



NEW HORIZON COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by **NAAC** with 'A' Grade, Accredited by **NBA**

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Ring Road, Bellandur Post, Near Marathalli, Bangalore -560 103, INDIA



Academic Year 2022-23
Department of Civil Engineering
Seventh and Eighth Semester
Scheme and Syllabus

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VISION

To contribute to society by imparting quality education encompassing Technical, Managerial and Entrepreneurial skills

MISSION

- To create an environment wherein Faculty and Students engage in cutting edge research.
- To undertake Collaborative projects in order to develop a partnership between Institute and Industry
- To motivate Entrepreneurship and to imbibe Professional Ethics
- To promote participation in activities which help in holistic development of students.

Program Education objectives (PEOs)

PEO1	Graduates will be able contribute to the development of sustainable infrastructure
PEO2	Graduates as part of an organization or as Entrepreneurs, will continue to learn to hone-up evolving technologies
PEO3	Graduates will be professional Civil Engineers with ethical and societal responsibility
PEO4	Graduates will be able to work as a team in intra and interdisciplinary endeavors for development of new ideas and products for the betterment of society

Program Specific objectives (PSOs)

PSO1	Enhancing the employability skills by making the students find innovative solutions for challenges and problems in various domains of Civil Engineering
PSO2	Inculcating in students tech suaveness to deal with practical aspects of Civil Engineering

PEO to Mission Statement Mapping

Mission Statements	PEO1	PEO2	PEO3	PEO4
To create an environment wherein Faculty and Students engage in cutting edge research.	2	3	2	3
To undertake Collaborative projects in order to develop a partnership between Institute and Industry.	2	2	2	3
To motivate Entrepreneurship and to imbibe Professional Ethics.	2	3	3	3
To promote participation in activities which help in holistic development of students.	2	3	2	2

Correlation: 3- High, 2-Medium, 1-Low

Program Outcomes (PO) with Graduate Attributes

	Graduate	Program Outcomes (POs)
1	Engineering Knowledge	PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex civil engineering problems.
2	Problem analysis	PO2: Identity, formulate, research literature and analyze complex civil engineering problems reaching substantiated conclusion using first principles of mathematics and engineering sciences.
3	Design/ Development of Solutions	PO3: The ability to analyse complexities of various civil engineering elements and design similar such elements.
4	Investigation of Problem	PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information related to civil engineering problems to provide valid conclusions.
5	Modern Tool usage	PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex civil engineering activities with an understanding of the limitations.
6	The Engineer and society	PO6: Apply reasoning based on the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the civil engineering professional practice.
7	Environment and sustainability	PO7: Understand the impact of the civil engineering solutions in societal and environmental contexts and demonstrate the knowledge of need for sustainable development.
8	Ethics	PO8: Apply ethical principles, commit to professional ethics, own up responsibilities and abide by the norms of the civil engineering practice.
9	Individual & team work	PO9: As a civil engineer function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	PO10: Communicate effectively on complex civil engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	PO11: Demonstrate knowledge and understanding of the civil engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments as a civil engineer.
12	Lifelong learning	PO12: Recognize the need for, willingness to prepare for and to exhibit pro-activeness to engage in independent and lifelong learning in the broadest context of technological change with respect to civil engineering field

Mapping of POs to PEOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	3	2	3	3	2	2	2	2	3
PEO2	3	3	3	3	3	3	2	3	2	2	3	3
PEO3	3	3	3	3	2	3	2	3	2	3	2	3
PEO4	3	3	3	3	2	3	2	3	3	3	3	3

Scheme of VII Semester B.E Program

Sl. No	Course Code	Course	BOS	Credit Distribution				Overall Credits	Contact Hours	Marks		
				L	T	P	S			CIE	SEE	Total
1	20CIV71A	Construction Management & Engineering Economics	CIV	3	0	0	0	3	3	50	50	100
2	20CIV72A	Design and drawing of Steel structural elements	CIV	2	1	0	0	3	4	50	50	100
3	20CIV73A	Estimation & Valuation	CIV	2	1	0	0	3	4	50	50	100
4	20CIV74*A	Professional Elective-IV	CIV	3	0	0	0	3	3	50	50	100
5	20CIV75*A	Professional Elective-V	CIV	3	0	0	0	3	3	50	50	100
6	20NHOPXX	Open Elective-II		3	0	0	0	3	3	50	50	100
7	20CIV76A	Drawing of Steel structural elements Lab	CIV	0	0	1.5	0	1.5	3	25	25	50
8	20CIV77A	Highway Materials Lab	CIV	0	0	1.5	0	1.5	3	25	25	50
9	20CIV78A	Project Work phase-I	CIV	0	0	2	0	2	-	25	25	50
Total								23	26	375	375	750

Professional Elective-IV		Professional Elective-V	
Course Code	Course	Course Code	Course
20CIV741A	Matrix Method of Structural Analysis	20CIV751A	Retrofitting and Rehabilitation of structures
20CIV742A	Theory of Elasticity	20CIV752A	Construction Quality and Safety
20CIV743A	Solid Waste Management	20CIV753A	Design of Masonry Structures
20CIV744A	Design & Drawing of Hydraulic Structures	20CIV754A	Water Resources Engineering
20CIV745A	Transportation systems	20CIV755A	Recycling of Waste water

Open Elective - II	
Course Code	Course
20NHOP701	Big Data Analytics using HP Vertica-1
20NHOP702	VM Ware Virtualization Essentials-1
20NHOP704	Big Data Analytics using HP Vertica-2
20NHOP705	VM Ware Virtualization Essentials-2
20NHOP707	SAP
20NHOP708	Schneider-Industrial Automation
20NHOP709	CISCO-Routing and Switching-1
20NHOP710	Data Analytics
20NHOP711	Machine Learning
20NHOP712	CISCO-Routing and switching - 2
20NHOP713	IIOT – Embedded System
20NHOP714	Block Chain
20NHOP715	Product Life Cycle Management
20NHOP717A	Network security and Cryptography
20NHOP718A	Physical Design
20NHOP719A	AI Data Analysis with Python

Scheme of VIII Semester B.E Program

Sl. No	Course Code	Course	BOS	Credit Distribution				Overall Credits	Contact Hours weekly	Marks		
				L	T	P	S			CIE	SEE	Total
1	20CIV81*A	Professional Elective-VI	CIV	3	0	0	0	3	3	50	50	100
2	20CIV82*A	Professional Elective-VII	CIV	3	0	0	0	3	3	50	50	100
3	20CIV83A	Internship	CIV	0	0	4	0	4	-	50	50	100
4	20CIV84A	Project Work phase-II	CIV	0	0	10	0	10	-	150	150	300
Total								20	6	300	300	600

Professional Elective-VI		Professional Elective-VII	
Course Code	Course	Course Code	Course
20CIV811A	Industrial waste water treatment	20CIV821A	Pavement Design
20CIV812A	Numerical Method of Civil Engineering	20CIV822A	Rural water Supply & Sanitation
20CIV813A	Earth and Earth Retaining Structures	20CIV823A	Advanced R.C Structures
20CIV814A	Bridge Engineering	20CIV824A	Ground Water Hydrology
20CIV815A	Air pollution	20CIV825A	Advanced Pre-stressed Concrete Structures

VII

Semester

CONSTRUCTION MANAGEMENT & ENGINEERING ECONOMICS

Course Code 20CIV71A

Credits : 03

L: T: P: S 3:0:0:0

CIE Marks : 50

Exam Hours 3 Hours

SEE Marks : 50

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

CO1	Understand the basic principles of Engineering Economics
CO2	Comprehend the fundamentals of contract administration
CO3	Understand the concepts of Project Management for planning to execution of projects
CO4	Manage Resources Economically
CO5	Understand different types of cost estimates
CO6	Analyze on highway economics using different methods

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	-	2	-	-	-	-	3	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	3	-	3	-
CO3	3	2	-	2	-	-	-	-	-	-	3	2	3	1
CO4	3	-	-	-	-	2	-	-	-	-	3	2	3	-
CO5	3	-	-	-	-	-	-	-	-	-	3	-	3	-
CO6	3	2	-	-	-	-	-	-	-	-	3	-	3	-

Module No	Content of Module	Hrs	COs
1	<p>Engineering Economics: Basic principles – Time value of money, quantifying alternatives for decision making, Cash flow , simple numerical problems</p> <p>Comparison of alternatives: Present, future and annual worth method of comparing alternatives, simple numerical problems</p>	09	CO1
2	<p>Break Even Analysis: Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis, simple numerical problems</p> <p>Contracts: Introduction, Types, Stages of awarding contract, Disputes and arbitrations, Case Study on contracts</p>	09	CO1, CO2
3	<p>Project Management: Project Organization, Bar Charts, Work Breakdown Structure, Time estimates Applications of CPM and PERT simple numerical problems</p> <p>Material Management: Introduction to Material Management, ABC analysis- simple numerical problems, Purchase management and inventory control.</p>	09	CO3, CO4
4	<p>Equipment Management : Identification ,Planning of equipment , Selection of Equipment , Equipment Management in Projects, Maintenance Management</p> <p>Equipment Economics :Equipment cost ,Operating cost, Replacement of Equipment- Replacement Analysis - Buy/Rent/Lease options , simple numerical problems</p>	09	CO4
5	<p>Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, Parametric estimate, Life cycle cost, Introduction to Documentation</p> <p>Highway economics: Highway user benefits, Economic analysis - annual cost method-Benefit Cost Ratio method- simple numerical problems, Highway financing-BOT-BOOT concepts</p>	09	CO5, CO6

Text Books:

1. Peurifoy. R L, “Construction Planning, Equipment and Methods”- Mc Graw Hill, (ISBN 978-0070498365)
2. “Construction Project Management, Theory and Practice”, by Jha, K. N., Pearson, New Delhi, 2011 (ISBN 9789332542013)
3. “Estimating Construction Costs” by Peurifoy, R. L. and Oberlender, G. D., 5th ed., McGraw- Hill, New Delhi, 2004 (ISBN 9781259002106)
4. <http://nptel.ac.in/downloads/105103023/>

Reference Books

1. Courtland A. Collier and William B. Ledbetter, “Engineering Economics and Cost Analysis” - Harper & Row. “Fundamentals of Financial management”, by Bose, D. C., 2nd ed., PHI, New Delhi, 2010, (ISBN 8120340744)
2. “Managing the Construction Process”, by Gould, F. E., 2nd ed., Prentice Hall, Upper Saddle River, New Jersey, 2002 (ISBN 9788131766804)
3. “Construction Equipment Management for Engineers, Estimators, and Owners”, CRC/Taylor & Francis, Boca Raton, 2006 (ISBN 9780849340376).
4. “Modern Construction Management”, by Harris, F. , Mc-Caffer, R. and Edum Fotwe, F., 6th ed., Blackwell Publishing, 2006 (ISBN 9780470672174)
5. “Construction Project Management, Theory and Practice”, by Jha, K. N., Pearson, New Delhi, 2011 (ISBN 9789332542013)
6. “Engineering Economic Analysis”, by Newnan, Donald , 2010 (ISBN 9781490290942)
7. “Construction Cost Analysis and Estimating”, by Ostwald, P. F., Prentice Hall, Upper Saddle River, New Jersey, 2001 (ISBN 9781490290942).

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	05	-	-
Understand	05	05	05
Apply	05	05	05
Analyze	05	05	-
Evaluate	05	-	-
Create	-	-	-

SEE - Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	10
Understand	10
Apply	15
Analyze	10
Evaluate	05
Create	-

Percentage Evaluation of Various Bloom's levels

Bloom's Category	CIE	SEE	Total	%
Remember	10	10	20	20
Understand	20	10	30	30
Apply	10	15	25	25
Analyze	05	10	15	15
Evaluate	05	5	10	10
Create	-	-	-	-
Total	50	50	100	100

DESIGN AND DRAWING OF STEEL STRUCTURAL ELEMENTS

Course Code : 20CIV72A

Credits : 03

L: T: P: S : 2:1:0:0

CIE Marks : 50

Exam Hours : 3 Hours

SEE Marks : 50

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

CO1	Understand design philosophy and to apply the IS code of practice for the design of various structural elements.
CO2	Analyze and design bolted and welded connections
CO3	Analyze and design the structural steel members subjected to tension.
CO4	Design axially loaded columns and column base connections.
CO5	Design laterally restrained & unrestrained steel beams.
CO6	Understand the concepts of plastic analysis and apply them to design steel beams.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO6	3	3	3	3	-	-	-	-	-	-	-	-	3	-

Module No	Contents of Module	Hrs	Cos
1	<p>Introduction: Advantages and disadvantages of steel structures, Specifications and section classification. Loads and load combinations, Design considerations, Limit state method (LSM) of design as per code, Failure criterion of steel.</p> <p>Introduction to connections, Types of connections, Types of joints, Advantages and Disadvantages of connections and Joints. Splicing of two members. Behavior of bolted joints, Design of Simple joints with ordinary black bolts and High strength Friction Grip Bolts(HSFG), Welding process, Advantages of welding, Types and properties of welds, Types of joints, weld symbols, Weld specifications, Effective areas of welds, Design of welds, Design of Simple joints.</p>	9	CO1 CO2
2	<p>Bolted Connections: Moment resistant connections (moment parallel and perpendicular to the plane of joint), beam to beam and beam to column connection, Seated stiffened and un-stiffened connections.</p> <p>Welded Connections: Moment resistant connections (moment parallel and perpendicular to the plane of joint), beam to beam and beam to column connection, Seated stiffened and un-stiffened connections.</p>	9	CO2
3	<p>Introduction to Tension Members: Introduction, Types of tension members, Slenderness ratio, Behavior of axially loaded tension members, Modes of failure, Factors affecting the strength of tension members.</p> <p>Design of Tension Members: Design of axially loaded tension members with bolted and welded connection, Lug angles.</p>	9	CO3
4	<p>Design of Compression Members: Introduction, Behavior of compression members, Sections used for compression members, built up sections, Effective length of compression members, Design of compression members with lacing and battens, Design of column splices (For columns of equal and un-equal sections)</p> <p>Design of Column Bases: Simple slab base and Gusseted base.</p>	9	CO4
5	<p>Design of laterally supported beams: Beam sections, factors affecting lateral stability, Behavior of simple rolled steel beams in bending, Concepts of laterally supported rolled steel beams, Design of laterally supported beams.</p> <p>Plastic Behavior Structural Steel: Introduction, plastic theory, Shear center, Plastic hinge concept, plastic collapse load, conditions of plastic analysis, Theorems of plastic collapse. Plastic Analysis and Design of beams.</p>	9	CO5 CO6

