NEW HORIZON
COLLEGE OF ENGINEERING

Autonomous College permanently affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

Department of Civil Engineering

Academic Year 2020-21

Seventh and Eighth Semesters
B.E Scheme and Syllabus

CONTENTS

VISION

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

MISSION

1. To create an environment wherein Faculty and Students engage in cutting edge research.
2. To undertake Collaborative projects in order to develop a partnership between Institute and Industry
3. To motivate Entrepreneurship and to imbibe Professional Ethics
4. 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.	3	3	3	3
To undertake Collaborative projects in order to develop a partnership between Institute and Industry.	3	3	3	3
To motivate Entrepreneurship and to imbibe Professional Ethics.	3	3	3	3
To promote participation in activities which help in holistic development of students.	3	3	3	3

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	3	3	3	3	2	2	3	3
PEO2	3	3	3	3	3	3	3	3	2	2	3	3
PEO3	3	3	3	3	3	3	3	3	2	2	3	3
PEO4	3	3	3	3	3	3	3	3	2	2	3	3

New Horizon College of Engineering
Department of Civil Engineering
Scheme of seventh Semester B.E Program

Sl.No	Course Code	Course	Credit Distribution				Overall Credits	Contact Hours weekly Theory	Contact Hours weekly (Lab)	Marks		
			L	P	T	S				CIE	SEE	Total
1	CIV71	Environmental Engineering-II	2	0	0	0	2	2		50	50	100
2	CIV72	Design and Drawing of Steel Structural Elements	3	2	0	0	5	3	4	75	75	150
3	CIV73	Estimation & Valuation	3	0	0	0	3	3		50	50	100
4	CIV74*	Professional Elective-IV	3	0	0	0	3	3		50	50	100
5	CIV75*	Professional Elective-V	3	0	0	1	4	4		50	50	100
6	CIV76	Highway Materials Lab	0	2	0	0	2		4	25	25	50
7	CIV77	Project phase-I	0	3	0	0	3			50	50	100
8	NHOPXX	Open Elective-II	3	0	0	1	4	4		50	50	100
Total							26	19	08	400	400	800

Elective-IV		Elective-V		Open Elective-II	
Course Code	Course	Course Code	Course	Course Code	Course
CIV741	Matrix Method of Structural Analysis	CIV751	Industrial waste water treatment		
CIV742	Design of Masonry Structures	CIV752	Numerical Method of Civil Engineering		
CIV743	Solid Waste Management	CIV753	Earth and Earth Retaining Structures		
CIV744	Design & Drawing of Irrigation Structures	CIV754	Transportation systems		
CIV745	Highway Geometric Design	CIV755	Advanced Pre-stressed Concrete Structures		

New Horizon College of Engineering
Department of Civil Engineering
Scheme of eight Semester B.E Program

Sl. No	Course Code	Course	Credit Distribution				Overall Credits	Contact Hours weekly Theory	Contact Hours weekly (Lab)	Marks		
			L	P	T	S				CIE	SEE	Total
1	CIV81	Pavement design	3	0	0	0	3	03		50	50	100
2	CIV82*	Professional elective VI	3	0	0	1	4	04		50	50	100
2	19CIV83	Project Work phase-II	0	7	0	0	7			50	50	100
3	19CIV84	Internship	0	4	0	0	4			50	50	100
Total							18	07	00	200	200	400

Course Code	Professional Elective-VI
	Course
CIV821	Rural water Supply & Sanitation
CIV822	Advanced R.C Structures
CIV823	Ground Water Hydrology
CIV824	Air Pollution

ENVIRONMENTAL ENGINEERING-II

Course Code : CIV71		**Credits**	**:2**
L:P:T:S : 2:0:0:0		**CIE Marks**	**:50**
Exam Hours : 3		**SEEMarks**	**:50**

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

CO1	To estimate the quantity of sewage
CO2	To design sewer pipes
CO3	To study different sewer appurtenances
CO4	To analyse the characteristics of sewage and study the disposal methods
CO5	Design of various units of sewage treatment plant and operation and maintenance measures.

Mapping of Course Outcomes to Program Outcomes:

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

Unit No	Contents of Module	Hrs	Co's
1	**INTRODUCTION:** Need for sewerage system, 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 **ESTIMATION OF QUANTITY OF SEWAGE: D**ry 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 esign of storm water drain, Time of concentration.	**09**	**CO1**

2	**DESIGN OF SEWERS:** Sewer Size, Determination of velocity of flow using empirical formulae ,self cleansing and non scouring velocities, Design of hydraulic elements for circular sewers flowing full and flowing partially full(No derivations), Pumping of sewage: Types, selection of pumps (No problems) **MATERIALS OF SEWERS AND APPURTENANCES :** Sewer materials, shapes of sewers, laying of sewers, joints and testing of sewers, ventilation and cleaning of sewers. Catch basins, manholes, flushing tanks, oil and grease traps, Drainage traps, construction and maintenance of sewers.	**09**	**CO2,CO3**
3	**WASTE WATER CHARACTERIZATION:** Sampling, significance, techniques and frequency. Physical, Chemical and Biological characteristics, Aerobic and Anaerobic activity, CNS cycles. BOD and COD. Their significance & problems **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).	**09**	**CO4**
4	**TREATMENT PROCESSES**: Objective, methods of treatment, flow sheets showing Preliminary, Primary, Secondary and Tertiary treatment. Preliminary & Primary treatment **:** Screening, grit chambers, skimming tanks, primary sedimentation tanks, Operation and maintenance of sedimentation tanks – Design criteria & Design examples. **SECONDARY TREATMENT:** Trickling filter – theory and operation, types and designs. Activated sludge process- Principle and flow diagram, Modifications of ASP, F/M ratio, Operation and maintenance, Design of ASP.	**09**	**CO5**
5	**ANAEROBIC SLUDGE DIGESTION**: Sludge characterization – Thickening – Biogas recovery – Sludge Conditioning and Dewatering – Sludge digestion tanks, Design of Sludge drying beds. Septic tank, Design. **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 – Reuse and recycle of waste water	**08**	**CO5**

Text Books:

1. Sewage disposal and air pollution engg by S.K. Garg, Khanna Publishers.
2. Water Supply and Sanitary Engg, G S Birdie, j S Birdie, Dhanpat Rai publishing company.
3. DEWT manual

Reference Books:

1. Wastewater Treatment, Disposal & Reuse: Metcalf & Eddy inc: Tata McGraw Hill Publications.
2. CPCB manual for waste water treatment systems.
3. BWSSB STP Manual.

