hours / Week	End Semester Examination:60 Marks Internal Assessment: 40 Marks	Theory: 04
		Total: 04

Course Pre-requisites: The students should have knowledge of

1	Statics and Dynamics
2	Geomechanics
3	Fluid Mechanics

Course Objective: On completion of the course -

To acquire knowledge of various parameter related to Engineering behaviour of soils and the suitability of soils for different civil Engineering Projects.

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

1	describe role of water in soil behavior and concept of flow net.
2	apply knowledge of consolidation to foundation design.
3	estimate the stress under any type of loading conditions.
4	demonstrate concept, principle and working of various geotechnical instruments.
5	analyse the stability of earth slopes using various methods.
6	understand dynamic soil properties.

Course Content:

Unit-I	**Stress distribution in soil: -** Introduction, state of stress at a point, equilibrium equation, pressure distribution on horizontal and vertical planes, stresses due to point load, line load, strip load, uniformly loaded circular and rectangular areas. use of Newmark's chart.	**(08 Hrs)**
Unit-II	**Seepage Analysis: -** Soil moisture and mode of occurrence, permeability, Darcy's law, field determination of coefficient of permeability: Pumping out tests, Pumping in test, flow net for one dimensional flow and two-dimensional flow, seepage through non-homogenous and anisotropic soil, methods of obtaining flow net, radial flow net.	**(08 Hrs)**
Unit-III	**Consolidation: -** Introduction, mechanism of consolidation, basic terms used in consolidation, three-dimensional consolidation equation, sand drain and other techniques to accelerate consolidation process, (Numerical on consolidation)	**(08 Hrs)**
Unit-IV	**Geotechnical Instrumentation: -** Introduction, definition of terms relating to instrumentation characteristics, measurement of pore pressure:- introduction and instrument types, measurement of deformation:- introduction and instrument types	**(08 Hrs)**
Unit-V	**Stability of Earth slopes: -** Introduction, infinite slopes in cohesionless and cohesion soil, stability analysis of finite slopes, planar surface failure:- Culmann's method, Swedish slip circle method, Taylor stability number.	**(08 Hrs)**

Unit-VI	**Introduction of Geotechnical Earthquake Engineering: -** Introduction, causes of earthquake, seismograph, nature and types of dynamic loading, concept of dynamic loading, characteristics of ground motion, effect of local site conditions on ground motions, dynamic soil properties, liquefaction and related phenomena, soil improvement for remediation of seismic hazards.	**(08 Hrs)**

Internal Assessment:	
Unit Test -1	Unit No: I, II, III
Unit Test -2	Unit No: IV, V, VI

	Project Based Learning: Any ONE based on following topics but not limited to it
1	To prepare demonstrate model of Darcy's law.
2	To prepare chart on flow net and its practical applications in Geotechnical Engineering.
3	To prepare detailed report on different techniques to accelerate consolidation process.
4	To prepare chart on mechanism of consolidation process with proper sketches.
5	To prepare PPT on stress calculation for different types of loading on soil.
6	To Prepare detailed report on Newmark chart and Westergaard's equation with suitable numerical problem.
7	To prepare detailed report on uses of different geotechnical instruments for measurement of pore pressure and deformation.
8	To Prepare chart on Culmann's method.
9	To prepare chart on Swedish slip circle method.
10	To Prepare PPT on liquefaction phenomena with case study.
11	To prepare detailed report of a case study on earthquake hazards.
12	To prepare detailed report on types of embankment failure due to earthquake.

Reference Books:	
1	A.K.Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers.
2	B.C. Punmia, "Soil Mechanics and Foundation Engineering", Laxmi Publication.
3	Dr. P.N. Modi, " Soil Mechanics and Foundation Engineering" Rajsons Publications Pvt. Ltd.
4	N.V. Nayak, "Foundation Design Manual", Dhanpat Rai and Sons
5	Braja M. Das, "Fundamentals of Geotechnical Engineering"

COURSE: ITC-VI: CONSTRUCTION QUALITY CONTROL AND SAFETY		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Theory: 03Hours / Week Practical: 02Hours / Week	End Semester Examination: 60 Marks Internal Assessment: 40Marks Term work: 25Marks Oral: 25 Marks	Theory: 03 Credits Practical: 01 Credits
		Total: 04 Credits

Course Pre-requisites: The students should have knowledge of	
1	Building Construction
2	Planning and Management of Construction Project
3	Arbitration and Laws related to Construction Industry.
Course Objective:	
	To give exposure and insight on needs of Construction quality control parameters and to make student understand application of safety norm in construction and professional practice.
Course Outcomes: The student will be able to	
1	interpret various quality management systems.
2	identify various system requirements and documentation for TQM.
3	apply quality standards/codes in design and construction.
4	comprehend the factors related to construction safety management.
5	knowledge about safety awareness programs.
6	implement safety guidelines on construction sites.