TEXT BOOKS

- 1) **Limit State Design of Steel Structures**, S.K Duggal, TATA McGraw Hill Publications,2017, ISBN:9789351343493.
- 2) **Design of Steel Structures**, N. Subramanian, Oxford University Press, 2016, ISBN: 9780199460915.
- 3) **Limit state Design in Structural Steel**, M.R Shiyekar, PHI learning Publications, 2013, ISBN: 9788120347847.
- 4) **Comprehensive Design of Steel Structures**, B.C Punmia, Laxmi Publications, 2015, ISBN: 9788131806456

REFERENCE BOOKS

- 1) “Design of Steel Structures”, Dayaratnam, P, Second edition, S. Chand & Company, 2003
- 2) Design of Steel Structures, S S Bhavikatti, Second edition, I.K International Publishing House Pvt. Ltd., 2010
- 3) “IS800-2007 -General construction in steel — code of practice” Bureau of Indian Standards
- 4) Steel Tables/SP 6-1

CIE- Continuous Internal Evaluation (50 Marks)

Bloom’s Category Marks (out of 50)	Tests	Assignments	Quizzes
Remember	25	15	10
Understand	05	-	-
Apply	05	05	05
Analyze	05	05	05
Evaluate	05	05	-
Create	05	-	-

SEE - Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	10
Create	10

Percentage Evaluation of Various Blooms Levels

Blooms Category	CIE	SEE	Total	%
Remember	5	5	10	10
Understand	15	5	20	20
Apply	15	10	25	25
Analyze	10	10	20	20
Evaluate	5	10	15	15
Create	-	10	10	10
Total	50	50	100	100

ESTIMATION AND VALUATION

Course Code : 20CIV73A

Credits : 03

L: T: P: S : 2:1:0:0

CIE Marks : 50

Exam Hours : 3 Hours

SEE Marks : 50

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

CO1	Estimate the quantities and prepare abstract of different items involved in building and road works.
CO2	Estimate the quantities and prepare abstract of different items involved in wooden joineries, and Trusses.
CO3	Estimate the quantities and prepare abstract of different items involved in RCC Culverts, Septic tanks and Manhole.
CO4	Prepare specifications for various items Civil engineering works.
CO5	Analyse the rates of different items of Civil Engineering works.
CO6	Understand different aspects of contracts and valuation.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	-	3	-	3	-	3	3	3	3	3
CO2	3	3	-	3	-	3	-	-	-	3	3	3	3	3
CO3	3	3	2	-	-	-	-	3	-	-	3	3	3	3
CO4	3	3	-	3	-	-	-	-	-	3	3	3	3	3
CO5	3	3	-	3	-	3	-	3	2	3	3	3	3	3
CO6	3	3	-	3	-	3	-	3	2	3	3	3	3	3

Module No.	Contents of Module	Hrs	Cos
1	<p>ESTIMATION: Study of various drawings with estimates, important terms, units of measurement, abstract Methods of taking out quantities and cost –Long and Short wall method or crossing method. Preparation of detailed and abstract estimates for the following Civil Engineering works – Buildings – RCC framed structures with flat, sloped RCC roofs with all Building components.</p> <p>Centre line method, Preparation of detailed and abstract estimates for the following Civil Engineering works – Buildings – RCC framed structures with flat, sloped RCC roofs with all Building components.</p>	09	CO1
2	<p>ESTIMATES: Different type of estimates, approximate methods of estimating buildings, cost of materials. Estimation of wooden joineries, Steel truss (Fink and Howe truss).</p> <p>ESTIMATES :Manhole and Septic tanks, RCC Culverts</p>	09	CO2, CO3
3	<p>SPECIFICATIONS: Definition of specifications, objective of writing specifications, essentials in specifications, general and detail specifications of common item of works in buildings.</p>	09	CO4
4	<p>RATE ANALYSIS – Definition and Purpose of rate analysis; rate analysis PCC bed, SSM in Foundation, DPC.</p> <p>RATE ANALYSIS -BBM in super structure flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works for doors, windows and ventilators.</p>	09	CO4
5	<p>MEASUREMENT OF EARTHWORK FOR ROADS: Methods for computation of earthwork – cross sections – mid section formula or average end area or mean sectional area, trapezoidal & Prismoidal formula with and without cross slopes.</p> <p>CONTRACTS: Types of contract – essentials of contract agreement – legal aspects, penal provisions on breach of contract. Definition of the terms – Tender, earnest money deposit, security deposit, tender forms, documents and types. Acceptance of contract documents. Termination of contract, completion certificate, quality control, right of contractor, refund of deposit. Administrative approval – Technical sanction. Nominal muster roll, measurement books – procedure for recording and checking measurements – preparation of bills.</p> <p>Valuation- Definitions of various terms, method of valuation, Freehold & Leasehold properties, Sinking fund, depreciation and method of estimating depreciation, Outgoings.</p> <p>An introduction to estimation using a sample AutoCAD drawing with Microsoft excel.</p>	09	CO1 CO6

TEXT BOOKS:

1. B. N. Dutta, “**Estimating & Costing in Civil Engineering**”, UBS Publishers and distributors Pvt. Ltd. New Delhi, 28th revised editon, 2016
2. E S.C. Rangwala **Estimating, “Costing & Valuation”** Charotar publishing house Pvt. Ltd. New delhi, 7th edition, 2017
3. P.L. Basin S. Chand “**Quantity Surveying**”: New Delhi. 2014

REFERENCE BOOKS:

1. G.S. Birde, **Text book of Estimating & Costing-**, Dhanpath Rai and sons publishing Pvt. Ltd, New Delhi , 6th edition, 2014
2. D.D. Kohli and R.C. Kohli ,” **A text book on Estimating & costing** “S. Chand publications- New Delhi.
3. B. S. Patel , “**Contracts and Estimates**”, University Press, New Delhi, 2006.

CIE- Continuous Internal Evaluation (Theory 50 Marks)

Bloom’s Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5	-	-
Understand	5	5	5
Apply	10	10	5
Analyze	5	-	-
Evaluate	-	-	-
Create	-	-	-

SEE – Semester End Examination (Theory 50 Marks)

Bloom's Category	Tests
Remember	5
Understand	5
Apply	30
Analyze	10
Evaluate	-
Create	-

Percentage Evaluation of Various Blooms' levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	5	5	10	10
Understand	15	5	25	25
Apply	25	30	55	55
Analyze	5	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

MATRIX METHOD OF STRUCTURAL ANALYSIS

Course Code : 20CIV741A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 3 Hours

SEE Marks : 50

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

CO1	Understand the behavior of determinate and indeterminate structures and to apply concepts of matrix method of analysis.
CO2	Analyze different structures using stiffness matrix methods with different degrees of freedom.
CO3	Analyze different structures using flexibility matrix methods with different degrees of freedom.
CO4	Estimate stress resultants using strain energy and virtual work concepts.
CO5	Analyze the three dimensional space structures using direct stiffness method.
CO6	Analyze the effect of temperature and sinking of supports on the structural element.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO6	3	3	3	3	-	-	-	-	-	-	-	-	3	-

Module No.	Content of Module	Hrs	COs
1	<p>INTRODUCTION TO MATRIX METHOD</p> <p>Introduction to matrices, Types of matrices, Solution techniques including numerical problems for simultaneous equation, Gauss elimination and Cholesky method, Band width consideration. Static and Kinematic indeterminacy of beams, rigid jointed frames, trusses and grids.</p> <p>Concepts of stiffness, Development of structure stiffness matrices for two dimensional rigid jointed structures using basic fundamental approach. Concepts of flexibility, Development of flexibility matrix for two dimensional determinate rigid jointed structures by fundamental approach.</p>	09	CO1
2	<p>Formation of global stiffness matrix for continuous beams, plane trusses and rigid plane frames by system approach (having not more than six degrees of freedom).</p> <p>Analysis of continuous beams and rigid plane frames by system approach (having not more than 3 degrees of freedom – 3x3 stiffness matrix) considering with and without the effect of sinking of supports and temperature effects.</p>	09	CO2, CO6
3	<p>Analysis of plane trusses by stiffness method (having not more than 3 degrees of freedom – 3x3 stiffness matrix).</p> <p>Analysis of plane trusses by stiffness method (having not more than 3 degrees of freedom – 3x3 stiffness matrix) considering effect of sinking of supports, temperature.</p>	09	CO2, CO6
4	<p>Strain Energy in terms of flexibility coefficients equivalent joint load concept through Betti's Law.</p> <p>Analysis of continuous beams and rigid plane frames by system approach using force-transformation matrix (having not more than 3 degrees of freedom – 3x3 stiffness matrix) considering with and without the effect of sinking of supports, temperature.</p>	09	CO3, CO4
5	<p>Development of stiffness matrix for continuous beam element and truss (having not more than 3 degrees of freedom – 3x3 stiffness matrix) by direct stiffness approach.</p> <p>Analysis of continuous beams and trusses (having not more than 3 degrees of freedom – 3x3 stiffness matrix) by direct stiffness approach.</p>	09	CO5

TEXT BOOKS:

1. 'Basic Structural Analysis' (Third Edition) by C S Reddy, ISBN 10: 0070702764 / ISBN 13: 9780070702769, Published by Tata McGraw-Hill Education Pvt. Ltd., 2010
2. 'Matrix Methods of Structural Analysis' by S. S. Bhavikatti, Publisher: I K International Publishing House Pvt. Ltd.; First Edition edition (August 5, 2011), ISBN-10: 9381141355, ISBN-13: 978-9381141359.
3. 'Matrix Methods of Structural Analysis' by M.B. Kanchi (Author), Publisher: New Age International Private Limited (1 January 2016), ISBN-10: 812244041X, ISBN-13: 978-8122440416.
4. 'Matrix Methods of Structural Analysis: Theory and Problems' by C. Natarajan (Author), P. Revathi (Author), Publisher: Prentice-Hall of India Pvt.Ltd; 1 edition (April 30, 2014), ISBN-10: 8120349008, ISBN-13: 978-8120349001
5. 'Matrix Methods of Structural Analysis' by P. N. Godbole (Author), R. S. Sonparote (Author), S. U. Dhote (Author), Publisher: Prentice-Hall of India Pvt.Ltd (30 August 2014), ISBN-10: 8120349849, ISBN-13: 978-8120349841

Reference books:

1. An Introduction to Matrix Structural Analysis and Finite Element Methods , by Jean H Prevost (Author), Serguei Bagrianski (Author).
2. 'Structural Analysis: A New Approach to Flow Analysis in Optimizing Compilers' by M. Sharir (Author), Publisher: Forgotten Books (December 4, 2017), ISBN-10: 1332201067, ISBN-13: 978-1332201068.
3. 'Matrix Methods of Structural Analysis' by Chu Kai Wang, Publisher: International Textbook Company, 1970, ISBN: 0700222677, 9780700222674.

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	3	2	2
Understand	5	2	3
Apply	7	5	3
Analyze	10	6	2
Evaluate	-	-	-
Create	-	-	-

SEE: Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	5
Understand	10
Apply	20
Analyze	15
Evaluate	-
Create	-

Evaluation of Various Bloom's levels (100 Marks)

Bloom's Category	CIE	SEE	Total	%
Remember	7	5	12	12
Understand	10	10	20	20
Apply	15	20	35	35
Analyze	18	15	33	33
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	50	100	100

THEORY OF ELASTICITY

Course Code : 20CIV742A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 3 Hours

SEE Marks : 50

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

CO1	Comprehend with fundamentals of stress, strain, principal stress and strain, stress and strain tensor.
CO2	Analyze two dimension elements using Airy's stress function.
CO3	Analyze plane stress and plane strain problems.
CO4	Analyze two dimensional problems in rectangular and polar coordinates.
CO5	Analyze stress distribution on Rotating discs and on thick cylinder.
CO6	Analyze stress distribution on plates and effect of torsion on circular and elliptical sections.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	-
CO6	3	3	3	2	-	-	-	-	-	-	-	-	3	-

Module No.	Content of Module	Hrs	COs
1	<p>A. INTRODUCTION</p> <p>Introduction to Mathematical theory of elasticity, definition of continuum, Concepts of stress at a point and stress tensors, Transformation of stresses, Stress Invariants - Principal stresses, Maximum Shear stresses and their planes,</p> <p>B. CONCEPT OF STRAIN</p> <p>Concepts of strain at a point and strain tensor, Engineering strain, Transformation of strains, Principal strains, Maximum strains and their planes.</p>	09	CO1
2	<p>A. BASIC EQUATIONS OF ELASTICITY</p> <p>Generalised Hooke's Law, Strain- displacement relations, St. Venant's principle, Differential equations of equilibrium, boundary conditions, compatibility equations,</p> <p>B. AIRY'S FUNCTION</p> <p>Airy's stress function, problems, Stress polynomials – for Two Dimensional cases only.</p>	09	CO2
3	<p>A. PLANE STRESS AND PLANE STRAIN PROBLEMS</p> <p>Plane stress and plane strain, Principal stresses and strains, strain rosettes.</p> <p>B. TWO DIMENSIONAL PROBLEMS IN RECTANGULAR COORDINATES</p> <p>Two-dimensional problems in rectangular coordinates, bending of a cantilever beam subjected to end load, effect of shear deformation in beams, Simply supported beam subjected to UDL.</p>	09	CO3
4	<p>A. TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES</p> <p>Two-dimensional problems in polar coordinates, strain- displacement relations, equations of equilibrium, compatibility equation,</p> <p>B.STRESS DISTRIBUTION</p> <p>Axis Symmetric stress distribution - Rotating discs, Lamé's equation for thick cylinder.</p>	09	CO4, CO5
5	<p>A.INTRODUCTION TO THEORY OF PLATES</p> <p>Effect of circular hole on stress distribution in plates subjected to tension, compression and shear, stress concentration factor.</p> <p>B.TORSION</p> <p>Inverse and Semi-inverse methods, stress function, torsion of circular and elliptical sections.</p>	09	CO6

TEXT BOOKS:

1. Theory of Elasticity, Timoshenko, S. and Goodier T.N, (ISBN-13: 9780070701229), 2nd Edition, McGraw Hill Education, 2010.
2. "Theory of Elasticity", Sadhu Singh, (ISBN 8174090606), 3rdEdition, Khanna Publishers, New Delhi, 2015.
3. Verma, PDS, "Theory of Elasticity", (ISBN 9788125903697), 1st Edition, Vikas Publishing Pvt. Ltd. New Delhi -1997.

Reference books:

1. Advanced Mechanics of Solids- Srinath.L.S, (ISBN-13 9780070139886), TataMcGraw Hill Publications Co.Ltd., New Delhi, 2008.
2. Structural Mechanics with Introduction to Elasticity and Plasticity-(ISBN-13: 9780070673984) Venkataraman and Patel : 1st edition, cddd McGraw Hill Book Inc.,New York,1970
3. Mechanics of Solids- Arbind Kumar Singh: Prentice hall of India Pvt. Ltd. New Delhi - 2007.