CIE-Continuous Internal Evaluation
(Theory 50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Curricular/ Co-curricular activities
Marks (out of 50)	**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

Design and Drawing of Steel Structural Elements

Course Code : CIV72   **Credits   : 05**

L: P: T: S   :   3:2:0:0   **CIE Marks   : 50+25**

Exam Hours : 3+3 Hours   **SEE Marks   : 50+25**

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	Analyse and design bolted and welded connections
CO3	Analyse the behavior of steel structural elements under tension, compression, bending and combined actions, evaluate and design them.
CO4	Analyse, evaluate and design various types of Column Bases.
CO5	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
CO1	3	3	3	-	-	-	-	3	-	2	2	2
CO2	3	3	3	2	-	-	2	3	-	2	2	2
CO3	3	3	3	2	3	2	2	3	-	2	2	2
CO4	3	3	3	2	3	2	2	3	-	2	2	2
CO5	3	3	3	2	3	2	2	3	2	2	2	-

Module No	Contents of Module	Hrs	Cos
1	**A. 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.	09	CO1
	B. Bolted Connections: Introduction, Behavior of bolted joints, Design of Simple joints with ordinary black bolts and High strength Friction Grip Bolts(HSFG), 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.		
	Drawing & Detailing: **Bolted connections** - beam-beam, Beam-column, seated, stiffened and un-stiffened.		
2	**A. Welded Connections:** Introduction, 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, 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.	09	CO2
	B. Design of 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, Design of axially loaded tension members with bolted and welded connection, Lug angles.		
	Drawing & Detailing: Welded connections - beam-beam, Beam-column, seated, stiffened and un-stiffened.		
3	**A. 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)	09	CO3
	B. Design of Column Bases: Simple slab base and Gusseted base.		
	Drawing & Detailing: Splices, Column-column of same and different sections. Lacing and battens. Slab base and gusseted base		
	Design of beams: Introduction, Beam sections, factors affecting lateral stability, Behavior of simple rolled steel beams in bending, Concepts of laterally unsupported and supported rolled steel beams, Design of laterally supported beams only.	09	CO3

4	**Drawing & Detailing:** Bolted and welded, beam-beam, Beam-column, seated, stiffened and un-stiffened connections.			
5	**Plastic Behavior Structural Steel:** Introduction, plastic theory, Plastic hinge concept, plastic collapse load, conditions of plastic analysis, Theorems of plastic collapse.	09	CO4
	B. Plastic Analysis and Design of Continuous beams by Kinematic Method.		
	Drawing & Detailing: Bolted and welded, beam-beam, Beam-column, seated, stiffened and un-stiffened connections.		

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 (Theory 50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Curricular/ Co-curricular activities
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	2.5			
Understand	2.5	2		2.5
Apply	5	2	2.5	2.5
Analyze	5	2	2.5	5
Evaluate	5	2		
Create	5	2		

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 50 Marks)

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

SEE – Semester End Examination (Theory (Practical 25 Marks)

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

Percentage Evaluation of Various Blooms' levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	7.5	10	17.5	11.67
Understand	12	10	22	14.67
Apply	19.5	17.5	37	24.67
Analyze	22	17.5	39.5	26.33
Evaluate	7	10	17	11.33
Create	7	10	17	11.33
TOTAL	75	75	150	100

ESTIMATION & VALUATION

Course Code : CIV73   **Credits : 03**

L: P: T: S : 3:0:0:0   **CIE Marks : 50**

Exam Hours : 3   **SEE Marks : 50**

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

CO1	Study and understand engineering drawings
CO2	Study methods of calculating quantities of building materials and preparation of detailed and abstract estimates
CO3	Study the Estimation of wooden joineries, RCC Culverts, Septic tanks, Trusses
CO4	Learn to define specifications
CO5	Study the different aspects of contracts like leagality, penal provisions etc

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Contents of Module	Hrs	Cos
1	**A.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. **B. ESTIMATE: 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.	09	CO1, CO2
2	**A. ESTIMATES:** Different type of estimates, approximate methods of estimating buildings, cost of materials. Estimation of wooden joineries, Steel truss (Fink and Howe truss). **B.ESTIMATES** :Manhole and Septic tanks, RCC Culverts	09	CO2, CO3
3	**A.SPECIFICATIONS:** Definition of specifications, objective of writing specifications, essentials in specifications, general and detail specifications of common item of works in buildings. **B.SPECIFICATIONS:** Definition of specifications, objective of writing specifications, essentials in specifications, general and detail specifications of common item of works in buildings	09	CO4
4	**A. RATE ANALYSIS** – Definition and Purpose of rate analysis; rate analysis PCC bed, SSM in Foundation, DPC.	09	
	B. 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.	09	CO4
5	**A. 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.	09	CO5

B. 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.

Valuation- Definitions of various terms, method of valuation, Freehold & Leasehold properties, Sinking fund, depreciation and method of estimating depreciation, Outgoings.

An introduction to estimation using a sample AutoCAD drawing with Microsoft exel.

TEXT BOOKS:

1. **Estimating & Costing**, B. N. Dutta, Chand Publisher
2. **Quantity Surveying**- P.L. Basin S. Chand : New Delhi.
3. **Estimating & Specification** - S.C. Rangwala :: Charotar publishing house, Anand.

REFERENCE BOOKS:

1. **Text book of Estimating & Costing**- G.S. Birde, Dhanpath Rai and sons : New Delhi.
2. **A text book on Estimating, Costing and Accounts**- D.D. Kohli and R.C. Kohli S. Chand: New Delhi.
3. **Contracts and Estimates,** B. S. Patel, University Press, 2006.

CIE- Continuous Internal Evaluation (Theory 50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Curricular/ Co-curricular activities
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	5			
Understand	5	5		5
Apply	10	5	5	5
Analyze	5			
Evaluate	-			
Create	-			

SEE – Semester End Examination (Theory 50 Marks)

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

Percentage Evaluation of Various Blooms' levels

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

MATRIX METHODS OF STRUCTURAL ANALYSIS

Course Code : CIV 741		**Credits** : 03	
L:P:T: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.

Mapping of Course Outcomes to Program Outcomes:

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

Module	Contents of Module	Hrs	COs
1	**A. INTRODUCTION TO MATRIX METHOD** 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. **B. BASIC CONCEPT OF STIFFNESS AND FLEXIBILITY METHOD** 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.	9	CO1, CO2
2	**A. STIFFNESS MATRIX – SYSTEM APPROACH** 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 – 6x6 stiffness matrix). **B.** 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 considering with and without linear and rotational springs.	9	CO2
3	**A.** Analysis of continuous beams and rigid plane frames by stiffness method (having not more than 3 degrees of freedom – 3x3 stiffness matrix) considering effect of temperature. **B.** Analysis of plane trusses by stiffness method (having not more than 3 degrees of freedom – 3x3 stiffness matrix).	9	CO3

4	**A.** 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. **B. FLEXIBILITY METHOD** Strain Energy in terms of flexibility coefficients equivalent joint load concept through Betti's Law. 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. Concept of lack of fit.	9	CO4
5	**A.** 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. **B.** Analysis of continuous beams and trusses (having not more than 3 degrees of freedom – 3x3 stiffness matrix) by direct stiffness approach.	9	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 **SEE – Semester End Examination**

(Theory 50 Marks) **(Theory 50 Marks)**

Bloom's Category	Tests	Assignments	Quizzes	Curricular/Co-curricular activities
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	5	-	-	-
Understand	5	-	-	-
Apply	5	5	5	
Analyze	10	5	-	10
Evaluate	-	-	-	-
Create	-	-	-	-

Bloom's Category	Tests
Remember	5
Understand	5
Apply	15
Analyze	25
Evaluate	-
Create	-

Percentage Evaluation of Various Blooms' levels

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

DESIGN OF MASONRY STRUCTURES

Course Code : CIV742		**Credits**	: 03
L: P: T: 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	Learn different types of masonry units, properties, suitability and types of mortars as per IS 1905
CO2	Comprehend the possible causes of defects in masonry, factors affecting strength of masonry and permissible stresses in masonry
CO3	Comprehend design parameters like effective height, slenderness ratio, load dispersion , arch action in masonry and design of lintels
CO4	Learn the design of walls subject to both axial and eccentric load and Design masonry buildings up to three floors as per IS 1905 and SP-20
CO5	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
CO1	3	-	3	3	-	-	-	-	-	-	-	-
CO2	3	-	-	3	3	-	-	-	-	-	-	-
CO3	-	3	3	-	3	-	-	-	--	-	-	-
CO4	3	-	3	3	3	-	-	-	-	-	-	-
CO5	-	3	-	3	3	-	-	-	-	-	-	-