Course Content:

Unit-I	**Construction Quality Management**: Overview of construction quality control and safety, Quality control and safety standards and regulations, Quality Assurance, Quality assurance plan, Inspection and Testing- Process, Inspection test report, concepts of quality policy, Quality standards, Quality manual.	**(6 Hours)**
Unit-II	**Total Quality Management**: Need for TQM in construction industry,Types of inspections and testing , Features and Elements of TQM, Critical factors of TQM, TQM in construction Projects Quality Certification for companies and laboratories (ISO Certification, NABL certification), Quality control records and documentation, Quality aspects in every phase in the life cycle of Construction project.	**(6 Hours)**
Unit-III	**Quality Management Systems in Construction:** Introduction to quality management systems (QMS), Quality standards/codes in design and construction; (ISO: 9000), Benchmarking, Types of Benchmarking and process, Third Party Certification- Process involved. Six sigma as an effective tool in TQM.	**(6 Hours)**
Unit-IV	**Construction Safety Management**: Role of various parties, duties and responsibilities of top management, site managers, supervisors etc. Role of safety officers, responsibilities of general employees, safety committee, safety training, Incentives, and	**(6 Hours)**

	monitoring. Writing safety manuals, preparing safety checklists and inspection reports.	
Unit-V	**Safety Awareness:** Various safety equipment and gear used on site, Details of PPE's used on sites, First aid on site, Safety awareness program. Labour laws, legal requirement, and cost aspects of accidents on site, Incentive for safety practices.	**(6 Hours)**
Unit-VI	**Safety in Construction Operations**: Safety against accidents on various construction sites such as buildings, dams, tunnels, bridges, roads, etc. Safety at various stages of construction. Prevention of accidents. Safety measures. Safety in handling construction equipment's e.g., vehicles, cranes, hoists, and lifts etc. Safety of scaffolding and working platforms. Safety while using electrical appliances and explosives, Quality control and safety inspection procedures.	**(6 Hours)**

Internal Assessment:	
Unit Test -1	UNIT – I, II, III
Unit Test -2	UNIT – IV, V, VI

Project Based Learning:	
1	Prepare a report on necessity and use of Quality Control and Quality Assurance for different construction projects.
2	Prepare a detailed report on Quality standards for different construction projects.
3	Prepare a detailed report on Quality manual for different construction projects.
4	Prepare chart for different types of Total Quality Management
5	Prepare a detailed report on need for TQM in construction industry
6	Collection of TQM in construction Projects Quality Certification for companies and laboratories (ISO Certification, NABL certification)
7	Collection of various documents required for the certification of ISO and NABL.
8	Collection of various Quality standards in design and construction.
9	Collection of various IS Codes in design and construction.
10	Prepare a detailed report on construction Safety Management – Role of various parties, duties and responsibilities of top management
11	Writing safety manuals on construction safety management.
12	Preparing safety checklists and inspection reports
13	Prepare a detailed report and PPT on safety of accidents on various construction sites
14	Prepare a detailed report and PPT on various safety equipment and gear used on site
15	Mini project on any topic of choice from above modules.
16	Site Visit to existing site.

Term work: (any 8 of the following)	
1	Report on construction quality management need for and importance of construction field.
2	Report on construction quality inspection and testing process of material.
3	Report on need for TQM in construction industry

4	Collect construction Projects Quality Certification for companies and laboratories (ISO Certification, NABL certification)
5	Report on detail information on ISO Certification and NABL certification
6	Report on quality standards/codes in design and construction; (ISO:9000),
7	Report on role of various parties, duties, and responsibilities of safety management.
8	Report on prevention of accidents on construction site
9	Report on various safety equipment and PPE kit used on site
10	Report on labour laws, legal requirement, and cost aspects of accidents on site
Oral:	
	The oral examination will be based on above term work and course content.
Textbooks:	
1	Abdul Razzak Rumane, "Quality Management in Construction Projects", Systems Innovation Book Series
2	Kumar Neeraj Jha/ Dilip A Patel/ Amarjit Singh"Construction Safety Management".
Reference Books:	
1	Tim Howarth and David Greenwood. "Construction".
2	James J. O'Brien. "Construction Inspection Handbook: Total Quality Management"
3	S.L. Tang, Syed M. Ahmed, Raymond T. Aoieong "Construction Quality Management", 2005
4	Construction safety manual published by National Safety Commission of India.
5	Construction Safety Publisher: Atbs Publisher
Codes:	
1	IS: 10386 (Part 1) – 1983- Indian Standard Safety code for -construction, operation, and maintenance of river valley projects
2	National Building code of India 2016 Volume 1 (Guidelines)
3	National Building code of India 2016 Volume 1 (Guidelines)