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	-	-	-
Understand	-	-	-
Apply	5	5	5
Analyze	20	10	5
Evaluate	-	-	-
Create	-	-	-

SEE: Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	-
Understand	-
Apply	10
Analyze	40
Evaluate	-
Create	-

Evaluation of Various Bloom's levels (100 Marks)

Bloom's Category	CIE	SEE	Total	%
Remember	-	-	-	-
Understand	-	-	-	-
Apply	15	10	25	25
Analyze	35	40	75	75
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	50	100	100

SOLID WASTE MANAGEMENT

Course Code : 20CIV743A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 3 Hours

SEE Marks : 50

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

CO1	Identify Improper Practices Of Solid Waste Disposal And Their Environmental Implications. Know The Basic Engineering Principles Of Solid Waste Management
CO2	Describe The Need For Economics In Collection And Transportation Of Solid Waste And Clearly Discuss Various Types Of Collection Systems and Analyse System Dynamics
CO3	Understand The Management Concepts, Define 4 R Approach, Apply PPP Model And Community Involvement For Effective Management Of Solid Waste
CO4	Develop A Concise Idea On Various Conventional And Advanced Treatment Options For Solid Waste
CO5	Conceive The Design Aspects Of Engineered Disposal Options And Apply The Gained Knowledge
CO6	Material And Energy Recovery Operations Reuse in Other Industries, Plastic Wastes, Environmental Significance And Reuse.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	3	3	-	-	-	3	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	3	-	3	-
CO3	3		-	-	-	3	3	-	-	-	3	-	3	-
CO4	3	3	3	-	-	3	3	-	-	-	-	-	3	-
CO5	3	3	3	-	-	3	3	-	-	-	3	-	3	-
CO6	3	-	-	-	-	3	3	-	1	-	-	-	3	-

Module No	Content of Module	Hrs	Cos
1	INTRODUCTION: Sources and engineering classification, characterization, generation and quantification; Objectives, principles, functional elements of solid waste management system – Regulatory aspects of solid waste management, major problems. Environmental implications of open dumping, Construction debris – management & handling, E-Waste Management, Rag pickers and their role.	09	CO1
2	WASTE GENERATION: Rate of generation, frequency, storage and refuse collection, physical and chemical composition, quantity of waste, engineering properties of waste, prediction, modelling concepts. COLLECTION, SEGREGATION AND TRANSPORT: Handling and segregation of wastes at source, Collection (primary & secondary) and storage of municipal solid wastes, collection equipment, transfer stations, collection route optimization and economics, regional concepts. System dynamics	09	CO2
3	WASTE MINIMIZATION: 4R: reduce, recover, recycle and reuse, case study, guidelines TREATMENT METHODS: Refuse processing technologies. Mechanical and thermal volume reduction. Biological and chemical techniques for energy and other resource recovery: composting, vermin composting, vermin gradation, fermentation. Incineration of solid wastes.	09	CO3
4	DISPOSAL METHODS: Impacts of open dumping, site investigation and selection, sanitary land filling - Types, geotechnical considerations, design criteria and design, Liners - earthen, geo membrane, geo synthetics and geo textiles. OPERATIONAL ASPECTS OF MSW LANDFILLS: Daily cover, leachate disposal, Ground Water monitoring, leachate and gas collection systems 10 9 – Design, leachate treatment. Landfill Final Cap Design and Water Balance, Modelling (HELP – Hydraulic Evaluation of Landfill Performance), post-closure environmental monitoring; landfill remediation	09	CO4
5	RECENT DEVELOPMENTS IN SOLID WASTES REUSE AND DISPOSAL: Power Generation, Blending with construction materials and Best Management Practices (BMP). Community based waste management, Waste as a Resource concept, Public private partnership (PPP) ROLE OF VARIOUS ORGANIZATIONS IN SOLID WASTE MANAGEMENT: Governmental, Non - Governmental, Citizen Forums.	09	CO5, CO6

Text Books:

1. Integrated Solid Waste Management: Engineering Principles and Management Issues by George Tchobanoglous, Hilary Theisen, Samuel Vigil , 1993, M/c Graw Hill (ISBN :0071128654, 9780071128650)
2. Solid Waste Management in developing countries by A. D. Bhide, B. B. Sundaresan1983,Indian National Scientific Documentation Centre
3. Environmental Engineering. By Howard S Peavy, Donald R Rowe, George Tchobanoglous, 1st Edition,1985,New York : McGraw-Hill (ISBN 10: 0070491348 ISBN 13: 9780070491342).
4. Solid waste management rules, 2016, Ministry of Environment and Forest.

Reference Books:

1. Environmental Engineering: Sewage Disposal and Air Pollution Engineering – Vol II.by S.K.Garg, 33rd Edition,2015 ,Khanna Publishers,(ISBN: 9788174092304,8174092307
2. Solid Waste Engineering by Vesilind.Pa Worrell &Reinhart.D, 2nd Edition, 2009, Cengage Learning India Private Limited, NewDelhi, (ISBN-13: 9781439062159).
3. Handbook of Solid Waste Management 2nd Edition by Frank Kreith (Author), George Tchobanoglous (Author), 2nd Edition,McGrawHill (ISBN-13: 978-0071356237)

CIE-Continuous Internal Evaluation (Theory 50 Marks)

Bloom's Category	Tests	Assignments	Quiz
Marks (out of 50)	25	15	10
Remember	5	5	5
Understand	10	5	5
Apply	5	5	-
Analyze	5	-	-
Evaluate	-	-	-
Create	-	-	-

SEE–Semester End Examination (Theory 50 Marks)

Bloom's Category	Tests
Remember	10
Understand	30
Apply	10
Analyze	-
Evaluate	-
Create	-

Percentage Evaluation of Various Blooms' levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	15	10	25	25
Understand	20	30	50	50
Apply	10	10	20	20
Analyze	5	-	5	5
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

DESIGN & DRAWING OF HYDRAULIC STRUCTURES

Course Code : 20CIV744A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 3 Hours

SEE Marks : 50

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

CO1	Understand the concept of Reservoir planning
CO2	Understand the properties and role of various constituent materials used in earth dams.
CO3	Analyze, Design and draw of Surplus weir
CO4	Analyze, Design and draw of Tank Plug sluice
CO5	Analyze, Design and draw of Canal Drop.
CO6	Analyze, Design and draw of Canal regulator.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	-	-	1	-	-	-	-	-	-	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO6	3	3	3	-	-	-	-	-	-	-	-	-	3	-

Module No	Content of Module	Hrs	COs
Hydraulic Structures:			
1	Reservoir Planning Introduction, classification of Reservoirs, Storage zones of a reservoir, Mass curve, fixing capacity of a reservoir, safe yield, problems, density currents, Trap efficiency, Reservoir sedimentation, life of a reservoir, economic height of a dam, Environmental effects of reservoir.	06	CO1
2	Earth Dams Introduction, types of Earth dams, construction methods, Design criteria for Earth dams, causes of failure of earth dams, section of dam, preliminary design criteria, problems, control of seepage through earth dams, Safety measures.	07	CO2
Irrigation Design- Drawing:			
3	Design and Drawing with all the three views of : Surplus weir with stepped apron	08	CO3 CO4 CO5 CO6
	Design and Drawing with all the three views of : Tank Plug sluice without tower head	08	
	Design and Drawing with all the three views of : Notch type Canal drop	08	
	Design and Drawing with all the three views of : Canal Cross regulator	08	

NOTE: Final Examination pattern:

1. Two questions of 20 marks from each module 1 and 2 will be given. The student has to answer ONE question from each module.
2. Two questions of 60 marks each will be given from module 3. The student has to answer ONE from it. (Part I should cover the designs carrying 45 marks. Part II should cover the drawings carrying 15 marks. Only elevation and section of structures need to be drawn).

TEXT BOOKS:

1. Text book of irrigation engineering & Hydraulic Structures-R.K.Sharma, Oxford & IBH publishing Co., New Delhi (2002)(ISBN : 9788121921282)
2. Irrigation & Water resources engineering- G.L.Asawa, New Age International Publishers, New Delhi (2005) (ISBN : 978-81-224-1673-2)
3. Irrigation, Water Resources & Water power engineering- Modi . P.N., Standard Book House, New Delhi, (ISBN-13: 978-8189401290)
4. Design of minor irrigation and Canal structures- C. SathyaNarayana Murthy, Wiley eastern limited, New Delhi (1990) (ISBN:978-92-79-78247-2)

REFERENCE BOOKS:

1. Irrigation engineering & Hydraulic structures- Garg.S.K.,khanna publishers, New Delhi (ISBN: 8174090479)
2. Hydraulic Structures & Irrigation Design Drawing -Dr.N.Balasubramanya, Tata Mcgraw-Hill Education Pvt.Ltd.,New Delhi
3. Irrigation and Water Power Engineering- Madan Mohan Das &Mimi Das Saikia, PHI Learning Pvt. Ltd., New Delhi (2009)(ISBN : 9788120335875)views)

CIE- Continuous Internal Evaluation (Theory 50 Marks)

Bloom's Category	Test	Assignment	Quiz
Marks (out of 50)	25	15	10
Remember	5	3	-
Understand	10	4	6
Apply	8	6	4
Analyze	2	2	-
Evaluate	-	-	-
Create	-	-	-

SEE – Semester End Examination (Theory 50 Marks)

Bloom's Category	Tests
Remember	5
Understand	5
Apply	20
Analyze	20
Evaluate	-
Create	-

Percentage Evaluation of Various Bloom's levels (100 Marks)

Bloom's Category	CIE	SEE	Total	%
Remember	08	5	13	13
Understand	20	5	25	25
Apply	18	20	38	38
Analyze	04	20	24	24
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	50	100	100

TRANSPORTATION SYSTEMS

Course Code : 20CIV745A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 3 Hours

SEE Marks : 50

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

CO'S	Description
CO1	Apply the engineering knowledge to understand different components of railway track and selection of materials for construction.
CO2	Design the geometric elements of track and component of railways for a given site condition. Understand Signals and station.
CO3	Identify the characteristics of aircrafts in planning and designing of Runway components
CO4	Design the taxiway geometry and understand the airport visual aids
CO5	Understand components of harbors and docks.
CO6	Understand the methods of setting out and construction process of tunneling.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	3	3	3	3	3	-	-	-	-	3	-
CO3	3	3	3	3	3	3	3	3	-	-	-	-	3	-
CO4	3	3	3	3	3	3	3	3	-	-	-	-	3	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO6	3	-	-	-	-	-	-	-	-	-	-	-	3	-

Module No	Module Contents	Hrs	Cos
1	<p>RAIL TRANSPORTATION</p> <p>A. INTRODUCTION: Role of railways in transportation, Indian Railways, Selection of Routes, Permanent way and its requirements, Gauges and types, Typical cross sections-single and double line broad gage (B G) track in cutting, embankment and electrified tracks, Coning of wheels and tilting of rails, Rails-functions-requirements - types and sections length- defects- wear-creep-welding-joints, creep of rails.</p> <p>B. SLEEPERS AND BALLAST: Functions, requirements, Types, Track fitting and fasteners-Dog spike, screw spike and Pandrol clip, - Fish plates-bearing plates, Calculation of quantity of materials required for laying a track- Examples, Tractive resistances and hauling capacity only problems.</p>	9	CO1
2	<p>A. GEOMETRIC DESIGN: Necessity, Safe speed on curves, Cant-cant deficiency- negative cant-safe speed based on various criteria, (both for normal and high speed tracks) Transition curve , Gradient and types, grade compensation, Examples on above.</p> <p>B. POINTS AND CROSSING: Components of a turnout, Details of Points and Crossing, Design of turnouts with examples types of switches, crossings, track junctions.</p>	9	CO2
3	<p>A. STATION AND SIGNALS:</p> <p>Types of yards, Signalling, Objects and types of signals, station and yard Equipment-Turn table, Fouling mark, buffer stop, level crossing, track defects, and maintenance.</p> <p>B. AIRPORT ENGINEERING:</p> <p>Introduction: Layout of an airport with component parts and functions, Site selection for airport, Aircraft characteristics affecting the design and planning of airport, Airport classification.</p>	9	CO2, 3
4	<p>A. RUNWAY AND TAXIWAY DESIGN: Runway orientation using wind Rose diagram with examples. Basic runway length-Corrections and examples, Runway geometrics.</p> <p>B. TAXIWAY - Factors affecting the layout - geometrics of taxiway Design of exit taxiway with examples, Visual aids- Airport marking (day and night) - lighting-Instrumental Landing System.</p>	9	CO4
5	<p>A. HARBOUR classifications, Layout with components, Natural phenomenon affecting the design of harbours - wind, wave and tide, currents. Dock and wet docks, Slipways, Navigational aids, ware house and transit - shed.</p> <p>B. TUNNELS Advantages and disadvantages, Size and shape of tunnels, Surveying- Transferring centre line , and gradient from surface to inside the tunnel working face, Tunnelling in rocks-methods, Tunnelling methods in soils-Needle beam, Liner plate , Tunnel lining, Tunnel ventilation, vertical shafts, Pilot tunnelling, mucking and methods, drilling and drilling pattern.</p>	9	CO5, 6

TEXT BOOKS:

1. Saxena and Arora, “Railway Engineering”, Dhanpat Rai & Sons, 10th edition New Delhi, 2015.
2. M M Agarwal, “Indian Railway Track”, Jaico Publications, 2nd edition, New Delhi, 2017.
3. Khanna Arora and Jain, “Airport planning and Design”, New Chand Bros, 10th edition, Scitech Publications, Roorkee 2012.
4. R Srinivasan, “ Dock and Tunnel Engineering”, Charaotar Publishing House, 28th edition, New Delhi, 2016

REFERENCE BOOKS:

1. Indian Railway Standards
2. Mundrey, “ Railway Engineering”, Mc Graw Hill Publications, 5th edition, 2017.
3. H P Oza and G H Oza, “Docks and Harbour Engineering”, Charaotar Publishing House, 7th edition, New Delhi, 2013

CIE- Continuous Internal Evaluation (50 Marks)

Bloom’s Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	05	-	-
Understand	05	05	05
Apply	10	05	05
Analyze	05	05	-
Evaluate	-	-	-
Create	-	-	-

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests (50)
Remember	10
Understand	10
Apply	20
Analyze	10
Evaluate	-
Create	-

Percentage Evaluation of Various Bloom's levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	5	10	15	15
Understand	15	10	25	25
Apply	20	20	40	40
Analyze	10	10	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