Module No	Contents of Module	Hrs	Cos
1	**A.** Introduction: Types of masonry units – properties – suitability and applications-classification and properties of mortars-description of types of mortar as per IS 1905.	5	CO1
	B. Masonry Construction: Defects and errors in masonry constructions causes of cracks in masonry-methods of controlling and prevention of cracks in masonry	4	CO2
2	**A.** 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	4	CO3
	B. 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.	5	CO3
3	**A.** Design Considerations: Effective height of walls and columns- different cases-effective length- different design cases-effective thickness-slenderness ratio-eccentricity-load dispersion in masonry- aching action-lintels – design of lintels for different design situations.	5	CO3
	B. Design of Structural Masonry - 1: Design of walls subjected	4	CO4

	to axial load& eccentric load		
4.	**A.** Design of Structural Masonry- 2: Design of walls with openings in different positions-free standing wall	4	CO4
	B. design of load bearing masonry buildings up to 3 storeys as per provisions of IS 1905 and SP 20	5	CO4
5	**A.** Reinforced Masonry: Applications –methods of placement of reinforcement in masonry- flexural and compression elements `	4	CO5
	B. design of reinforced masonry lintels and slabs	5	CO5

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& Fspon –199

32

CIE- Continuous Internal Evaluation

(Theory 50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Curricular/ Co-curricular activities
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	10	5		5
Understand	10	5	5	5
Apply	5			
Analyze	-			
Evaluate	-			
Create	-			

SEE – Semester End Examination

(Theory 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	20	20	40	40
Understand	25	20	45	45
Apply	5	10	15	15
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	**50**	**50**	**100**	**100**

SOLID WASTE MANAGEMENT

Course Code	: CIV743	**Credits**	: 03
L: P: T: 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 classification and functional elements of solid waste management
CO2	Understand mode of collection, transportation and treatment of solid waste
CO3	Understand composting , sanitary land filling and incineration methods of solid waste management
CO4	Study the various methods of disposal
CO5	Understand recycling & reuse of solid waste

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	POI0	POII	PO12
CO1	-	-	-	-	-	3	3	-	-	-	-	2
CO2	-	-	-	-	-	3	3	-	-	-	-	2
CO3	-	-	-	-	-	3	3	-	-	-	-	2
CO4	-	-	-	-	-	3	3	-	-	-	-	2
CO5	-	-	-	-	-	3	3	-	-	-	-	2

Module No	Content of Module	Hrs	Cos
1	**INTRODUCTION:** Definition, scope and importance of solid waste management, functional elements of solid waste management. **SOURCES**: Classification and characteristics – municipal, commercial & industrial. Methods of quantification.	09	CO1

2	**COLLECTION AND TRANSPORTATION:** Systems of collection, transfer stations, route optimization techniques and problems. **TREATMENT / PROCESSING TECHNIQUES**: Components separation, volume reduction, size reduction and chemical reduction	09	CO2, CO3
3	**INCINERATION:** Process – 3 T's, factors affecting incineration process, incinerators – types, prevention of air pollution, pyrolysis **COMPOSTING**: Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore processes,Vermi composting.	09	CO3,CO4
4	**SANITARY LAND FILLING**: Different types, trench area, Ramp and pit method, site selection, basic steps involved in sanitary landfill **SANITARY LANDFILL SITE POLLUTION**: Prevention of site pollution, leachate & gas collection and control methods, Brief idea about function of geosynthetic fabrics in sanitary landfills.	09	CO3, CO5
5	**DISPOSAL METHODS**: Open dumping, ocean disposal, feeding to hogs, incineration, pyrolysis, composting, sanitary land filling along with merits and demerits, concept of integrated solid waste management. **RECYCLE AND REUSE**: Material and energy recovery operations, reuse in other industries, plastic wastes, metal and construction wates, environmental significance and reuse.	09	CO5

> ➢ Field visit to bio methanation plant /Solid Waste Management Site is recommended.

Text Books:

1. Integrated Solid Waste Management:Engineering Principles and Management IssuesbyGeorge 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: 978-1439062159).

3. Handbook of Solid Waste Management 2nd Edition by <u>Frank Kreith</u> (Author), <u>George Tchobanoglous</u> (Author), 2nd Edition,McGrawHill (ISBN-13: 978-0071356237)

CIE-Continuous Internal Evaluation   **SEE–Semester End Examination**

(Theory 50 Marks)   **(Theory 50 Marks)**

Bloom's Category	Tests	Assignments	Quiz	Curricular/ Co-curricular activities
Marks (outof 50)	**25**	**10**	**5**	**10**
Remember	10	3	3	5
Understand	10	5	2	5
Apply	5	2	-	-
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

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	21	10	31	31
Understand	22	30	52	52
Apply	07	10	17	17
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL			100	100

DESIGN & DRAWING OF IRRIGATION STRUCTURES

Course Code : CIV744   Credits   : 3
L: P: T: 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 concept of Reservoir planning
CO2	Understand the properties and role of various constituent materials used in earthdams.
CO3	Analyze & Design of Surplus weir and Tank Plug sluice
CO4	Analyze & Design of Canal Drop.
CO5	Analyze & Design of Canal regulator.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	1	-	1	1	-	-	-	-	1
CO2	3	3	-	1	-	1	-	-	-	-	-	1
CO3	3	3	3	1	-	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-
CO5	3	3	3	1	-	-	-	-	-	-	-	-
Module No.	**Module content**										**Hrs**	**CO's**

1	**PART-A** **Hydraulic Structures:** **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. **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.	12	C01 C02
2	**PART-B** **Irrigation Design- Drawing** **Design and Drawing with all the three views of :** Surplus weir with stepped apron	08	C03
3	**Design and Drawing with all the three views of :** Tank Plug sluice without tower head	08	C03
4	**Design and Drawing with all the three views of :** Notch type Canal drop	08	C04
5	**Design and Drawing with all the three views of :** Canal Cross regulator	08	C05

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   **SEE-Semester End Examinations**

 (Theory 50 Marks)   **(Theory 50 Marks)**

Blooms Category	Test	Assignment	Quiz	Curricular/Co-curricular activities
Marks (Out of 50)	**25**	**10**	**5**	**10**
Remember	5	2	1	2
Understand	5	3	2	3
Apply	5	3	2	5
Analyse	10	2		
Evaluate	-	-	-	
Create	-			

Blooms Category	marks
Remember	5
Understand	5
Apply	20
Analyse	20
Evaluate	-
Create	-

Evaluation of Various Bloom's levels (100 Marks)

Bloom's Category	CIE	SEE	Total	%
Remember	10	5	15	15
Understand	13	5	18	18
Apply	15	20	35	35
Analyze	12	20	32	32
Evaluate	-	-	-	-
Create	-	-	-	-
Total	**50**	**50**	**100**	**100**