COURSE: PROJECT STAGE- II		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical: 04Hrs / Week	Term work: 100Marks Oral: 100Marks	Practical: 06 Credits
		Total: 06 Credits

Course Pre-requisites: The students should have knowledge of	
1	Project Stage - I
2	Core Civil Engineering Courses
3	Analytical skills
4	Soft and Computing Skill
Course Objective: On completion of the course -	
	The student shall be able to work out suitable solution for the problem.
Course Outcomes: On completion of the course, the students will be able to -	
1	plan, communicate, coordinate, and exhibit responsibility to complete work in time.
2	execute the process / experiment based on methodology
3	observe and analyse the output / results and validate it.
4	interpret the results and derive the conclusions
5	evaluate and optimise the solution in social, environmental context.
6	prepare report and present the work

Course Content:		
Unit-I	**Project Coordination:** Plan the project experimentation / execution process, distribute responsibility, coordinate the communicate for completion oof work in time.	**(08 Hrs)**
Unit-II	**Experimentation:** Execute the methodology by doing experimentation / design / process.	**(08 Hrs)**
Unit-III	**Result Validation:** Observe and tabulate the results systematically and validate the results with sample analytical calculation.	**(08 Hrs)**
Unit-IV	**Result Analysis and Conclusion:** Interpret the results by plotting graphs, charts and derive conclusion based on it.	**(08 Hrs)**
Unit-V	**Optimal solution:** Try to optimise the results with due consideration for cost effectiveness, environment sustainability and social aspect. Define scope for further improvement.	**(08 Hrs)**
Unit-VI	**Project Report:** Collect data required, arrange resources and material required.	**(08 Hrs)**

Term work: The project stage – II consists of continuation of Project stage -I with addition to above topics and prepare **Hard Bound copy** of Project Report based on consolidated work of Stage – I and Stage- II (Maximum Five Students per Project Group)
Oral:
The oral examination will be based on above term work and presentation with reference to course content.

COURSE: CIVIL ENGINEERING SOFTWARE – IV (ETABS)		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical: 02 Hrs / Week	Term work: 25 Marks	Practical: 01
		Total: 01

Course Pre-requisites: The students should have knowledge of

1	Design and Detailing of Reinforced Concrete Structures
2	Analysis of Indeterminate Structures
3	Analysis of determinate Structures

Course Objective: On completion of the course -

	The students will be able to design the structures using ETABS Software

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

1	generate structural model using ETABS
2	apply Loads and analyze the structure for different Load combinations using ETABS
3	design the structure using ETABS and interpret the results

Course Content:

Unit-I	**Structure Modelling in ETABS:** Introduction to ETABS, GUI interface, Settings, Layout of Toolbars and Menu bars, Generation of skeletal model, Assigning material properties, Support conditions, Constraints and restraints at joints.	**(08 Hrs)**
Unit-II	**Generate Load, Load Combination and Analysis:** Create primary loads, application of loads, Generate Load combinations, Analysis of structure, Checking for equilibrium, interpretation of output of the analysis.	**(08 Hrs)**
Unit-III	**RC Design and interpretation of output:** Generate RC Design parameters, Design of structure and interpretation of output of the structural design.	**(08 Hrs)**

Term work: The term work shall consist of consists **Any FOUR** out of following –

1	Assignment on different toolbars and menu bars used in ETABS
2	Assignment on flowchart of steps for design of structure using ETABS
3	Modelling of structure using ETABS including support, constraints, and releases at joints.
4	Analysis and Design of Plane Frame using ETABS and validation of results
5	Analysis and Design of Space Frame using ETABS.
6	Analysis and Design of Truss using ETABS.

Reference Books:

1	Computers and Structures Inc, “ETABS Training manuals”, CSI Knowledge Base
2	Azuko, “ETABS Handbook”, Azuko Technical Institute
3	Gaurav Verma, “ETABS”, Cadcamcae Works