RETROFITTING AND REHABILITATION OF STRUCTURES

Course Code : 20CIV751A

Credits : 3

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 3 hrs

SEE Marks : 50

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

CO1	Understand the various methods of investigation to study deterioration of concrete structures
CO2	Understand the repair materials and techniques employed in retrofitting and rehabilitation.
CO3	Apply various methods of retrofitting of building components
CO4	Analyse various methods of retrofitting of RC structural elements.
CO5	Understand the methods of repair of cracks found on slabs
CO6	Analyse retrofitting of steel structures

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	3	-	3	3	-	-	-	-	3	3	3
CO2	3	-	-	-	2	3	3	-	-	-	-	3	3	3
CO3	3	-	3	-	-	3	3	1	-	-	-	3	3	3
CO4	3	3	3	3	-	3	3	-	-	-	-	3	3	3
CO5	3	-	-	3	2	3	3	-	-	-	-	3	3	3
CO6	3	3	3	3	-	3	3	-	-	-	-	3	3	3

Module No	Content of Module	Hrs	COs
1	INTRODUCTION: Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental method	5	CO1
	Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking.	4	
2	REPAIR: Concept of Repairing-Retrofitting-strengthening-rehabilitation-restoration-remoulding; Repair materials/methods- Repair methodology, issues related to material technology- desired properties of repair materials-materials for repair-new repair systems / products.	5	CO2
	Distresses in concrete structures-Deterioration of structures-causes and prevention- crack repair techniques-repair techniques/materials for structures- repair of structural components	4	
3	RETROFITTING OF MASONRY BUILDINGS: Failure mode of masonry buildings- out of plane failure-in plane failure- diaphragm failure-failure of connection	4	CO3
	METHODS OF RETROFITTING- cement or epoxy injection- using wire mesh and cement mortar- reconstruction of bulged portion of masonry wall-grouting with cement-pointing with mortar- shotcreting-using FRP fabric-using RC and steel frames- adding reinforcements to masonry-stitching of wall corners- use of tie rods- Prestressing of masonry- external binding or jacketing- splint and bandage technique- inserting new walls- exterior supplemental elements- strengthening of parapets	5	
4	RETROFITTING OF RC STRUCTURE: Global retrofitting methods-adding new shear walls-adding steel bracing-adding infill walls- non conventional methods – seismic base isolation – supplemental damping devices;	5	CO4
	MEMBER OR LOCAL RETROFIT METHODS – jacketing/confinements – jacketing of columns using steel sections – reinforced concrete jacketing- FRP jacketing – beam jacketing – beam column joint jacketing – slab column connection – foundation	4	
5	REPAIR OF CONCRETE FLOORS: Surface preparation- thin bonded toppings – reinstating joint sealants – crack repair – crack cleaning and resin injection – crack cutting and mortar filling – application of cement/sand screed – use of toppings;	5	CO5, CO6
	RETROFITTING OF STEEL STRUCTURE: Rain water protection – drainage in structural members – preparation of surface by sand blasting – protective coatings – cathodic protection – sacrificial metal – concrete jacketing	4	

TEXT BOOKS:

1. Peter H.Emmons, “Concrete Repair and Maintenance Illustrated”, Galgotia Publications pvt. Ltd., 2001.
2. R.T.Allen and S.C. Edwards, “Repair of Concrete Structures”, Blakie and Sons
3. Sidney, M. Johnson “Deterioration, Maintenance and Repair of Structures”.

REFERENCE BOOKS:

1. Dayaratnam.P and Rao.R, “Maintenance and Durability of Concrete Structures”, University Press, India, 1997.
2. Denison Campbell, Allen & Harold Roper, “Concrete Structures – Materials, Maintenance and Repair”, Longman Scientific and Technical
3. Lakshmipathy, Metal Lecture notes of Workshop on " Repairs and Rehabilitation of Structures ",29 - 30th October 1999
4. M.S.Shetty, “Concrete Technology - Theory and Practice ", S.Chand and Company, New Delhi, 1992..
5. Santhakumar A.R., “Concrete Technology” Oxford University Press, 2007 Printed in India by Radha Press, New Delhi, 110 031

CIE- Continuous Internal Evaluation (50 Marks)

Bloom’s Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	10	15
Remember	5	5	5
Understand	10	5	5
Apply	10	-	5
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	20
Understand	20
Apply	10
Analyze	
Evaluate	-
Create	-

Percentage Evaluation of Various Blooms' levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	15	20	35	35
Understand	20	20	40	40
Apply	15	10	25	25
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

CONSTRUCTION QUALITY AND SAFETY

Course Code : 20CIV752A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 3 Hours

SEE Marks: 50

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

CO1	Understand the Quality concepts in Civil Engineering.
CO2	Understand the quality certifying agencies for construction industry.
CO3	Comprehend the features and elements of Total Quality Management
CO4	Understand the various aspects of safety in Civil Engineering projects
CO5	Analyse the accidents and Safety components in Construction Site.
CO6	Apply the safety measures for various civil engineering activities.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	3	3	3	-	-	-	3	-	3
CO2	3	-	-	-	-	3	3	3	-	-	-	3	-	3
CO3	3	-	-	-	-	3	3	3	-	-	-	3	-	3
CO4	3	-	-	-	-	3	3	3	-	-	-	3	-	3
CO5	3	3	3	-	-	3		3	3	-	3	3	-	3
CO6	3	3	3	-	-	3		3	3	-	3	3	-	3

Module No	Content of Module	Hrs	Cos
1	Construction Quality Management -need and importance, Quality control and methods, Quality Assurance, Quality assurance plan, Inspection and Testing- Process, Inspection test report, concepts of quality policy, Quality standards, Quality manual	9	CO1
2	Quality Certification for companies and laboratories (ISO Certification, NABL certification). Total Quality Management , Features and Elements of TQM, Critical factors of TQM, TQM in construction Projects. Benchmarking, Types of Benchmarking and process, Third Party Certification- Process involved.	9	CO2,CO3
3	Construction Safety -meaning and scope, Safety in construction Technological aspects, organizational aspects and behavioral aspects, Safety in Project management, Education and training. Safety legislation and Standards, Contract conditions on safety in Civil Engineering projects.	9	CO4
4	Accidents: Causes, classification, cost and measurement of an accident, accident report. Safety Components: Safety information systems, safety programme for construction, Safety budgeting, Factors affecting safety, Strategic Planning for safety provisions, SOPs, PPE, Inspections.	9	CO5
5	Personal & Structural safety and Safety measure: a) For storage and handling of building materials. b) Construction of elements of a building c) During use of equipment d) In demolition of buildings- Safety lacuna in Indian scenario Site safety programmes - JSA, JHA, Safety audit, safety policy, manuals, training & orientation.	9	CO6

Text Books:

1. D S Rajendra Prasad, "Quality Management System in Civil Engineering", Sapna Book House, Bangalore
2. N. Logothetis, "Management for Total Quality", Prentice Hall
3. David Gold Smith, "Safety Management in construction and Industry", Mc Graw Hill

References

1. Leavenworth, "Statistical Quality Control" Grant Publication.
2. BesterField,"Total Quality Management", by Pearson Education
3. Juran Frank, J.M. and Gryna, F.M, Quality Planning and Analysis, Tata McGraw Hill, 1982.
4. Hutchins.G, ISO 9000, Viva Books, New Delhi, 1993.

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5	5	
Understand	10	5	5
Apply	10	5	5
Analyze			
Evaluate			
Create			

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	10
Understand	20
Apply	20
Analyze	
Evaluate	

Percentage Evaluation of Various Blooms levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	10	10	20	20
Understand	20	20	40	40
Apply	20	20	40	40
Analyze				
Evaluate				
Create				
TOTAL	50	50	100	100

DESIGN OF MASONRY STRUCTURES

Course Code : 20CIV753A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 3 Hours

SEE Marks: 50

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

CO1	Understand the different types of masonry units, properties, suitability and types of mortars as per IS 1905.
CO2	Comprehend the possible causes of cracks and defects in masonry.
CO3	Comprehend the factors affecting strength of masonry and permissible stresses in masonry.
CO4	Comprehend design parameters like effective height, slenderness ratio, load dispersion arch action in masonry and lintels.
CO5	Design of walls subject to both axial and eccentric loads and Design masonry buildings up to three floors as per IS 1905 and SP-20
CO6	Comprehend the concept of reinforced masonry and design reinforced masonry lintels and slabs

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	-	-	-	-	-	-	-	--	-	-	-	3	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO6	3	3	3	-	-	-	-	-	-	-	-	-	3	-

Module No	Contents of Module	Hrs	COS
1	Introduction: Types of masonry units – properties – suitability and applications-classification and properties of mortars-description of types of mortar as per IS 1905.	9	CO1, CO2
	Masonry Construction: Defects and errors in masonry constructions causes of cracks in masonry-methods of controlling and prevention of cracks in masonry		
2	Strength of Masonry: Factors affecting strength of masonry – unit strength, joint thickness- rate of absorption, effects of curing etc. – stresses in masonry under direct compressive force- derivation of formulae	9	CO3
	Permissible basic compressive stress in masonry- stress reduction factor, area reduction factor, shape modification factor, Increase in permissible stresses for eccentric- vertical and lateral loads- permissible tensile stress and shear stress.		
3	Design Considerations: Effective height of walls and columns-different cases-effective length- different design cases-effective thickness-slenderness ratio-eccentricity-load dispersion in masonry- acting action-lintels – design of lintels for different design situations.	9	CO4, CO5
	Design of Structural Masonry- 1: Design of walls subjected to axial load& eccentric load		
4.	Design of Structural Masonry- 2: Design of walls with openings in different positions-free standing wall	9	CO5
	Design of load bearing masonry buildings up to 3 storeys as per provisions of IS 1905 and SP 20		
5	Reinforced Masonry: Applications –methods of placement of reinforcement in masonry- flexural and compression elements	9	CO6
	Design of reinforced masonry lintels and slabs		

TEXT BOOKS:

1. Hendry A.W. Structural Masonry, Mac Milan Education Ltd., 1990(Ch 1 – 6)
2. P.Dayarathnam- Brick and Reinforced Brick Structures–Oxford and IBH, 1987(Ch1-8)
3. K.S. Jagadeesh-Design of structural masonry

REFERENCE BOOKS:

1. SP21 Summary of IS codes on Building Materials – BIS New Delhi
2. SP20 Hand book on Masonry design and Construction BIS New Delhi
3. IS 1905 Code of Practice for use of un-reinforced Masonry – BIS New Delhi
4. Sinha B.P., Davies S.R. “Design of Masonry Structures” E&Fson –199

Assessment Pattern:**CIE- Continuous Internal Evaluation (Theory 50 Marks)**

Bloom’s Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5	-	-
Understand	5	5	5
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	15	10	5

SEE-Semester End Examination (Theory 50 Marks)

Bloom's Category	Tests
Remember	10
Understand	15
Apply	-
Analyze	-
Evaluate	-
Total	25

Percentage Evaluation of Various Blooms' levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	5	10	15	15
Understand	15	15	30	30
Apply	-	-	-	-
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	30	25	55	55
TOTAL	50	50	100	100

WATER RESOURCES ENGINEERING

Course Code : 20 CIV754A

Credits: 03

L: T: P: S : 3:0:0:0

CIE Mark: 50

Exam Hours : 3 Hours

SEE Marks: 50

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

CO1	Understand water resources and water resources systems
CO2	Apply Engineering knowledge in the determination of reservoir capacity and site assessment for dam
CO3	Get acquaint with flood design, estimation, frequency analysis, flood routing, flood control and management
CO4	Understand the concepts of drought and water logging with remedial measures.
CO5	Understand the concept of watershed management and harvesting.
CO6	Develop an idea in understanding of GIS and remote sensing applications in Water Resources Engineering

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3		3	3	-	-	-	-	-	3	-
CO4	3	3	3	3	-	3	3	-	-	-	-	-	3	-
CO5	3	3	-	-	-	3	3	-	-	-	1	-	3	-
CO6	3	3	3	3	3	3	-	-	-	-	-	-	3	1

Module No	Content of Module	Hrs	COs
1	<p>Introduction: Introduction, The world's fresh water resources, water use in the world, water management sectors, the future of water resources, water budget, Single and multipurpose projects.</p> <p>Water resources systems: Components of the system, objectives of water resources development, planning, and design, construction and operation of water resources systems.</p>	09	CO1
2	<p>Reservoir: Reservoir planning - Investigations - zones of storage in a reservoir - Determination of storage capacity and yield (including numericals), Reservoir life - Reservoir sedimentation and control.</p> <p>Dams: Introduction and types of dams, spillways and ancillary works, Site assessment and selection of type of dam, Information about major dams and reservoirs of India</p>	09	CO2
3	<p>Flood control and Management: Indian rivers and floods, Causes of floods, flood plain management, flood control alternatives – Structural and non-structural measures, flood forecasting.</p> <p>Hydrologic Analysis: Design flood, Flood estimation, Frequency analysis, Flood routing through reservoirs and open channels.</p>	09	CO3
4	<p>Drought: Definition of drought, Causes of drought, measures for water conservation and augmentation, drought contingency planning.</p> <p>Water logging: Causes and effects of water logging - remedial measures - land drainage - benefits - classification of drains - surface drains - subsurface drains - design principles and maintenance of drainage systems.</p>	09	CO4
5	<p>Watershed Management and Harvesting: Objectives, Watershed Development and Management - Water Conservation and Harvesting- Rainwater collection, small dams, runoff enhancement, runoff collection. Field Visit</p> <p>GIS and Remote Sensing applications: Evaluation of Water Resources Potential – Rainfall runoff modeling using remote sensing inputs. Flood and Drought Studies – Drought assessment and Monitoring. Command Area Studies – Cropping patterns, conditions of crops, irrigation system performance – crop yield estimation. Visit to GIS and remote sensing lab.</p>	09	CO5 & CO6

TEXT BOOKS:

1. R.A. Wurbs and W.P. James, “Water Resources Engineering”, Prentice Hall of India, Eastern Economic Edition, New Delhi, 2007, ISBN: 81-203-2151-0.
2. Larry W. Mays, “Water Resources Engineering”, John Wiley and Sons, New York. 3rd Edition, 2019. ISBN: 978-1-119-49316-7.
3. Dr. A. K. Arora, “Irrigation, Water power and water resources Engineering”, Standard Publishers Distributors, New Delhi. ISBN-13: **8180142543-978**

REFERENCE BOOKS:

1. R.K. Sharma and T.K. Sharma, “Hydrology and Water Resources Engineering”, Dhanpat Rai Publications, New Delhi.
2. Swain P.H., and S.M. Davis, “Remote Sensing – The Quantitative Approach”, McGraw Hill Publishing Company, N York.
3. R.K. Linsley, J.B. Franzini, D.L. Freyberg and G. Tchobanoglous, “Water Resources Engineering”, McGraw Hill, Singapore.