HIGHWAY GEOMETRIC DESIGN

Course Code   : CIV745   **Credits   : 03**

L:P:T: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	To analyse the design consideration for various type of sight distance and to understand geometrical aspects of design vehicle and concept of Passenger car unit .
CO2	Understand the design standards of cross sectional elements for road and other related field problems. Design of road humps as per IRC guidelines
CO3	To learn the concept of design of horizontal curves and other components for stability of vehicles negotiating horizontal curves.
CO4	Understanding the significance and design of vertical alignment, hill roads and highway drainage
CO5	Understanding the basic principles of intersection design and rotary intersection in the design of roads.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	POI0hhu	POII	PO12
CO1	3	2	2	2	-	3	-	2	-	-	2	3
CO2	3	2	2	2	-	3	-	2	-	-	2	3
CO3	3	2	2	2	-	3	-	2	-	-	2	3
CO4	3	2	2	2	-	3	-	2	-	-	2	3
CO5	3	2	2	2	-	3	-	2	-	-	2	3

Module No	Content of Module	Hrs	Cos
1	A. **Introduction:** Geometric Control factors like Topography -design speed – design vehicle – Traffic – Capacity – volume – environment and other factors as per IRC and AASHTO standards and specifications- PCU concept factors controlling PCU for different design purpose B. **Sight Distance**: Important, types, Sight distance at uncontrolled intersection, derivation, factors affecting side distance, IRC, AASHTO standards, problems on above. Overtaking sight distance- overtaking zones- numerical problems.	09	CO1
2	A. **Cross Sectional Elements:** Pavement surface characteristics – friction – skid resistance – pavement unevenness - light reflecting characteristics – camber – objectives – types of camber – methods of providing cambers in the field – problems B. **Road Margins** carriage way – kerb – median – shoulder – foot path – parking lanes – service roads – cycle tracks – Driveways – Right of way – Factors influencing right of way – Design of Road humps as per latest I RC provisions.	09	CO2 & CO3
3	A. **Horizontal Alignment:** Definition, Checking the stability of vehicle, while moving on horizontal curve, Super elevation, Ruling minimum and maximum radius, Assumptions – problems – method of providing super elevation for different curves – Extra widening of pavement on curves – objectives – Mechanical widening – psychological widening – B. **Transition curve** – objectives – Ideal requirements – Types of transition curve – Method of evaluating length of transition curve – Setting the transition curve in the field, set back distance on horizontal curve and	09	CO3

		problems on above		
4	A.	**Vertical Alignment:** Gradient – Types of gradient – Design criteria of summit and valley curve – Design of vertical curves based on SSD – OSD – Night visibility considerations – Design standards for hilly roads – problems on the above.	**09**	**CO4**
	B.	**Hill Roads And Highway Drainage:** Geometrics of hill roads, Horizontal Curves, Vertical alignment Significance and requirements, Surface drainage system and design-Examples, sub surface drainage system, design of filter material		
5	A.	**Intersection Design:** Principle – Atgrade and Grade separated junctions – Types – channelization – Features of channelising Island – median opening – Gap in median at junction.	**09**	**CO5**
	B.	**Rotary Intersection:** Elements – Advantages – Disadvantages – Design guide lines – problem on the above – Grade separated intersection – Three legged inter section – Diamond inter change – Half clover leaf – clover leaf-Advantages- Disadvantages only		

TEXT BOOKS:

1. Highway Engineering, ISBN:13-978-8185240800, S.K.Khanna, C.E.G.Justo, A.Veeraragavan, 10th ,2015, Nem Chand Bros, Roorkee

2. Principles and Practices of Highway Engineering, ISBN:13-978-8174091659, L R Kadiyali, 4th ,2005, Khanna Publishers, New Delhi.

3. Highway Engineering, ISBN:13-9788179716812, R. Sreenivasa Kumar, 1st , 2013, University Press. Pvt.Ltd. Hyderabad

REFERENCE BOOKS:

1. **Relevant IRC Codes,** IRC, New Delhi.
2. **Specifications for Roads and Bridges,** MoRT&H, IRC, New Delhi.
3. **Transportation Engineering and Planning,** Papa Coastas And Prevendors, ISBN-13: 978-0133448702 3rd , 2009, PHI Learning Pvt. Ltd. New Delhi.

CIE- Continuous Internal Evaluation

(50Marks)

SEE – Semester End Examination

(50Marks)

Bloom's Category	Tests	Assignments	Quizzes	Curricular/Co-curricular activities
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	2.5	-	-	5
Understand	10		05	5
Apply	10	05		
Analyze	2.5	05	-	
Evaluate	-	-	-	
Create	-	-	-	

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

Percentage Evaluation of Various Bloom's levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	7.5	10	17.5	17.5
Understand	20	15	35	35
Apply	15	15	30	30
Analyze	7.5	10	17.5	17.5
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	**50**	**50**	**100**	**100**

INDUSTRIAL WASTE WATER TREATMENT

Course Code : CIV751	**Credits** : 04
L:P:T:S : 3:0:0:1	**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 effect of industrial wastewater on stream and municipal treatment plant
CO2	Understand the importance of recycling of wastewater.
CO3	Understand the various methods of treating industrial wastewater
CO4	Develop an insight in feasibility of combined treatment
CO5	Study the treatment process of selected industries

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	POI0	POII	PO12
CO1	-	-	-	-	-	2	2	-	-	-	-	2
CO2	-	1	-	-	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	1	-	-	-	-	-	2
CO4	-	-	-	-	-	1	1	-	-	-	-	-
CO5	2	-	-	-	-	1	-	-	-	-	-	2

Module No	Content of Module	Hrs	COs
1	**INTRODUCTION:** Difference between Domestic and Industrial Wastewater, Need for treatment of industrial waste water, Effect of wastewater on Streams, **WATER (PREVENTION AND CONTROL) ACT**, Legislation to Control Water Pollution in India, Importance of treatment and recycle of industrial effluent .	09	CO1,CO2
2	**TREATMENT METHODS**-: Volume Reduction, Strength Reduction, Neutralization, Equalization and Proportioning**.** **TREATMENT METHODS**: Removal of suspended solids and colloids-Grit chamber, Sedimentation tank and Chemical coagulation.	09	CO3
3	**TREATMENT METHODS**: Removal of Organic Solids, Treatment of sludge solids, Disposal of Sludge Solids **COMBINED TREATMENT:** Effect of wastewater on Municipal Sewage treatment Plant ,Feasibility of combined Treatment of Industrial waste with Domestic Waste, Concept of CETP	09	CO3,CO4
4	**TREATMENT OF SELECTED INDUSTRIAL WASTE**: Manufacturing Process along with flow chart , Characteristics of waste water, Treatment & disposal of wastewater-Cotton Textile Industry,Tanning Industry & Paper and Pulp Industry **TREATMENT OF SELECTED INDUSTRIAL WASTE**: Manufacturing Process along with flow chart , Characteristics of waste water, Treatment & disposal of wastewater- Cane Sugar Industry, Fertilizer industry, Dairy Industry	09	CO5
5	**TREATMENT OF FERMENTATION INDUSTRY WASTE:** Manufacturing Process along with flow chart , Characteristics of waste water, Treatment & disposal of wastewater, Recovery of By-Products-Distilleries, Breweries & Wineries **TREATMENT OF SELECTED INDUSTRIAL WASTE**: Manufacturing Process along with flow chart , Characteristics of waste water, Treatment & disposal of wastewater, Recovery of By-Products-Pharmaceutical Industry & Food Processing Industry	09	CO5

> ➢ Field visit to CETP recommended

Text Books:

1. 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)
2. Industrial Waste Water Treatment by Rao MN, and DuttaA.K,. 3rd Edition 2008 ,English-OXFORD & IBH PUBLISHING CO. PVT LTD ,(ISBN: 9788120417120, 8120417127)
3. Waste Water Treatment, Disposal and Reuse by Metcalf and Eddy inc ,4th Edition,2002, TataMcGraw Hill Publications,(ISBN: 9780070495395)

Reference Books:

1. Pollution Control Processes in industries by MahaianS.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. Relevant IS Code

CIE-Continuous Internal Evaluation   **SEE–Semester End Examination**

(Theory 50 Marks)   **(Theory50 Marks)**

Bloom'sCategory	Tests	Assignments	Quizzes	Self study
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	10	3	3	-
Understand	10	5	-	5
Apply	5	2	2	5
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

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	16	10	26	26
Understand	20	30	50	50
Apply	14	10	24	24
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL			100	100

Numerical Method of Civil Engineering

Course Code : CIV752   **Credits**   : 4

L: P: T: S   : 3:0:0:1   **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	Solve civil engineering problems involving linear simultaneous equations by different numerical techniques
CO2	Solve civil engineering problems involving non-linear algebraic equations by different techniques
CO3	Apply Numerical Integration for computing areas, volumes and determine the slope and deflections in simple beams by Newmark's method
CO4	Solve ordinary differential equations related to engineering problems using numerical techniques
CO5	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
CO1	3	-	-	-	-	-	-	-	2	-	-	3
CO2	3	3	-	-	-	-	-	-	2	-	3	-
CO3	3	-	3	-	-	2	3	-	2	-	-	-
CO4	3	3		-	-	2	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	2	-	-	-

Module No	Contents of Module	Hrs	Cos
1	**Introduction:** Introduction to Numerical techniques, Errors, Matrices and Determinants. Solution of Linear Simultaneous Equation: a) Gaussian elimination method b) Gauss-Jordan matrix inversion method c) Gauss-Siedel method d) Cholesky method **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.	09	CO1
2	**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	09	CO2
3	**Application of Numerical Integration for Solving Civil Engg. Problems:** a) Trapezoidal rule b) Simpson's one third rule c) Newmark's method.	09	CO3
4	**Solution of Ordinary Differential Equation to Civil Engineering Problems by:** Euler's method **Solution of Ordinary Differential Equation to Civil Engineering Problems by** : Runge Kutta 4th order method	09	CO4
5	**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 a) statically determinate beams, b) statically indeterminate beams **Application of Finite difference technique in structural mechanics** a) Buckling of columns b) Beams on elastic foundation	09	CO5

TEXT BOOKS:

1.Chapra S.C & R.P.Canale "Numerical Methods for Engineers", edition 2nd McGraw Hill, 1992.
2.N.Krishna Raju, K.U.Muthu "Numerical methods in Engineering Problem", MacMillan Indian Limited, 1990. 2000

REFERENCE BOOKS:

1. Iqbal H.Khan, Q. Hassan "Numerical methods for Engineers and Scientists- Galgotia", New Delhi, 1997.
2. Pallab Ghosh Numerical methods in Computer Programs in C++", Prentice Hall of India Private Limited, New Delhi, 2006.

CIE- Continuous Internal Evaluation (Theory 50 Marks)

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

SEE – Semester End Examination (Theory 50 Marks)

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

Percentage Evaluation of Various Blooms' levels

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

EARTH AND EARTH RETAINING STRUCTURES

Course Code   : CIV753   **Credits   : 04**
L: P: T: S   : 3:0:0:1   **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	To understand the earth pressure theories and study their drainage and stability
CO2	To learn the concept of sheet pile walls and their applications as retaining structures
CO3	To study about dams, their design criteria and their suitability to various conditions
CO4	To learn about Braced cuts, Rock fill dams and their design considerations
CO5	To acquaint with retaining walls and the study of reinforced earth retaining walls, with various reinforcing materials.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Contents of Module	Hrs	CO's
1	**A. 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. **B. DRAINAGE AND STABILITY CONSIDERATIONS:** Lateral pressure due to compaction, strain softening, wall flexibility, influence of drainage. Stability of retaining structure.	9	**CO1**
2	**A. 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. **B. 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.	9	**CO2**

3	**A. 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. **B. COFFER DAMS:** Introduction – types of coffer dams - Design of cellular coffer dams, safety against sliding, slipping, overturning, vertical shear and stability against bursting.	9	**CO3**
4	**A. BRACED CUTS:** Introduction, Lateral earth pressure on sheeting, Different types of sheeting and bracing systems – design of various components of bracings. **B. ROCK FILL DAMS:** Introduction, Origin and usage of rock fill dams, types of rock fill dams, construction of rock fill dams.	9	**CO4**
5	**A. RETAINING WALLS:** Types of retaining walls, failure of retaining walls by sliding, overturning and bearing. 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. **B. REINFORCED EARTH RETAINING WALL:** Reinforced earth retaining wall – principles, Concepts and mechanism of reinforced Earth-Materials used in reinforcing the earth - Geotextile – Geogrids.	9	**CO5**

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.

REFERENCE BOOKS:

1. Soil Mechanics and Foundation Engineering,: Dr. B.C. Punmia : Pub : Laxmi Publications Ltd.,
2. Foundation Engineering.: Dr. B.J. Kasmalkar
3. Numericals in Geotechnical Engineering : A.V. Narasimha Rao & C. Venkataramaiah :Pub : University Press.
4. Hydraulic Structures: S.K. Garg : Pub : Khanna Publishers.
5. Soil Mechanics and Foundation Engineering, : Dr. V.N.S. Murthy : Pub : Sai Tech.
6. Geotechnical Engineering, : Dr. C. Venkataramaiah : Pub : New age publications.
7. Geotechnical Engineering : Purushotam Raj .
8. Theory and Practice of Soil Engineering : Alum Singh .
9. Principles of Geotechnical Engineering, Das, B. M., Cengage Learning, 2009

CIE- Continuous Internal Evaluation

(Theory 50 Marks)

Bloom's Category	Tests	Assignments	Quiz	Self study
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	5			5
Understand	10	5	2	5
Apply	10	5	3	
Analyze				
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 Blooms' levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	10	10	20	20
Understand	22	20	42	42
Apply	18	20	38	38
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

TRANSPORTATION SYSTEMS

Course Code   : CIV754   **Credits   : 04**

L: P: T: S   : 3:0:0:1   **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	Identify different components of railway track and selection of materials for construction.
CO2	Compute various geometric elements of railways for a given set of requirements.
CO3	Identify the characteristics of aircrafts in planning and designing of components
CO4	Understand components and concepts of harbor and dock.
CO5	Understand the process of tunneling.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs	Cos
1	**RAIL TRANSPORTATION** **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 broadgage (BG) 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. **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.	09	CO1
2	**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. **B.POINTS AND CROSSING:** Components of a turnout, Details of Points and Crossing, Design of turnouts with examples types of switches, crossings,	09	CO2

	track junctions.		
3	**A.STATION AND SIGNALS:** Types of yards, Signaling-Objects and types of signals, station and yard Equipment-Turn table, Fouling mark, buffer stop, level crossing, track defects, and maintenance. **B.AIRPORT ENGINEERING:** **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.	**09**	CO3
4	**A.RUNWAY AND TAXIWAY DESIGN:** Runway orientation using wind rose diagram with examples. Basic runway length-Corrections and examples, Runway geometrics, **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.	**09**	CO3
5	**HARBOURS, DOCK AND TUNNELS:** **A. Harbour** classifications, Layout with components, Natural phenomenon affecting the design of harbours - wind, wave and tide, currents. Dry **Dock** and wet docks, Slipways, Navigational aids, warehouse and transit-shed. **B.Tunnels:-** Advantages and disadvantages, Size and shape of tunnels, Surveying- Transferring centre line, and gradient from surface to inside the tunnel working face, Tunneling in rocks-methods, Tunneling methods in soils-Needle beam, Liner plate, Tunnel lining, Tunnel ventilation, vertical shafts, Pilot tunneling, mucking and methods, drilling and drilling pattern.	**09**	CO4,5