CIE- Continuous Internal Evaluation (50 Marks)

Bloom’s Category	Test	Assignment	Quizzes
Marks (out of 50)	25	15	10
Remember	5	-	5
Understand	5	10	-
Apply	10	5	5
Analyze	5	-	-
Evaluate	-	-	-
Create	-	-	-

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	5
Understand	15
Apply	15
Analyze	15
Evaluate	-
Create	-

Percentage Evaluation of Various Blooms levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	10	05	15	15
Understand	15	15	30	30
Apply	20	15	35	35
Analyze	5	15	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

RECYCLING OF WASTE WATER

Course Code: 20CIV755A

Credits: 3

L: T: P: S : 3:0:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

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

CO1	Implement wastewater recycling practices
CO2	Estimate the quantity of sewage
CO3	Analyse the characteristics of sewage
CO4	Identify different disposal methods of sewage.
CO5	Design of various units of sewage treatment plant and operation and maintenance measures.
CO6	Adopt best practices in waste water management.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-		3	3						3	
CO2	3	3	3	-									3	
CO3	3	3	-	-									3	
CO4	3	3	-	-		3	3						3	
CO5	3	3	3	3									3	
CO6	3	3	3	3		3	3						3	1

Module No	Content of Module	Hrs	COs
1	<p>INTRODUCTION: Waste water generation in India, Need for sewerage system, Need for recycling of waste water, Methods of domestic waste water disposal, Definitions: sewage, sullage, sewerage, Conservancy and water carriage system, Systems of sewerage and their layouts : Separate, Combined and partially combined system, Merits and demerits</p> <p>ESTIMATION OF QUANTITY OF SEWAGE: Dry weather flow, factors affecting dry weather flow, flow variations and their effects on design of sewerage system; computation of design flow, estimation of storm flow, rational method and empirical formulae of design of storm water drain, Time of concentration.</p>	09	CO1, CO2
2	<p>WASTE WATER CHARACTERIZATION: Sampling techniques, Physical, Chemical and Biological characteristics, Aerobic and Anaerobic activity, CNS cycles. BOD and COD. Their significance & problems</p> <p>DISPOSAL OF EFFLUENTS: Disposal of Effluents by dilution, self purification phenomenon. Oxygen sag curve, Zones of purification, Sewage farming, sewage sickness, Effluent Disposal standards for land, surface water & ocean as per BIS, Numerical Problems on Disposal of Effluents. Streeter Phelps equation (No derivation).</p>	09	CO3, CO4
3	<p>TREATMENT PROCESSES: Objective, methods of treatment, flow sheets showing Preliminary, Primary, Secondary and Tertiary treatment.</p> <p>Preliminary & Primary treatment : Screening, grit chambers, skimming tanks, primary sedimentation tanks, Operation and maintenance of sedimentation tanks – Design criteria & Design examples.</p> <p>SECONDARY TREATMENT: Trickling filter – theory and operation, types and designs.</p> <p>Activated sludge process- Principle and flow diagram, Modifications of ASP, F/M ratio, Operation and maintenance, Design of ASP.</p>	09	CO5
4	<p>ANAEROBIC SLUDGE DIGESTION: Sludge characterization – Thickening – Biogas recovery – Sludge Conditioning and Dewatering– Sludge digestion tanks, Design of Sludge drying beds. Septic tank, Design.</p> <p>ADDITIONAL TREATMENT METHODS: Low cost treatment systems, Oxidation Pond and Oxidation ditches, Design, Membrane bio reactors (MBR), Sequential bio reactor (SBR), DEWAT System, Operation and maintenance issues, Reclamation and Reuse of sewage - sewage recycle in residential complex - Recent Advances in Sewage Treatment</p>	09	CO5
5	<p>BEST PRACTICES IN WASTEWATER MANAGEMENT: Wastewater-A growing resource, Economic characteristics of recycled wastewater, Key-Drivers in wastewater recycling. Government/Institutional Role in wastewater recycling,</p> <p>REUSE AND RECYCLE OF WASTE WATER: Social Aspect of wastewater recycling, Wastewater reuse in India. Direct and indirect reuse of wastewater- Municipal reuse/industrial reuse/agricultural reuse/recreational reuse/ground water recharge.</p>	09	CO6

TEXT BOOKS:

1. Environmental Engineering Sewage Waste Disposal and Air Pollution Engineering – Vol.2 – S.K.Garg, Khanna Publishers, ISBN:9788174092304
2. Waste water Engineering (Including Air Pollution) –B C Punima and Ashok Jain, Arun K Jain, Laxmi Publications, ISBN:8131805964, 2nd edition.
3. Metcalf & Eddy (2009), Wastewater Engineering- Treatment, Disposal and Reuse, Second edition, Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS:

1. Hammer, M.J., (1986), Water and Wastewater Technology –SI Version, 2nd Edition, John Wiley and Sons.ISBN: 10: 0471838284
2. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986),Environmental Engineering– Mc Graw Hill Book Co.ISBN:9780070495395 .
3. Sincero, A.P., and Sincero, G.A., (1999), Environmental Engineering – A Design Approach–Prentice Hall of India Pvt. Ltd., New Delhi. ISBN: 10: 0024105643.

CIE- Continuous Internal Evaluation (Theory 50 Marks)

Bloom's Category	Test	Assignment	Quiz
Marks (out of 50)	25	15	10
Remember		5	5
Understand	10	5	3
Apply	10	3	2
Analyze	5	2	
Evaluate			
Create			

SEE – Semester End Examination (Theory 50 Marks)

Bloom's Category	Tests
Remember	5
Understand	20
Apply	15
Analyze	10
Evaluate	
Create	

Percentage Evaluation of Various Bloom's levels (100 Marks)

Bloom's Category	CIE	SEE	Total	%
Remember	10	5	15	15
Understand	18	20	38	38
Apply	15	15	30	30
Analyze	7	10	17	17
Evaluate				
Create				
Total				

DRAWING OF STEEL STRUCTURAL ELEMENTS LAB

Course Code: 20CIV76A

Credits: 1.5

L: T: P: S: 0:0:1.5:0

CIE Marks: 25

Exam Hours: 03

SEE Marks: 25

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

CO1	Apply IS provisions and computational tool in detailing.
CO2	Prepare detailed drawings for connecting beam with column using bolted and welded connections using AUTOCAD drawing tools.
CO3	Prepare detailed drawings for framing build up columns using AUTOCAD drawing tools.
CO4	Prepare detailed drawings for column splicing and column base using AUTOCAD drawing tools.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	3	-	-	-	3	3
CO2	3	3	3	3	3	-	-	-	3	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	3	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	3	-	-	-	3	3

Exercise No	Description	Hrs	COs
01.	Drawing and detailing of Beam to Beam bolted connection.	3	CO1, CO2
02.	Drawing and detailing of Beam to Column bolted connection.	3	CO1, CO2
03.	Drawing and detailing of Beam to Beam welded connection.	3	CO1, CO2
04.	Drawing and detailing of Beam to Column welded connection.	3	CO1, CO2
05	Drawing and detailing of Beam to Beam and Beam to Column stiffened bolted connection.	3	CO1, CO2
06	Drawing and detailing of Beam to Beam and Beam to Column unstiffened bolted connection.	3	CO1, CO3
07	Drawing and detailing of Beam to Beam and Beam to Column stiffened welded connection.	3	CO1, CO3
08	Drawing and detailing of Beam to Beam and Beam to Column unstiffened welded connection.	3	CO1, CO3
09	Drawing and detailing of Column Lacing & Column Battens.	3	CO1, CO3
10.	Drawing and detailing of Column splices.	3	CO1, CO4
11.	Drawing and detailing of Slab base and Gusseted base.	3	CO1, CO4

Note: Submissions:-

1. All the drawings should be drawn using AUTOCAD drafting software.
2. Detailed connection should be drafted in drawing book (A3 Size).

Text Books:

1. Limit State Design of Steel Structures, S.K Duggal, TATA McGraw Hill Publications, 2017, ISBN:9789351343493.
2. Design of Steel Structures, N. Subramanian, Oxford University Press, 2016, ISBN: 9780199460915.
3. Limit state Design in Structural Steel, M.R Shiyekar, PHI learning Publications, 2013, ISBN: 9788120347847.
4. Comprehensive Design of Steel Structures, B.C Punmia, Laxmi Publications, 2015, ISBN: 9788131806456

Reference Books:

1. Dayaratnam, P., “Design of Steel Structures”, Second edition, S. Chand & Company, 2003
2. S S Bhavikatti, Design of Steel Structures, Second edition, I.K International Publishing House Pvt. Ltd., 2010
3. Bureau of Indian Standards, IS800-2007, IS875-1987
4. Steel Tables/SP 6-1

CIE Continuous Internal Evaluation (Practical 25 Marks)

Bloom's Category	Marks
Remember	5
Understand	5
Apply	7.5
Analyze	7.5
Evaluate	-
Create	-

SEE – Semester End Examination (Practical 25 Marks)

Bloom's Category	Marks
Remember	5
Understand	5
Apply	7.5
Analyze	7.5
Evaluate	-
Create	-

Bloom's Category	CIE	SEE	TOTAL	%
Remember	5	5	10	20
Understand	5	5	10	20
Apply	7.5	7.5	15	30
Analyze	7.5	7.5	15	30
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	25	25	50	100

HIGHWAY MATERIALS LAB

Course Code: 20CIV77A

Credits: 1.5

L: T: P: S: 0:0:1.5:0

CIE Marks: 25

Exam Hours: 03

SEE Marks: 25

COURSE OUTCOMES: At the end of the Course, the Student will be able to:

CO1	Determine the CBR value of sub grade for flexible pavement design
CO2	Determine the basic physical properties of coarse aggregates
CO3	Determine the physical properties of bitumen
CO4	Determine the proportioning of coarse aggregates and bitumen mix design

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	3	3	-	-	3	-	3	-
CO2	3	3	3	3	-	-	3	3	-	-	3	-	3	-
CO3	3	3	3	3	-	-	3	3	-	-	3	-	3	-
CO4	3	3	3	3	-	-	3	3	-	-	3	-	3	-

Expt No	Contents of Module	Hrs	Cos
1	To conduct the sieve analysis and bulk density test of given coarse aggregates	3	CO2
2	To determine the Impact value, Specific gravity and water absorption of given aggregates	3	CO2
3	To determine the Shape test Flaky , Elongation and Angularity number of given aggregates	3	CO2
4	To determine the Crushing value and Abrasion Value of given aggregates	3	CO2
5	To determine the Specific Gravity and Penetration value of given bitumen	3	CO3
6	To determine the Ductility and Softening point of given bitumen	3	CO3
7	To determine the Flash & fire point and Viscosity of given bitumen,	3	CO3
8	To determine the California Bearing Ratio (CBR) test on given soil	3	CO1
9	To determine the proportioning of aggregate mixes by Rothfutch Method,	3	CO4
10	To conduct the Marshall Stability test of given bituminous Mix	3	CO4

REFERENCE BOOKS:

1. Relevant IS Codes and IRC Codes.
2. Highway Material Testing Laboratory Manual by Khanna S Kand Justo, – CEG Nemi Chand & Bros.
3. G. VenkatappaRao : Highway Material testing and Quality control : DhanpatRai& sons New – Delhi
4. MORTH 5TH EDITION

CIE-Continuous Internal Evaluation (25 Marks)

Bloom's Category	Test	Exam
Remember	-	-
Understand	5	5
Apply	10	10
Analyze	5	5
Evaluate	5	5
Create	-	-

Percentage evaluation of various blooms levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	-	-		
Understand	5	5	10	20
Apply	10	10	20	40
Analyze	5	5	10	20
Evaluate	5	5	10	20
Create	-	-	-	-
TOTAL	25	25	50	100

Project Work Phase-I

Course Code: 20CIV78A

Credits: 2

L: T: P: S : 0:0:2:0

CIE Marks: 25

Exam Hours: 03

SEE Marks: 25

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

CO1	Prepare the students to solve/work on the real world/ Practical/Theoretical problems involving issues in civil engineering
CO2	Perform a detailed literature review to understand the current scenario.
CO3	Use Modern tools and technologies to solve research problems
CO4	Practice presentations, Communications and team work skills
CO5	Develop new concepts in multidisciplinary area
CO6	Able to face reviews and viva voce examinations

Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1	1	3	3	3	3	3	1	3	3
CO2	3	3	3	3	3	2	3	3		3	3	2	3	3
CO3	2	2	2	2	2	2	2	2	3	3	3	1	3	3
CO4	3	3	3	3	3	3	2	3	3	3	3	1	3	3
CO5	3	3	3	3	3	3	2	3	3	3	3	1	3	3
CO6	2	2	2	2	2	2	2	2	3	3	3	1	3	3

This course will be conducted largely as group of 2-4 students under the direct supervision of a member of academic staff. Students will be required to

1. Identify the Problem and choose the specific project topic which will reflect the common interests and expertise of the student and supervisor.
2. Perform a literature review to understand the state of art in the chosen technical area.
3. Conduct a Feasibility study of the Project.
4. Submit the main Project Proposal.