Text Books

1. Railway Engineering, 978-8189928834, Saxena and Arora, 7th, 2011, Dhanpat Rai Publications (p) Ltd.-new Delhi

2. Indian Railway Track, 978-8190061315 M M Agarwal, 19th, 2013, Sachdeva Press, New Delhi.

3. Airport Planning and Design, 9788185240688, Khanna Arora and Jain, 6th, 1999, Nem Chand Bros, Roorkee.

4. Harbour Dock & Tunnel Engineering, 978-8192869261,R Srinivasan, 2015, Charaotar Publishing House

Reference Books

1. Roads Railways Bridges Tunnels Engineering, 978-81-89401-33-7, T.D.Ahuja & G.S. Birdi, 17th, 2015, Standard Publishers Distributors.
2. Airport Engineering: Planning and Design, 978-8123915500, S. C. Saxena, 1st, 2010, CBS *Publishers.*
3. Dock & Harbour Engineering , 978-9380358789, Oza, 2012, Charotar Publishing House Pvt.Ltd.
4. Railway Tunnel and Harbour Engineering9788128018527, H S Vishwanath, 2016, Sapna Book House

CIE Continuous Internal Evaluation Theory (50Marks)

SEE-Semester End Examinations (Theory 50 Marks)

Blooms Category	Tests	Assignments	Quizz	Self study
Marks (out of 50)	25	10	5	10
Remember	05	-	-	5
Understand	10	05	05	05
Analyze	05	-	-	-
Apply	05	05	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

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

Percentage Evaluation of Various Bloom's levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	10	10	20	20
Understand	25	20	45	45
Apply	10	15	25	25
Analyze	5	5	10	10
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	50	50	100	100

ADVANCED PRE – STRESSED CONCRETE STRUCTURES

Course Code: CIV755   **Credits: 4**

L: P: T: S   : 3:0:0:1   **CIE Marks: 50**

Exam Hours: 03   **SEE Marks: 50**

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

CO1	Learn basic concepts of pre-stressed concrete structures
CO2	Understand the concepts of precast elements and deck slab
CO3	Analyze the anchorage zones in post tensioned members.
CO4	Analyze and design of beams subjected to shear and torsion
CO5	Analyze and design of tension member, compression member plate elements.

Mapping of Course Outcomes to Program Outcomes

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

Module No	Contents of Module	Hrs	Cos
1	A. **Introduction:** Materials for pre-stressed concrete, high strength concrete and high strength steel. Stress-Strain characteristics and properties, advantages of pre-stressed concrete B. **Anchorage Zone Stresses in Post-Tensioned Members:** Introduction, stress distribution in end block, investigations on Anchorage zone stresses, Magnel and Guyon's Methods, Comparative Analysis, Anchorage zone reinforcement	6	CO1
2	A. **Shear And Torsional Resistance:** Shear and principal stresses, ultimate shear resistance, design of shear reinforcement, Torsion, Design of reinforcement for torsion B. **Composite Beams:** Introduction, types of composite beams, analysis for stresses, differential shrinkage, serviceability limit state. Design for flexural and shear strength	10	CO1
3	A. **Tension Members:** Introduction, Ties, Pressure pipes – fabrication process, analysis, design and specifications. Cylindrical containers - construction techniques, analysis, design and specifications B. **Statically Indeterminate Structure :** Introduction, Advantages of continuous members, effect of pre-stressing in indeterminate structures, methods of analysis for secondary moments, concordant cable profile, Guyon's theorem, Ultimate load analysis, Design of continuous beams and portal frames	10	CO2

4	**A.** **Compression Members :** Introduction, Columns, short columns, long columns, biaxially loaded columns, Design specifications	9	CO3
	B. **Slab and Grid Floors:** Types of floor slabs, Design of one way ,two way and flat slabs. Distribution of pre-stressing tendons, Analysis and design of grid floors.		
5	**A.** **Precast Elements:** Introduction, Pre-stressed concrete poles manufacturing techniques, shapes and cross sectional properties, design loads, design principles. Railway sleepers-classification and Manufacturing techniques, design loads, analysis and design principles. Pre-stressed concrete pavements, slab and wall panels	9	CO4
	B. **Pre – Stresses Concrete Bridges :** General aspects – Pre -tensioned Prestressed bridge decks, Post tensioned pre – stressed bridge decks – Principle of design only.		

TEXT BOOKS

1. Design of Prestressed concrete structures - Lin T.Y. and H. Burns - John Wiley & Sons, 1982.

2. Prestressed Concrete- N. Krishna Raju - Tata Megrahill, 3rd edition, 1995.

3. Prestressed Concrete Structures- P. Dayaratnam - Oxford & IBH, 5 th Edition, 1991

4. Prestressed Concrete- G.S. Pandit and S.P. Gupta - CBS Publishers, 1993.

5. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, New Delhi 1998

6. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Co. Pvt.Ltd. 1997.

7. Rajagopalan, N, "Prestressed Concrete", Alpha Science, 2002

REFERENCE BOOKS

1. IS: 1343: 1980.

2. Krishnaraju, N., "Design of Bridges" Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 1988

3. Hambly E. C., "Bridge Deck Behaviour",CRC Press, 2nd edition

4. Surana C. S., "Grillage Analogy in Bridge Deck Analysis ", Alpha Science International Ltd

5. Krishna Raju N. Pre stressed Concrete, Tata McGraw Hill Co. 2. Rajagopal N., Prestressed Concrete, Narosa Publishing House.

CIE- Continuous Internal Evaluation

(50 Marks)

SEE – Semester End Examination

(Theory 50 Marks)

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

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

Percentage Evaluation of Various Blooms' levels

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

HIGHWAY MATERIAL TESTING LAB

Course Code : CIV76

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

Exam Hours : 3

Credits : 02

CIE Marks : 25

SEE Marks : 25

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

CO1	Determine the CBR value of subgrade 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
CO5	Selecting the suitable materials for road constructions by its properties

Mapping of Course Outcomes to Program Outcomes:

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

Expt No	Contents of Module	Hrs	Cos
1	To conduct the sieve analysis and bulk density test of given coarse aggregates	3	CO2,CO5
2	To determine the Impact value, Specific gravity and water absorption of given aggregates	3	CO2,CO5
3	To determine the Shape test Flaky , Elongation and Angularity number of given aggregates	3	CO2,CO5
4	To determine the Crushing value and Abrasion Value of given aggregates	3	CO2,CO5
5	To determine the Specific Gravity and Penetration value of given bitumen	3	CO3,CO5
6	To determine the Ductility and Softening point of given bitumen	3	CO3,CO5
7	To determine the Flash & fire point and Viscosity of given bitumen,	3	CO3,CO5
8	To determine the California Bearing Ratio (CBR) test on given soil	3	CO1,CO5
9	To determine the proportioning of aggregate mixes by Rothfutch Method,	3	CO4,CO5
10	To conduct the Marshall Stability test of given bituminous Mix	3	CO4,CO5

TEXT BOOKS:

1. **"Highway Material Testing Laboratory Manual"** by Khanna S K and Justo, – CEG Nemi Chand & Bros.

2. **Relevant IS Codes and IRC Codes**

CIE- Continuous Internal Evaluation   **SEE: Semester End Examination**

(25 Marks)   **(25 Marks)**

Bloom's Category	Tests	Assignments
Marks (out of 25)	**20**	**05**
Remember	05	
Understand	05	
Apply	10	05
Analyze		
Evaluate		
Create		

Bloom's Category	Test (Practical)
Remember	05
Understand	05
Apply	15
Analyze	
Evaluate	
Create	

Percentage Evaluation of Various Bloom's levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	5	5	10	20
Understand	5	5	10	20
Apply	15	15	30	60
Analyze				
Evaluate				
Create				
TOTAL	**25**	**25**	**50**	**100**

PAVEMENT DESIGN

Course Code   : CIV81   **Credits   : 03**

L:P:T: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 types, characteristics of pavements and their components. Understand the fundamentals of pavement design and basic properties of pavement materials
CO2	Understand and apply the layer theory concepts and axle load distribution in different cases
CO3	Understand and analyse the different design methods of flexible design methods 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 failures in pavements and functional and structural evaluation of pavements

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	POI0	POII	PO12
CO1	3	2	2	2	-	3	-	2	-	-	2	3
CO2	3	2	2	2	-	3	-	2	-	-	2	3
CO3	3	2	2	2	-	3	-	2	-	-	2	3
CO4	3	2	2	2	-	3	-	2	-	-	2	3
CO5	3	2	2	2	-	3	-	2	-	-	2	3

Module No	Content of Module	Hrs	Cos
1	A. **Pavements and pavement layers** - types, functions, choice. Factors affecting design and performance of flexible and rigid pavements – Pavement design factors, B. **Subgrade support** - CBR and plate bearing tests, Resilient Modulus, fatigue tests ,Problems on above	09	CO1
2	A. **Stresses and Deflection / strain in flexible pavements**: Application of elastic theory, stresses deflections / strains in single, two and three layer system. B. **Axle load distribution**- ESWL for single and two layer system in flexible pavement. EWL,VDF due to varying loads and CSA	09	CO2 & CO3
3	A. **Flexible pavement design:** Empirical, semi empirical and theoretical design approaches and principles. Design steps by CBR method as per IRC-37-2012, B. Application of design methods such as AASHTO and Asphalt Institute methods .	09	CO3
4	A. **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. B. **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.	09	CO4
5	A. **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 deflectometer, GPR Method B. **RIGID PAVEMENT FAILURES, MAINTENANCE AND EVALUATION**: Types of failures, causes, remedial/maintenance measures in rigid pavements – Functional Evaluation by visual inspection and unevenness measurements.	09	CO5

TEXT BOOKS:

1. Yoder and Witczak "Principles of Pavement Design"- John Wiley and sons Inc(second edition) 1975.

2. Principles and Practices of Highway Engineering, ISBN:13-978-8174091659, L R Kadiyali, 4th ,2005, Khanna Publishers, New Delhi.

3. Khanna S.K. and Justo, C.E.G."Highway Engineering", Nem Chand and Bros. Roorkee, 10th Edition, 2014.

REFERENCE BOOKS:

1. Yang H. Huang "Pavement Analysis & Design"- Elsevier Publications, 2nd Edition.

2. David Croney Paul Croney, "Design & Performance of Road Pavements", McGraw Hill Book Co., 1997

3. W.Ronald Hudson, Ralph Haas and Zeniswki "Modern Pavement Management", McGraw Hill and Co., 1st Edition, 1994.

4. Relevent IRC Codes

CIE- Continuous Internal Evaluation (50 Marks)

Bloom'sCategory	Tests	Assignments	Quizzes	Curricular/Co-curricular activities
Marks(out of 50)	**25**	**10**	**5**	**10**
Remember	05	-	-	
Understand	5		5	5
Apply	5	05		5
Analyze	5	05	-	
Evaluate	5			
Create				

SEE – Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	05
Understand	5
Apply	10
Analyze	15
Evaluate	15
Create	-

Percentage Evaluation of Various Bloom's levels

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

RURAL WATER SUPPLY & SANITATION

Course Code : CIV821

Credits : 4

L: P: T: S : 3:0:0:1

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 and analyze the problems in rural water supply and sanitation methods in rural areas
CO2	Understand the drainage systems and water harvesting practices adopted
CO3	Understand the water harvesting practices to be adopted
CO4	Analyse different methods for the prevention of communicable diseases and collection of refuse
CO5	Understand the methods for insect control and hygienic milk processing.

Mapping of Course Outcomes to Program Outcomes:

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

Module No		Content of Module	Hrs	Cos
1	A	**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
	B	**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	A	**ECO SANITATION :** public latrine, concept of Eco-sanitation, trenching and composting methods.	09	CO2
	B	**SANITATION PRACTICES:** Two pit latrines, aqua privy, W.C, septic tank, soak pit- Simple design problems.		
3	A	**DRAINAGE SYSTEMS:** Storm water and sullage disposal, rain water harvesting and uses.	09	CO3
	B	**DISPOSAL OF SOLIDS WASTE**: composting, land filling. Biogas plants with design criteria.		
4	A	**COMMUNICABLE-DISEASES:** Terminology, classifications, methods of communication, general methods of control of vector borne diseases.	09	CO4
	B	**REFUSE COLLECTION AND DISPOSAL**: collection methods, transportation, disposal – salvaging, dumping, manure pits, dumping in low lands, composting, dung disposal – digester.		
5	A	**MILK SANITATION:** Essentials, test for milk quality, pasteurization.	09	
	B	Domestic animals: Cow, goat, hen and sheep related diseases , planning of sheds.		CO5

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

Reference Books

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	Self Study
Marks (out of 50 for Theory)	**25**	**10**	**5**	**10**
Remember	5			5
Understand	10	5	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	Theory			
	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

ADVANCED RC STRUCTURES

Course Code	**:**	**CIV822**	**Credits**	**: 04**
L: P: T: S	**:**	**3:0:0:1**	**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 and apply the concepts of yield line theory for the analysis of slabs
CO2	Design the flat slab with the thorough understanding and application of theoretical concepts
CO3	Design the RCC Chimneys with the thorough understanding and application of theoretical concepts
CO4	To apply the theoretical concepts to evaluate and design overhead water tanks
CO5	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
CO1	3	3	-	-	-	1	-	-	-	2	-	2
CO2	3	3	2	-	-	1	-	-	-	2	-	2
CO3	3	3	2	-	-	1	-	-	-	2	-	2
CO4	3	3	2	-	-	1	-	-	-	2	-	2
CO4	3	3	2	-	-	1	-	-	-	2	-	2