CIE-Continuous Internal Evaluation (50Marks)

Bloom's Category	Project
Remember	-
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10

SEE-Semester End Examination (50Marks)

Bloom's Category	Project
Remember	-
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10

Percentage evaluation of various blooms levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	-	-		
Understand	10	10	20	20
Apply	10	10	20	20
Analyze	10	10	20	20
Evaluate	10	10	20	20
Create	10	10	20	20
TOTAL	50	50	100	100

VIII

Semester

INDUSTRIAL WASTE WATER TREATMENT

Course Code: 20CIV811A

Credits: 3

L: T: P: S: 3:0:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

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

CO1	Understand the effect of industrial wastewater on stream and municipal treatment plant. and the importance of recycling of wastewater
CO2	Identify advanced industrial water treatment methods
CO3	Develop an insight in feasibility of common effluent treatment plant.
CO4	Analyze different methods of recirculation and effluent disposal.
CO5	Understand the manufacturing process of various industries.
CO6	Suggest treatment methods for effluent from different industries.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					3	3				2		3	
CO2	3	3	1			3	3						3	1
CO3	3	3				3	3				2		3	
CO4	3	3				3	3						3	
CO5	3	3				3	3						3	
CO6	3	3				3	3						3	

Module No	Content of Module	Hrs	COs
1	<p>INTRODUCTION: Difference between Domestic and Industrial Wastewater, Need for treatment of industrial waste water, Effect of wastewater on Water bodies. WATER (PREVENTION AND CONTROL) ACT, Legislation to Control Water Pollution in India,</p> <p>Importance of treatment and recycle of industrial effluent, Industrial wastewater disposal management, Discharges into Streams, Lakes and oceans and associated problems.</p>	09	CO1
2	<p>TREATMENT METHODS-: Volume Reduction, Strength Reduction, Neutralization, Equalization and Proportioning.</p> <p>Advanced water treatment - Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, elutriation, Removal of Iron and Manganese, Removal of Colour and Odour</p>	09	CO2
3	<p>COMBINED TREATMENT: Effect of wastewater on Municipal Sewage treatment Plant, Recirculation of Industrial Wastes- Effluent Disposal Method.</p> <p>Feasibility of combined Treatment of Industrial waste with Domestic Waste, Concept of CETP, Common Effluent Treatment Plants, Its advantages and suitability, Limitations and challenges.</p>	09	CO3, CO4
4	<p>Process and Treatment of specific Industries-1-Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from, Fertilizers and cotton Textile industries</p> <p>Process and Treatment of specific Industries-2: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Sugar Mills and tanneries.</p>	09	CO5, CO6
5	<p>Process and Treatment of specific Industries-3: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Paper and Pulp industries.</p> <p>Process and Treatment of specific Industries-4: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Dairy and Food Processing industries.</p>	09	CO5, CO6

Site Visit to any treatment plant to be done by all students

TEXT BOOKS:

1. Industrial Waste Water Treatment by Rao MN, and DuttaA.K.,3rd Edition2008, English-OXFORD & IBH PUBLISHING CO. PVT LTD ,(ISBN: 9788120417120, 8120417127)
2. Waste Water Treatment, Disposal and Reuse by Metcalf and Eddy inc ,4th Edition,2002, TataMcGraw Hill Publications,(ISBN: 9780070495395)
3. Industrial Waste Water Treatment by Nelson L.Nemerow.1st edition 2006, Butterworth-Heinemann Imprint(ISBN-13: 978-0-12-372493-9, ISBN-10: 0-12- 372493-7)

REFERENCE BOOKS:

1. Pollution Control Processes in industries by MahajanS.P, 2004 , Tata McGraw-Hill Education Pvt. Ltd (ISBN 10: 0074517724 / ISBN 13: 9780074517727)
2. Industrial Wastewater Treatment by Patwardhan A.D., 2008, PHI Learning PrivateLtd ,New Delhi , (ISBN-8120333500,9788120333505)
3. Standard Methods for examination of Water and Wastewater, APHA, AWWA and WPCF, 20th Edition

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Category	Test	Assignment	Quiz
Marks (out of 50)	25	15	10
Remember		5	5
Understand	10	5	3
Apply	10	3	2
Analyze	5	2	
Evaluate			
Create			

SEE: Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	5
Understand	20
Apply	15
Analyze	10
Evaluate	
Create	

PERCENTAGE EVALUATION OF VARUIOUS BLOOM LEVEL

Bloom's Category	CIE	SEE	Total	%
Remember	10	5	15	15
Understand	18	20	38	38
Apply	15	15	30	30
Analyze	7	10	17	17
Evaluate				
Create				
Total				

Numerical Method of Civil Engineering

Course Code: 20CIV812A

Credits: 3

L: T: P: S: 3:0:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

Course Out comes : At the end of the Course, the student will be able to:

CO1	Apply linear simultaneous equations to complicated engineering problems by different numerical techniques
CO2	Develop solution using linear system of equations to Civil Engineering Practice.
CO3	Develop research ideas to analyze structural behavior using nonlinear algebraic and transcendental equations.
CO4	Investigate the integration of structural elements using Numerical Integration Techniques.
CO5	Initiate R & D ideas for solving Ordinary Differential Equations.
CO6	Apply finite difference techniques to solve structural mechanics problems.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3								3	3	3
CO2	3	3	3	3								3	3	3
CO3	3	3	3	3								3	3	3
CO4	3	3	3	3								3	3	3
CO5	3	3	3	3								3	3	3
CO6	3	3	3	3								3	3	3

Module No	Content of Module	Hrs	COs
1.	<p>Introduction: Introduction to Numerical techniques, Errors, Matrices and Determinants.</p> <p>Solution of Linear Simultaneous Equation:</p> <p>a) Gaussian elimination method</p> <p>b) Gauss-Jordan matrix inversion method</p> <p>c) Gauss-Siedel method</p> <p>d) Cholesky method</p> <p>Application of Solution of Linear System Of Equations To Civil Engineering Problems related to: Construction planning, slope deflection method applied to beams, frames and truss analysis.</p>	09	CO1, CO2
2.	<p>Solution of non-linear and Transcendental equations for Civil Engineering Problems: Bisection method and its applications for solution of non linear algebraic and transcendental equations for problems in hydraulics, irrigation engineering, structural engineering and environmental engineering. Newton-Raphson method and its applications for solution of non linear algebraic and transcendental equations for problems in hydraulics, irrigation engineering, structural engineering and environmental engineering</p>	09	CO2, CO3
3.	<p>Application of Numerical Integration for Solving Civil Engg. Problems:</p> <p>a) Trapezoidal rule</p> <p>b) Simpson's one third rule</p> <p>c) Newmark's method.</p>	09	CO2, CO4
4.	<p>Solution of Ordinary Differential Equation to Civil Engineering Problems by: Euler's method</p> <p>Solution of Ordinary Differential Equation to Civil Engineering Problems by: Runge Kutta 4th order method.</p>	09	CO2 CO5
5.	<p>Application of Finite Difference Technique in Structural Mechanics: Introduction, expression of derivatives by finite difference: backward differences, forward differences and central differences. Application of finite difference method for analysis of</p> <p>a) Statically determinate beams,</p> <p>b) Statically indeterminate beams</p> <p>Application of Finite difference technique in structural mechanics:</p> <p>a) Buckling of columns</p> <p>b) Beams on elastic foundation</p>	09	CO6

Text Books:

1. N.Krishna Raju&K.U.Muthu “Numerical methods in Engineering Problem”, MacMillan Indian Limited, Bengaluru, 2000.
2. Rajesh Kumar Gupta, “Numerical Methods: Fundamentals and Applications.” Cambridge University Press New Delhi, 2019.
3. Chapra S.C & R.P.Canale “Numerical Methods for Engineers”, McGraw Hill,edition 2nd New York, 1992.

Reference Books:

1. Y.M. Cheng, J. H. Wang, L. Liang, W. H. Fung, “Numerical Methods and Implementation in Geotechnical Engineering – Part 1.” Bentham Books, London. 2020.
2. Petre Teodorescu, Nicolae-Doru Stanescu, Nicolae Pandrea, “Numerical Analysis with Applications in Mechanics and Engineering.” Wiley, New York, 2013.
3. Bilal Ayyub, Richard H. McCuen, “Numerical Analysis for Engineers Methods and Applications,”CRC Press, 2ndEdition.London, 2015

CIE-Continuous Internal Evaluation (50 Marks)

Bloom’s Category	Tests	Assignments	Quizzes
Marks(out of 50)	25	15	10
Remember			5
Understand	5		5
Apply	10	5	
Analyze	10	10	
Evaluate			
Create			

SEE-Semester End Examinations (Theory 50 Marks)

Bloom's Category	Tests
Remember	5
Understand	5
Apply	20
Analyze	20
Evaluate	
Create	

Percentage Evaluation of Various Bloom's levels:

Bloom's Category	CIE	SEE	TOTAL	%
Remember	5	5	10	10
Understand	10	5	15	15
Apply	15	20	35	35
Analyze	20	20	40	40
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

Earth and Earth Retaining Structures

Course Code: 20CIV813A

Credits: 3

L: T: P: S: 3:0:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

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

CO1	Understand the concepts of earth pressure theories and study their drainage and stability.
CO2	Understand the concept of sheet pile walls and their applications as retaining structures
CO3	Analyze causes of failure of earth dam and design criteria.
CO4	Analyze lateral earth pressure on sheeting and bracing and design of bracings.
CO5	Analyze stability of retaining walls and Principles of the design.
CO6	Understand the Concepts and mechanism of reinforced Earth-Materials

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	3	3	-	-	-	-	-	3	-
CO2	3	3	-	-	-	3	3	-	-	-	-	-	3	-
CO3	3	3	3	3	-	3	3	-	-	-	-	-	3	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO6	3	3			-	-	-	-	-	-	-	-	3	-

Module No	Content of Module	Hrs	COs
1	<p>EARTH PRESSURE THEORIES: Introduction – State of stress in retained soil mass – Earth pressure theories –Active and passive cases – Earth pressure due to external loads, empirical methods.</p> <p>DRAINAGE AND STABILITY CONSIDERATIONS: Lateral pressure due to compaction, strain softening, wall flexibility, influence of drainage. Stability of retaining structure.</p>	09	CO1 CO2
2	<p>CANTILEVER SHEET PILE WALLS: Types of sheet pile walls – Free cantilever sheet pile - cantilever sheet pile in cohesion-less soils – cantilever sheet pile in clay.</p> <p>ANCHORED SHEET PILE WALLS: Anchored sheet pile with free earth support in cohesion-less and cohesive soil. Bulkheads with fixed earth support method – Types and locations of anchors.</p>	09	CO2 CO3
3	<p>EARTH DAMS: Different types of earthen dams with sketches and their suitability. Hydraulic fill and rolled fill methods of construction – Causes of failure of earth dam – Design criteria of earth dams– Stability analysis of earthen dams – Seepage control in earthen dams. Role of Filters in Earth Dam Design.</p> <p>COFFER DAMS: Introduction – types of coffer dams - Design of cellular coffer dams, safety against sliding, slipping, overturning, vertical shear and stability against bursting.</p>	09	CO3
4	<p>BRACED CUTS: Introduction, Lateral earth pressure on sheeting, Different types of sheeting and bracing systems – design of various components of bracings.</p> <p>ROCK FILL DAMS: Introduction, Origin and usage of rock fill dams, types of rock fill dams, construction of rock fill dams.</p>	09	CO4 CO5
5	<p>RETAINING WALLS: Types of retaining walls, failure of retaining walls by sliding, overturning and bearing. Stability analysis and Principles of the design of retaining walls – Gravity retaining walls, Cantilever retaining walls, Counter fort retaining walls (no structural design) – Modes of failure of retaining walls – Drainage from the backfill.</p> <p>REINFORCED EARTH RETAINING WALL: Reinforced earth retaining wall – principles, Concepts and mechanism of reinforced Earth-Materials used in reinforcing the earth - Geotextile – Geogrids.</p>	09	CO5 CO6

TEXT BOOKS:

1. Soil Mechanics and Foundation Engineering: Dr. K.R. Arora : Pub : Standard Publishers & Distributors.
2. Soil Mechanics and Foundation Engineering: S.K. Garg : Pub : Khanna Publishers.
3. Numericals in Geotechnical Engineering: A.V. Narasimha Rao & C. Venkataramaiah :Pub : University Press.

REFERENCE BOOKS:

1. Soil Mechanics and Foundation Engineering: Dr. B.C. Punmia : Pub : Laxmi Publications Ltd.,
2. Foundation Engineering.: Dr. B.J. Kasmalkar
3. Hydraulic Structures: S.K. Garg: Pub : Khanna Publishers.

CIE- Continuous Internal Evaluation (Theory 50 Marks)

Bloom's Category	Test	Assignment	Quiz
Marks (out of 50)	25	15	10
Remember	5	3	-
Understand	10	4	6
Apply	8	6	4
Analyze	2	2	-
Evaluate	-	-	-
Create	-	-	-

SEE – Semester End Examination (Theory 50 Marks)

Bloom's Category	Tests
Remember	10
Understand	20
Apply	20
Analyze	-
Evaluate	-
Create	-

Percentage Evaluation of Various Bloom's levels (100 Marks)

Bloom's Category	CIE	SEE	Total	%
Remember	08	10	18	18
Understand	20	20	40	40
Apply	18	20	38	38
Analyze	04	-	04	04
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	50	100	100

Bridge Engineering

Course Code: 20CIV814A

L: T: P: S: 3:0:0:0

Exam Hours: 03

Credits: 3

CIE Marks: 50

SEE Marks: 50

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

CO1	Demonstrate knowledge and understanding of the IRC codal standards in applying loads in bridge design.
CO2	Apply engineering knowledge in analyzing and designing box and slab culvert under IRC loading conditions.
CO3	Apply engineering knowledge in analyzing and designing T Beam bridge under IRC loading conditions.
CO4	Apply engineering knowledge in analyzing and designing Bearings and Railings.
CO5	Identify the suitability of the type of foundation for bridges.
CO6	Apply engineering knowledge in analyzing and designing the foundation for bridges.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3									3	3
CO2	3	3	3	3	3								3	3
CO3	3	3	3	3	3								3	3
CO4	3	3	3	3	3								3	3
CO5	3	3	3	3									3	3
CO6	3	3	3	3									3	3

Module No	Content of Module	Hrs	COs
1	BRIDGE PRELIMINARIES: Definition and Basic Forms, Component of bridge, classification of bridge, history of bridge development, Site selection-Soil Exploration for site Importance of Hydraulic factors in Bridge Design.	09	CO1
	STANDARD SPECIFICATION FOR ROAD BRIDGES: Span Determination, Width of carriageway, Clearances, Loads to be considered- Dead load – I.R.C. standard, live loads- Impact effect – Wind load –Longitudinal forces-Centrifugal forces- Horizontal forces due to water currents –Buoyancy effect- Earth pressure.		
2	BOX CULVERTS: Introduction to box culverts, its components, analysis, design and detailing of box culvert.	09	CO1, CO2
	SOLID SLAB BRIDGES: Introduction, General design features, Effective width method. Simply supported Slab Bridge, analysis and design of RCC slab culvert for IRC class-AA loading, & class A loading.		
3	BEAM AND SLAB BRIDGES: (T BEAM BRIDGE) Introduction to T beam Bridge, proportioning of interior panel of slab using Pigeaud’s method, Design of a T-beam bridge subjected to class AA tracked vehicle only.	09	CO1, CO3,
	Calculation of longitudinal moment for T beam bridge using Courbon’s theory, Design of longitudinal girder, design example. and reinforcement detailing.		
4	DESIGN OF BEARINGS AND RAILINGS: Introduction to bearings and railings, classification of bearings and railings, forces on bearing and railings, design of bearing and railings.	09	CO4
	DESIGN OF SUBSTRUCTURES: Types of abutments and wing walls, Stability analysis of Abutments, Design of abutments and wing walls.		
5	BRIDGE FOUNDATIONS: Introduction to deep foundations, Pile, Pier and well foundation. Introduction to Pile foundations, Classification of Pile Foundations: Open, Pile, and Well Foundations	09	CO5, CO6
	DESIGN OF PILE & PILE CAPS: Choice of Foundation for Abutments and Piers; Design of Pile & Pier Caps.		