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
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	CO2
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	CO3
4	**DESIGN OF WATER TANKS** Design of RCC overhead circular and rectangular water tanks in compliance with IS 3370.	9	CO4
5	**SILOS & BUNKERS** Introduction, design concepts,Janssen's theory and Airy's theory Design of silos and bunkers	9	CO5

TEXT BOOKS:

1. Advance RCC Design, S.S Bhavikatti, ISBN-10: 81-224-2276-4, 2nd 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)

3. Theory and Design of R. C. C. Structures, G Singh, ISBN-10: 8180141519, Standard Publishers-Distributors (2011)

CIE- Continuous Internal Evaluation Theory (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 (Theory 50 Marks)

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

Percentage Evaluation of Various Blooms' 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: CIV823
L: P: T: S   : 3:0:0:1
Exam Hours: 03

Credits   : 4
CIE Marks: 50
SEE Marks: 50

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

CO1	Understand the concepts 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	Able to learn the surface and subsurface investigation techniques of ground water.
CO4	Understand the concepts of ground water development & management.
CO5	Analyze ground water modeling and sea water intrusion.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Contents of Module	Hrs	Cos
1	**A. 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 pearched aquifers. **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.	09	CO1
2	**A. WELL HYDRAULICS – STEADY FLOW:** Steady unidirectional flow, steady radial flow to a well. Dupit's and Theism's equations, Pumping tests. **WELL HYDRAULICS – UNSTEADY FLOW:** Unsteady radial flow in confined and unconfined aquifers, Theis method, Cooper and JaCob method, Chow's method.	09	CO2
3	**A. SURFACE INVESTIGATION OF GROUND WATER:** Geologic methods, Remote sensing, geophysical explorations: Seismic refraction method, Electrical resistivity method, gravity and magnetic methods, water witching. **B. 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.	09	CO3
4	**A. GROUND WATER DEVELOPMENT:** Types of wells, Methods of constructions, Well completion and development, Pumps for lifting water: Working principles, Power requirements. **B. 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.	09	CO3

5	**A. GROUND WATER MODELLING** Porous media models, analog models, electric analog models, digital computer models. **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.	09	CO4

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.

4. Ground Water Hydrology- Bhagu R. Chahar; McGraw Hill Education, Edition: First-2014, ISBN: 9789339204631.

REFERENCE BOOKS:

1. Ground Water and Tube Wells- Garg Satya Prakash; Oxford and IBH, New Delhi, Edition: Second-1982, ISBN: 8120400569.

2. Ground Water Resource Evaluation- W.C. Walton; McGraw-Hill Inc., US, Edition: First-1970, ISBN: 9780070680517.

3. Water wells and Pumps – Michel D.M., Khepar. S.D., Sondhi. S.K.; McGraw Hill Education, Edition: Second-2008, ISBN: 9780070657069.

4. Applied Ground water modeling – Mary P Anderson, William W Woessner and Randall J

Hunt; Academic Press an imprint of Elsevier, Edition: Second-2015, ISBN: 9780080916385.

CIE- Continuous Internal Evaluation

(50Marks)

Bloom's Category	Tests	Assignments	quiz	Self Study
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	5	-	2	2
Understand	10	5	3	3
Apply	5	-		5
Analyze	5	5	-	
Evaluate	-	-	-	
Create	-	-	-	

SEE – Semester End Examination

(50 Marks)

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

Percentage Evaluation of Various Blooms' levels

Bloom's Category	CIE	SEE	TOTAL	%
Remember	9	10	19	19
Understand	21	20	41	41
Apply	10	10	20	20
Analyze	10	10	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
TOTAL	**50**	**50**	**100**	**100**

AIR POLLUTION

Course Code :	CIV824	**Credits**	: 4
L:P:T:S :	3:0:0:1	**CIE Marks**	: 50
Exam Hours :	3	**SEEMarks**	: 50

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

CO1	Identify the air pollutants and their classification and effects
CO2	Identify sampling and analysis techniques for air quality assessment
CO3	Describe the plume behavior for atmospheric stability conditions and assess the concentrations
CO4	Design air pollution controlling devices
CO5	Knowledge on automobile pollution and understand the legislations

Mapping of Course Outcomes to Program Outcomes:

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

Unit No	Contents of Module	Hrs	Co's
1	**DEFINITION** – Classification and Characterization of Air Pollutants,Emission Sources, Behavior and Fate of air Pollutants, Chemical Reactions in the Atmosphere, **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.	**09**	**CO1**
2	**EFFECTS OF AIR POLLUTION:** On Human Health, Animals, Plants and Materials **SAMPLING, AND ANALYSIS:** Sampling and Measurement of Gaseous and Particulate matter, Stack Sampling, Analysis of Air Pollutants, Smoke and Smoke Measurement	**09**	**CO1, CO2**
3	**METEOROLOGICAL VARIABLES**- General Characteristics of Stack Plumes, Primary and Secondary Lapse Rate, maximum mixing depths, plume rise Inversions, Stability Conditions. **PREDICTION OF AIR QUALITY**, Box model - Gaussian model - Dispersion coefficient - Application of tall chimney for Pollutant dispersion. Windrose,	**09**	**CO3**
4	**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) **CONTROL BY ABSORPTION-** , Control of Gaseous Emissions, Adsorption by Liquids, Adsorption by Solids, Combustion Odours and their control.	**09**	**CO4**

5	**AIR POLLUTION DUE TO AUTOMOBILES:** Air Pollution due to Gasoline Driven and Diesel Driven Engines, Effects, Direct and Indirect Methods of control. **ENVIRONMENTAL LEGISLATION:** Environmental Policy, Environmental Acts, Air Pollution Standards, Case study of cement/coal industry.	**09**	**CO5**

TEXTBOOKS:

1. Crawford, M., (1980), **Air Pollution Control Theory** –TMH Edition, TataMcGraw Hill Publishing Co. Ltd., New Delhi.

2. Henry. C. Perkins, (1980), **Air Pollution** –McGraw Hill.

2. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), **EnvironmentalEngineering** – McGraw Hill Book Co.

4. Sincero, A.P and Sincero, G.A., (1999), **Environmental Engineering – ADesign 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..

Recommended Books:-

1. Air Pollution Control Guidebook for Management: Edited by A.T. Rossano, Environ 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 Delhi.

CIE-Continuous Internal Evaluation   **SEE–Semester End Examination**

(Theory 50 Marks)   **(Theory50 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	-			

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

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 Accredition:

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

COURSE OUTCOME

↓

PROGGRAM OUTCOME

↓

PROGRAM EDUCATIONAL OBJECTIVES

↓

DEPARTMENTAL MISSION

↓

DEPARTMENTAL VISION
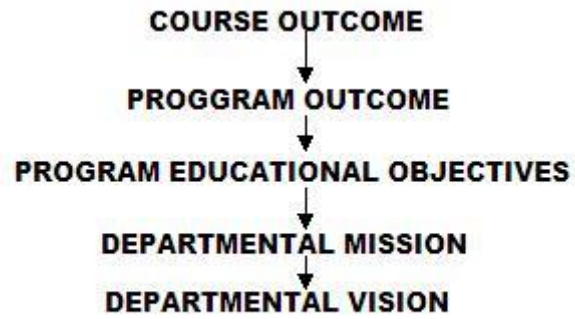
APPENDIX B

The Graduate Attributes of NBA

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

Problem analysis: Identify, formulate, research literature, and analyse 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.

[eduglosarry.org]