Text Books:

1. Essentials of Bridge Engineering : Johnson – victor : Oxford IBH
2. Agadeesh .T.R. and Jayaram.M.A., “Design of Bridge Structures”, Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2013.
3. Dr.B.C.Punmia, Ashok Kumar, Jain and Arun Kumar Jain, R.C.C. Designs, Laxmi Publications (P) Ltd., New Delhi, 1998

Reference Books:

1. Phatak D.R., “Bridge Engineering”, Satya Prakashan, New Delhi, 1990.
2. Ponnuswamy S., “Bridge Engineering”, Tata McGraw-Hill, New Delhi, 1996.
3. Rajagopalan. N. “Bridge Superstructure”, Alpha Science International, 2006.

CIE- Continuous Internal Evaluation (50Marks)

Bloom’s Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember			5
Understand	5		5
Apply	5	5	
Analyze	15	10	
Evaluate			
Create			

SEE-Semester End Examinations (Theory 50 Marks)

Bloom's Category	Tests
Remember	5
Understand	10
Apply	10
Analyze	25
Evaluate	
Create	

Percentage Evaluation of Various Bloom's levels:

Bloom's Category	CIE	SEE	TOTAL	%
Remember	5	5	10	10
Understand	10	10	20	20
Apply	10	10	20	20
Analyze	25	25	50	50
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

AIR POLLUTION

Course Code: 20CIV815A

Credits: 3

L: T: P: S: 3:0:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

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

CO1	Identify the air pollutants and their classification and its effects
CO2	Identify sampling and analysis techniques for air quality assessment
CO3	Describe the plume behavior and atmospheric stability conditions and assess the concentrations of pollutants
CO4	Design air pollution controlling devices
CO5	Understand automobile emission and controlling method
CO6	Understand the environmental legislation on a different environmental sector

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	3	3	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	-	1	-	-	-	-	-	-	-	3	-
CO4	3	3	3	-	-	3	3	-	-	-	-	-	3	-
CO5	3	-	-	-	-	3	3	-	-	-	-	-	3	-
CO6	3	3	-	-	-	3	3	-	-	-	-	-	3	-

Module No	Contents of Module	Hrs	Co's
1	<p>DEFINITION – Classification and Characterization of Air Pollutants, Emission Sources, Behavior and Fate of air Pollutants, Chemical Reactions in the Atmosphere,</p> <p>CLASSIFICATION OF AIR POLLUTANTS. Sources of air pollution natural and man- made. Photo-chemical Smog, Coal-induced smog, Major Environmental Air Pollution Episodes – London Smog, Los Angeles Smog & Bhopal Gas Tragedy.</p>	09	CO1
2	<p>EFFECTS OF AIR POLLUTION: On Human Health, Animals, Plants and Materials</p> <p>SAMPLING, AND ANALYSIS: Sampling and Measurement of Gaseous and Particulate matter, Stack Sampling, Analysis of Air Pollutants, Smoke and Smoke Measurement</p>	09	CO1 CO2
3	<p>METEOROLOGICAL VARIABLES- General Characteristics of Stack Plumes, Primary and Secondary Lapse Rate, maximum mixing depths, plume rise Inversions, Stability Conditions.</p> <p>PREDICTION OF AIR QUALITY, Box model - Gaussian model - Dispersion coefficient - Application of tall chimney for Pollutant dispersion. Windrose,</p>	09	CO3
4	<p>AIR POLLUTION CONTROL METHODS – Particulate, Emission Control, Gravitational Settling Chambers, Cyclone Separators, Fabric Filters, Electrostatic Precipitators, Wet Scrubbers along with working principles and advantages/ disadvantages (No design)</p> <p>CONTROL BY ABSORPTION- , Control of Gaseous Emissions, Adsorption by Liquids, Adsorption by Solids, Combustion odours and their control.</p>	09	CO4
5	<p>AIR POLLUTION DUE TO AUTOMOBILES: Air Pollution due to Gasoline Driven and Diesel Driven Engines, Effects, Direct and Indirect Methods of control.</p> <p>ENVIRONMENTAL LEGISLATION: Environmental Policy, Environmental Acts, Air Pollution Standards, Case study of cement/coal industry.</p>	09	CO5 CO6

TEXTBOOKS:

1. Crawford, M., (1980), **Air Pollution Control Theory** –TMH Edition, TataMcGraw Hill Publishing Co. Ltd., NewDelhi.
2. Henry. C. Perkins, (1980), **Air Pollution** –McGrawHill.
3. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), **Environmental Engineering** –
4. McGraw Hill Book Co. Sincero, A.P and Sincero, G.A., (1999), **Environmental Engineering – A Design Approach**– Prentice Hall of India.
5. Wark, K., Warner, C.F. and Davies, W.T., (1998), **Air Pollution- ItsOriginand Control**– Harper & Row Publishers, New York..

Reference Books:-

1. Air Pollution Control Guidebook for Management: Edited by A.T. Rossano, Environmental Science Service Division. ERA Inc., USA
2. Government of India’s Publication of laws related to air pollution, Maharashtra Pollution Control Board’s (MPCB) Publication of standards. Indian standards relevant to air Pollution monitoring, definitions, standards.
3. Air Pollution: Rao M N &Rao H V N, Tata McGraw Hill Pub., New Delhi.
4. Air Pollution Vol.1: Tripathi A.K (editor) Ashish Publication House, New Delhi.
5. Air Pollution (Bio-pollutants in air): Srivastava A.K., Ashish Publication House, New

CIE-Continuous Internal Evaluation (Theory 50 Marks)

Bloom’s Category	Tests	Assignments	Quizzes	Self study
Marks	25	10	5	10
Remember	5			5
Understand	10	5	5	5
Apply	5	5		
Analyze	5			
Evaluate	-			
Create	-			

SEE–Semester End Examination (Theory 50 Marks)

Bloom's Category	Tests
Remember	10
Understand	15
Apply	20
Analyze	5
Evaluate	-
Create	-

Percentage Evaluation of Various Blooms' levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	10	10	20	20
Understand	25	15	40	40
Apply	10	20	30	30
Analyze	5	5	10	10
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

PAVEMENT DESIGN

Course Code: 20CIV821A

Credits: 3

L: T: P: S: 3:0:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

COURSE OUTCOMES: AT THE END OF THE COURSE, THE STUDENT WILL BE ABLE TO:

	Description
CO1	Understand the characteristics, its components and basic properties of pavement materials.
CO2	Understand and apply the layer theory concepts and axle load distribution for different cases
CO3	Apply the different design methods of flexible pavement pertaining to relevant standards
CO4	Understand the concept of stresses in rigid pavement. Analyse and evaluate the design of Rigid pavement and its components as per relevant standards
CO5	Understand the functional and structural evaluation of flexible pavements and overlay design
CO6	Understand the functional and structural evaluation of rigid pavements

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	3	-	-	-	-	3	-
CO3	3	3	3	-	2	-	3	3	-	-	-	3	3	-
CO4	3	3	3	-	2	-	3	3	-	-	-	3	3	-
CO5	3	3	3	1	-	2	3	3	-	-	-	3	3	-
CO6	3	-	-	1	-	2	3	3	-	-	-	-	3	-

Module No	Contents of Module	Hrs	Co's
1	<p>Pavements and pavement layers - types, functions, choice. Factors affecting design and performance of flexible and rigid pavements – Pavement design factors.</p> <p>Sub grade support - CBR and plate bearing tests, Resilient Modulus, fatigue tests ,Problems on above</p>	09	CO1
2	<p>Stresses and Deflection / strain in flexible pavements: Application of elastic theory, stresses deflections / strains in single, two and three layer system.</p> <p>Axle load distribution- ESWL for single and two layer system in flexible pavement. EWL,VDF due to varying loads and CSA</p>	09	CO2
3	<p>Flexible pavement design: Empirical, semi empirical and theoretical design approaches and principles. Design steps by CBR method as per IRC-37- 2012.</p> <p>Application of design methods such as AASHTO and Asphalt Institute methods.</p>	09	CO3
4	<p>Stresses in rigid pavements: General principle, stresses in rigid pavements, types of stresses, factors influencing the stresses, computation of stresses due to wheel loads and temperature variations, frictional stresses, stresses under worst conditions. Types of joints in cement concrete pavements and their functioning.</p> <p>Design of rigid pavements: Design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements.</p>	09	CO4
5	<p>Flexible Pavement Failures, Maintenance And Evaluation: Types of failures, causes, remedial/maintenance measures in flexible pavements – Functional Evaluation by visual inspection and unevenness measurement by using different techniques - Structural Evaluation technique by Benkelman Beam Deflection Method, Falling weight deflect meter, GPR Method</p> <p>Rigid Pavement Failures, Maintenance And Evaluation: Types of failures, causes, remedial/maintenance measures in rigid pavements – Functional Evaluation by visual inspection and unevenness measurements</p>	09	CO5,6

TEXT BOOKS:

1. S.K.Khanna,C.E.G.Justo,A.Veeraragavan,“HighwayEngineering”, Nem Chand Bros, 10th edition Roorkee,2015.
2. L.R.Kadiyali “Principles and Practices of Highway Engineering”, Khanna Publishers, 4th edition, New Delhi, 2005.
3. K P Subramanium “Transportation Engineering”, 2nd edition, Scitech Publications, Chennai 2011.

REFERENCEBOOKS:

1. Guidelines for the design of flexible pavements IRC: 37-2012-3rd revision, New Delhi, 2013.
2. Guidelines for the design of Plain jointed rigid pavements for Highways IRC: 58-2015-4th revision, New Delhi, 2015.
3. Specifications for Roads and Bridge works, MORT&H-5th revision, New-Delhi, 2013.

CIE- Continuous Internal Evaluation (50 Marks)

Bloom’s Category	Tests	Assignments	Quizzes	Total
Marks (out of 50)	25	15	10	50
Remember	5			5
Understand	5	5	5	15
Apply	5	5	5	15
Analyze	5	5		10
Evaluate	5			5
Create				
Total	25	15	10	50

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests (Theory)
Remember	5
Understand	15
Apply	15
Analyze	10
Evaluate	5
Create	-
Total	50

Percentage Evaluation of Various Bloom's levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	5	5	10	10
Understand	15	15	30	30
Apply	15	10	25	25
Analyze	10	10	20	20
Evaluate	5	10	15	15
Create	-	-	-	-
TOTAL	50	50	100	100

RURAL WATER SUPPLY & SANITATION

Course Code: 20CIV822A

Credits: 3

L: T: P: S: 3:0:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

COURSE OUTCOMES: AT THE END OF THE COURSE, THE STUDENT WILL BE ABLE TO:

	Description
CO1	Analyze the problems of water supply and treatment methods in rural areas
CO2	Applying different concepts of Eco sanitations in rural areas
CO3	Illustrate the water harvesting practices and disposal method.
CO4	Analyze different methods for the prevention of communicable diseases and adopting disposal method
CO5	Illustrate the process of milk sanitation and disposal method in rural areas..
CO6	Investigate various methodologies involved in pumping and disinfection process

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3			3	3						3	
CO2	3	3	3			3	3						3	
CO3	3	3	3			3	3						3	
CO4	3	3				3	3						3	
CO5	3	3				3							3	
CO6	3	3	3			3	3						3	

Module No	Contents of Module	Hrs	Co's
1	INTRODUCTION: Concept of environment and scope of sanitation in rural areas. Magnitude of problem of water supply and sanitation – population to be covered and difficulties related to water supply, National policy, protection of well water and lakes,	09	CO1
	TREATMENT AND DISTRIBUTION SYSTEM: Treatment of Iron, manganese, Fluorides etc in rural water supply. Low cost treatment planning of distribution system in rural areas.		
2	ECO SANITATION: public latrine, concept of Eco- sanitation, trenching and composting methods.	09	CO2
	SANITATION PRACTICES: Two pit latrines, aqua privy, W.C, septic tank, soak pit- Simple design problems.		
3	DRAINAGE SYSTEMS: Storm water and sullage disposal, rain water harvesting and uses.	09	CO3
	DISPOSAL OF SOLIDS WASTE: composting, land filling. Biogas plants with design criteria.		
4	COMMUNICABLE-DISEASES: Terminology, classifications, methods of communication, general methods of control of vector borne diseases.	09	CO4
	REFUSE COLLECTION AND DISPOSAL: collection methods, transportation, disposal – salvaging, dumping, manure pits, dumping in low lands, composting, dung disposal – digester.		
5	MILK SANITATION: Essentials, test for milk quality, Pasteurization.	09	CO5, CO6
	TYPES OF PUMPS:- Supply Systems Viz., BWS, MWS, PWS, Water Treatment Methods Disinfection, Defluoridation, Hardness And Iron Removal, Ground Water Contamination And Control.		

TEXT BOOKS:

1. Rural Water Supply & Vayu Education Of India, New Delhi Sanitation, Sanjay Gupta, ISBN-13 9789381348949, 2016.
2. Preventive & Social Medicine, Park & Park, 2016

REFERENCEBOOKS:

1. Environmental Sanitation, 2016, steel TMH, New Delhi.
2. Water Supply & Sanitary Engineering, E.W steel 2016

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5	5	5
Understand	10	5	5
Apply	5	5	
Analyze	5		
Evaluate			
Create			

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests (Theory)
Remember	10
Understand	15
Apply	20
Analyze	5
Evaluate	--
Create	---

Percentage Evaluation of Various Bloom's levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	15	10	25	20
Understand	20	15	35	40
Apply	10	20	30	30
Analyze	5	5	10	10
Evaluate				
Create				
TOTAL	50	50	100	100

ADVANCED RC STRUCTURES

Course Code: 20CIV823A

Credits: 03

L: T: P: S: 3:0:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

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

CO1	Understand design philosophy and to apply the IS code of practice for the design of various structural elements.
CO2	Understand and apply the concepts of yield line theory for the analysis of slabs
CO3	Design the flat slab with the thorough understanding and application of theoretical concepts
CO4	Design the RCC Chimneys with the thorough understanding and application of theoretical concepts
CO5	To apply the theoretical concepts to evaluate and design overhead water tanks
CO6	Design RCC Bunkers & Silos using different theorems

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO6	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Module No	Contents of Module	Hrs	Cos
1	YIELD LINE ANALYSIS OF SLABS: Introduction, assumptions, characteristic features of yield lines, Sign conventions for yield lines, yield line patterns, Moment capacity along the yield line. Yield line analysis of slabs by virtual work and equilibrium method – Square and rectangular slabs only.	9	CO1 CO2
2	DESIGN OF FLAT SLABS FLAT SLABS: Introduction, Components, Proportioning of flat slab I.S. Code Provisions, Design methods- Direct design method and equivalent frame method	9	CO1 CO3
3	DESIGN OF CHIMNEYS: Introduction, design factors, stresses due to self-weight and wind load, temperature stresses, combined effect of self-weight, wind load and temperature, stresses in horizontal reinforcement, Design of chimneys.	9	CO1 CO4
4	DESIGN OF WATER TANKS: Design of RCC overhead circular and rectangular water tanks in compliance with IS 3370.	9	CO1 CO5
5	SILOS & BUNKERS: Introduction, design concepts, Janssen's theory and Airy's theory Design of silos and bunkers	9	CO1 CO6

TEXT BOOKS:

1. Advance RCC Design, S.S Bhavikatti, ISBN-10: 81-224-2276-4, 2 nd edition, International Publishers.
2. Advanced Reinforced Concrete Design, Krishna Raju, ISBN-10: 8123929609, Prentice Hall India Learning Private Limited; 2 edition (2005)
3. Advanced Reinforced Concrete Design, VARGHESE, P. C. ISBN-10: 812032787X

REFERENCE BOOKS:

1. Design of RC structures, S. Ramamurtham, ISBN-10: 9352161327, Dhanpat Rai Publishing Company (P) Ltd-New Delhi (2016)
2. R.C.C Theory and Design, Shah, ISBN-10: 8190371762, Structures Publishers, (2010)
3. Reinforced concrete (Vol. 1 & 2), H J Shah, ISBN:9789385039188/9788192869223, Charotara publishing house Pvt. Ltd. (2016)

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Self Study
Marks (out of 50)	25	10	5	10
Remember	2.5	-	-	-
Understand	2.5	2	-	5
Apply	5	2	2.5	5
Analyze	5	2	2.5-	-
Evaluate	5	2	-	-
Create	5	2	-	-

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests (Theory)
Remember	2.5
Understand	2.5
Apply	10
Analyze	15
Evaluate	10
Create	10

Percentage Evaluation of Various Bloom's levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	2.5	2.5	5	5
Understand	9.5	2.5	12	12
Apply	14.5	10	24.5	24.5
Analyze	9.5	15	24.5	24.5
Evaluate	7	10	17	17
Create	7	10	17	17
TOTAL	50	50	100	100

GROUND WATER HYDROLOGY

Course Code: 20CIV824A

Credits: 3

L: T: P: S: 3:0:0:0

CIE Marks: 50

Exam Hours: 03

SEE Marks: 50

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

CO1	Understand about types of aquifer, aquifer parameters and movement of ground water
CO2	Apply basic principles of well hydraulics related to steady & unsteady flow in aquifers with general derivations.
CO3	Gain basic knowledge about ground water investigation techniques.
CO4	Understand Ground water development and management skills.
CO5	Analyze Ground water modeling.
CO6	Analyze Sea water intrusions in aquifers.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3											3	
CO2	3	3					3						3	
CO3	3	3		3	1								3	1
CO4	3	3	3	3			3				1		3	
CO5	3	3	3	3	1								3	1
CO6	3	3	3			1	3						3	

Module No	Contents of Module	Hrs	Cos
1	<p>INTRODUCTION: Scope and Importance of Ground Water Hydrology. Vertical distribution of ground water. Ground water occurrence in different types of rocks and soils. Definition of aquifer, Aquifuge, Aquitard and Aquiclude. Confined, unconfined, leaky and perched aquifers.</p> <p>MOVEMENT OF GROUND WATER: Aquifer parameters – Specific yield, Specific retention, Porosity, Storage coefficient, Darcy’s Law, Hydraulic conductivity, Coefficient of permeability and intrinsic permeability, Transmissibility. Permeability in Isotropic medium.</p>	09	CO1 CO2
2	<p>WELL HYDRAULICS – STEADY FLOW: Steady unidirectional flow, steady radial flow to a well. Dupit’s and Theism’s equations, Pumping tests.</p> <p>WELL HYDRAULICS – UNSTEADY FLOW: Unsteady radial flow in confined and unconfined aquifers, Theis method, Cooper and JaCob method, Chow’s method.</p>	09	CO1, CO2
3	<p>SURFACE INVESTIGATION OF GROUND WATER: Geologic methods, Remote sensing, geophysical explorations: Seismic refraction method, Electrical resistivity method (Hands on training), gravity and magnetic methods, water witching.</p> <p>SUBSURFACE INVESTIGATION OF GROUND WATER: Test drilling, Water level measurements, Borehole geo-physical techniques: Electrical logging, Radioactive logging, Induction logging, Sonic logging and Fluid logging.</p>	09	CO2, CO3, CO4
4	<p>GROUND WATER DEVELOPMENT: Types of wells, Methods of constructions, Well completion and development, Pumps for lifting water: Working principles, Power requirements.</p> <p>GROUND WATER MANAGEMENT: Concepts of basin management, equation of hydrologic equilibrium, ground water basin investigation, data collection and field work. Artificial recharge of ground water. Field Visit.</p>	09	CO2 CO3 CO4 CO6
5	<p>GROUND WATER MODELLING: Porous media models, analog models, electric analog models, digital computer models.</p> <p>SEA WATER INTRUSIONS IN AQUIFERS: Occurrence of saline water intrusion, Ghyben-Herzberg relation between fresh and saline water, shape and structure of fresh-salt water interface, control of saline water intrusion.</p>	09	CO4 CO5 CO6

TEXT BOOKS:

1. Ground Water- H.M. Raghunath; New Age International (P) Limited, Edition: Third-2014, ISBN: 9788122419047.
2. Ground Water Hydrology- David K. Todd, Larry W. Mays; Wiley India, Edition: Third- 2011, ISBN: 9788126530038.
3. Numerical Ground Water Hydrology- A.K. Rastogi; Penram, International Publishing India Pvt. Ltd., Mumbai, Edition: First-2007, ISBN: 9788187972921.

REFERENCE BOOKS:

1. Water wells and Pumps – Michel D.M., Khepar. S.D., Sondhi. S.K., McGraw Hill Education – 2nd Edition.
2. Ground Water and Tube Wells- Garg Satya Prakash; Oxford and IBH, New Delhi, Edition: Second-1982, ISBN: 8120400569.
3. Ground Water Resource Evaluation- W.C. Walton; McGraw-Hill Inc., US, Edition: First- 1970, ISBN: 9780070680517.

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5	-	5
Understand	5	5	5
Apply	10	5	-
Analyze	5	5	-
Evaluate	-	-	-
Create	-	-	-

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests (Theory)
Remember	10
Understand	15
Apply	15
Analyze	10
Evaluate	--
Create	---

Percentage Evaluation of Various Bloom's levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	10	10	25	20
Understand	15	15	35	40
Apply	15	15	30	30
Analyze	10	10	10	10
Evaluate				
Create				
TOTAL	50	50	100	100

ADVANCED PRE-STRESSED CONCRETE STRUCTURES

Course Code: 20CIV825A

Credits : 3

L: T: P: S: 3:0:0:0

CIE Marks : 50

Exam Hours: 03

SEE Marks : 50

Course Outcomes: At the end of the Course, the Student will be able to do the following:

CO1	Understand the concepts of prestressed concrete elements.
CO2	Design the prestressed concrete Sections for flexure.
CO3	Design the prestressed concrete Sections for shear and Torsion.
CO4	Analyze and Design composite sections.
CO5	Understand the concept of Prestress transfer and design End Anchorage Blocks.
CO6	Analyze Continuous beams and Portal Frames of prestressed concrete members.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO6	3	3	1	3	-	-	-	-	-	-	-	-	3	-

Module No	Contents of Module	Hrs	Cos
1	Design of Section for Flexure: Allowable stresses - Elastic design of simple beams having rectangular and I-section for flexure - kern lines - cable profile and cable layout. Design of Sections for Shear: Shear and Principal stresses - Improving shear resistance by different prestressing Techniques - horizontal, sloping and vertical prestressing - Analysis of rectangular and I-beam - Design of shear reinforcement - Indian code provisions, Importance of modulus of elasticity of Prestressing tendons, failures of prestressed concrete.	9	CO1, CO2
2	Shear and Torsional resistance- ultimate shear resistance- Design of shear reinforcement in torsion.	9	CO3
3	Composite sections of prestressed concrete beam and cast in situ RC slab analysis of stresses differential shrinkage deflections Flexural and shear strength of composite sections Design of composite sections.	9	CO4
4	Transfer of Prestress in Pretensioned Members: Transmission of prestressing force by bond Transmission length, Flexural bond stresses - IS code provisions - Anchorage zone stresses in post tensioned members - stress distribution in End block - Analysis by approximate, Guyon and Magnel methods -Anchorage zone reinforcement.	9	CO5
5	Statically indeterminate Structures: Advantages & disadvantages of continuous Prestressed beams -Primary and secondary moments - P and C lines - Linear transformation concordant and non-concordant cable profiles -Analysis of continuous beams and simple portal frames (single bay and single story)	9	CO6

Text Books

1. N. Krishna Raju, "Pre-stressed Concrete", Tata McGraw Publishers, (ISBN: 9781259003363), 5th Edition, 2012.
2. P. Dayarathnam "Pre-stressed Concrete", Oxford and IBH Publishing Co. (ISBN: 9788120417915), 2016.
3. A. Nilson, Design of Prestressed Concrete, John Willey & Sons., ISBN 1765 1997, 2nd edition.

Reference Books

1. T.Y. Lin and Ned H Burns “Design of pre-stressed concrete structures”, Wiley India Private Limited, (ISBN: 978-8126528035), 3rd Edition, 2010.
2. N.C. Sinha & S.K. Roy “Fundamentals of pre-stressed concrete”, S Chand Publishers, New Delhi, (ISBN: 9788121924276), 3rd Edition, 2011,
3. Rajagopalan, “Pre-stressed Concrete”, Narosa Publishing House, (ISBN:9781842652121), 2nd Edition, 2015
4. IS-1343

CIE Continuous Internal Evaluation (Theory 50 Marks)

Blooms Category	Internal	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	-	-	-
Understand	5	5	-
Apply	-	-	-
Analyze	10	5	5
Evaluate	-	-	-
Create	10	5	5

SEE-Semester End Examinations (Theory 50 Marks)

Blooms Category	marks
Remember	-
Understand	10
Apply	-
Analyze	20
Evaluate	-
Create	20

Evaluation of Various Bloom's levels (100 Marks)

Bloom's Category	CIE	SEE	Total	%
Remember	-	-	-	-
Understand	10	10	20	20
Apply	-	-		
Analyze	20	20	40	40
Evaluate	-	-	-	-
Create	20	20	40	40
Total	50	50	100	100

Internship

Course Code: 20CIV83A

Credits: 04

L: T: P: S: 0:0:4:0

CIE Marks: 50

Exam Hours: 3 Hours

SEE Marks: 50

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

CO1	Correlate theoretical knowledge to practical work on the real world
CO2	Use Modern tools and technologies to complex engineering activities
CO3	Communicate effectively and function effectively as a team member in multidisciplinary settings
CO4	Understand the engineering and management principles and apply these on work
CO5	Engage himself in independent and lifelong learning
CO6	Perform better in reviews and interviews

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	POS2
CO1		3											3	3
CO2					3								3	3
CO3									3	3			3	3
CO4											3		3	3
CO5												3	3	3
CO6										3		3	3	3

All the students are encouraged to undergo a minimum of 45 days industrial training in an ongoing construction project and submit a report consisting the details of the organization, project details and specific construction aspect which they have learnt during that period for CIE and SEE.

This course will be monitored individually under the direct supervision of a member of academic staff.

The students individually undertake training in reputed civil engineering companies for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of staff members

CIE- Continues Internal Evaluation (50 Marks)

Bloom's Category	Internship
Remember	-
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10
Total	50

SEE- Semester End Examination (50 Marks)

Bloom's Category	Internship
Remember	-
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10
Total	50

Evaluation of Various Bloom's levels (100 Marks)

Bloom's Category	CIE	SEE	Total	%
Remember	-	-	-	-
Understand	10	10	20	20
Apply	10	10	20	20
Analyze	10	10	20	20
Evaluate	10	10	20	20
Create	10	10	20	20
Total	50	50	100	100

PROJECT WORK Phase-II

Course Code: 20CIV84A

Credits: 10

L: T: P: S : 0:0:10:0

CIE Marks: 150

Exam Hours: 03

SEE Marks: 150

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

CO1	Prepare the students to solve/work on the real world/ Practical/Theoretical problems involving issues in civil engineering
CO2	Use Modern tools and technologies to solve research problems
CO3	Practice presentations, Communications and team work skills
CO4	Develop new concepts in multidisciplinary area
CO5	Evaluate the results and document the work.
CO6	Able to face reviews and viva voce examinations

Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1	1	3	3	3	3	3	1	3	3
CO2	3	3	3	3	3	2	3	3		3	3	2	3	3
CO3	2	2	2	2	2	2	2	2	3	3	3	1	3	3
CO4	3	3	3	3	3	3	2	3	3	3	3	1	3	3
CO5	3	3	3	3	3	3	2	3	3	3	3	1	3	3
CO6	2	2	2	2	2	2	2	2	3	3	3	1	3	3

This course will be conducted largely as group of 2-4 students under the direct supervision of a member of academic staff. Students will be required to

1. Undertake the detailed technical requirements in the chosen area.
2. Define the objective, methodology involved and scope of the project work.
3. Produce progress reports or maintain a professional journal to establish work completed, and to schedule additional work within the time frame specified for the project.
4. Prepare an interim report describing the work undertaken and results obtained so far
5. Demonstrate the Completed Project work with results.
6. Present the work in a forum like conference, seminar etc.

CIE-Continuous Internal Evaluation (50 Marks)

Bloom's Category	Project
Remember	-
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10

SEE–Semester End Examination (50 Marks)

Bloom's Category	Project
Remember	-
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10

Evaluation of Various Bloom's levels (100 Marks)

Bloom's Category	CIE	SEE	Total	%
Remember	-	-	-	-
Understand	10	10	20	20
Apply	10	10	20	20
Analyze	10	10	20	20
Evaluate	10	10	20	20
Create	10	10	20	20
Total	50	50	100	100

APPENDIX A

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

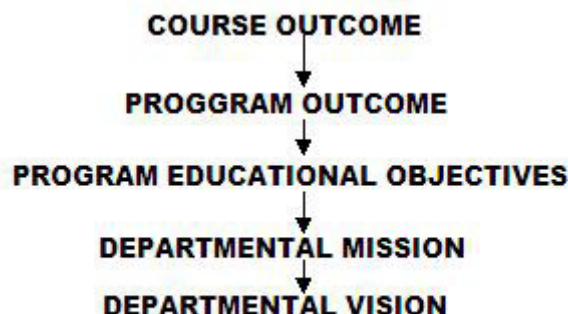
There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX B

The Graduate Attributes of NBA

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX C

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.

