CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum with effect from AY 2022-23

B.E (Civil Engineering)

SEMESTER – V:

Sl No	Course code	Title of the Course	Scheme of instruction Hour per week			Scheme of examination			Credits
			L	T	P	Duration of SEE in hours	Max Marks CIE	Max Marks SEE	
1	20CE C16	Transportation Engineering	3	-	-	3	40	60	3
2	20CE C17	Geotechnical Engineering	3	-	-	3	40	60	3
3	20CE C18	Structural Analysis II	3	-	-	3	40	60	3
4	20CE C19	Design of Steel Structures - I	3	-	-	3	40	60	3
.5	-	PE-2	3	-	-	3	40	60	3
6	-	OE-1	3	-	-	3	40	60	3
7	20CE C20	Transportation Engineering Lab	-	-	2	3	50	50	1
8	20CE C21	Geotechnical Engineering Lab	-	-	2	3	50	50	1
9	20CE M01	Environmental Science (MC)	2	-	-	2	-	50	Non Credit
10	20CE I02	Industrial / Rural Internship	3-4 weeks/ 175 hours						2
Total			**20**	**-**	**4**	**-**	**340**	**510**	**22**
Clock Hours per week: 24									

L: Lecture **T: Tutorial** **P: Practical/Drawing/Seminar/Project**

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

Professional Elective-2 (PE-2)

Subject code	Subject Name
20CE E05	Applications of Artificial Intelligence in Civil Engineering
20CE E06	Pre-Stressed Concrete
20CE E07	Hazards and Management
20CE E08	Masonry Structures

Open Electives - 1 (OE-1)

20EE O02	Energy Management Systems
20ME O12	3D Printing
20EC O04	Fundamentals of DSP

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum with effect from AY 2022-23

B.E (Civil Engineering)

SEMESTER – VI

Sl. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week						
			L	T	P	Duration of SEE in hours	Max marks		
							CIE	SEE	
1	20CE C22	Hydrology and Water Resource Engineering	3	-	-	3	40	60	3
2	20CE C23	Estimation, Specification & Costing	3	-	-	3	40	60	3
3	20CE C24	Reinforced Concrete Design - II	3	-	-	3	40	60	3
4	20CE C25	Environmental Engineering	3	-	-	3	40	60	3
5	--	OE - 2	3	-	-	3	40	60	3
6	--	PE - 3	3	-	-	3	40	60	3
7	20CE C26	Environmental Engineering Lab	-	-	2	3	50	50	1
8	20CE C27	Engineering Geology Lab	-	1	2	3	50	50	2
9	20EG C03	Employability Skills	-	-	2	3	50	50	1
		Total	**18**	**1**	**6**	**-**	**390**	**510**	**22**
	Clock Hours per week: 25								

L: Lecture **T: Tutorial** **P: Practical/Drawing/Seminar/Project**

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

Professional Electives (PE-3)

Subject code	Subject Name
20CE E09	Foundation Engineering
20CE E10	River Engineering
20CE E11	Urban Transportation Planning
20CE E12	Basics of Earthquake Engineering

Open Electives - 2 (OE-2)

20BT O02	Biomaterials for Engineering
20ME O06	Nano Materials and Technology
20CS O14	Cloud Technologies

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

AICTE Model Curriculum with effect from AY 2023-24

B.E (Civil Engineering)

SEMESTER-VII:

Sl No	Course code	Title of the Course	Scheme of instruction Hours per week			Scheme of Examination			Credits
			L	T	P	Duration of SEE in hours	Max marks CIE	Max marks SEE	
1	20CE C28	Construction Engineering And Management	3	-	-	3	40	60	3
2	20MBC01	Engineering Economics and Accountancy	3	-	-	3	40	60	3
3	-	PE -4	-	-	-	-	-	-	-
4	-	PE - 5	3	-	-	3	40	60	3
5	-	OE - 3	3	-	-	3	40	60	3
6	20CE C29	Concrete Technology Lab	-	-	2	3	50	50	1
7	20CE C30	Computer Applications Lab	-	-	2	3	50	50	1
8	20EG M03	Gender sensitization (MC)	2	-	-	3	-	50	NC
9	20CE C31	Project Part 1	-	-	4	-	50	-	2
10	20CE I03	Internship	4-6 weeks / 180 hours						3
	Total		17	-	8		350	450	22
	Clock Hours per week: 25								

L: Lecture T: Tutorial P: Practical/Drawing/Seminar/Project

CIE: Continuous Internal Evaluation SEE: Semester End Examination

Professional Electives-4 (PE-4)

20CE E13	Finite Element Methods
20CE E14	Applications of Data Analytics in Civil Engineering
20CE E15	Design of Hydraulic Structures
20CE E16	Concrete Technology & Special Concrete

Professional Electives-5 (PE-5)

20 CE E17	Railway and Airport Engineering
20CE E18	Applications of Block Chain Technology in Civil Engineering
20CE E19	Design of Steel Structures II
20CE E20	Advanced Environmental Engineering

Open Electives – 3 (OE-3)

20CS O07	Basics of Machine Learning
20AD O01	Introduction to Python Programming
20IT O02	Principles of IoT

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

AICTE Model Curriculum with effect from AY 2023-24

B.E (Civil Engineering)

SEMESTER: VIII

Sl No	Course code	Title of the Course	Scheme of instruction Hours per week			Scheme of Examination			Credits
			L	P	T	Duration of SEE in hours	Max marks CIE	Max marks SEE	
1	-	PE-6	3	-	-	3	40	60	3
2	20CE C32	Technical Seminar	-	-	2	-	50	-	1
3	20CE C33	Project Part 2	4-6 weeks of industry Internship (180 hours)/ 12 hours			Viva-voce Exam	100	100	4
4	20CE C34	Practical Skills in Civil Engineering		2		3	50	50	1
		Total	3	14	2		240	210	9
		Clock Hours per week: 19							

L: Lecture **T: Tutorial** **P: Practical/Drawing/Seminar/Project**

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

Professional Electives - 6

20CE E21	Pavement management system
20CE E22	Repair and rehabilitation of Structures
20CE E23	Water shed management
20CE E24	Ground Improvement Techniques

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum with effect from AY 2022-23

B.E (Civil Engineering)

SEMESTER – V

Sl No	Course code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hour per week						
			L	T	P	Duration of SEE in hours	Max Marks		
							CIE	SEE	
1	20CE C16	Transportation Engineering	3	-	-	3	40	60	3
2	20CE C17	Geotechnical Engineering- I	3	-	-	3	40	60	3
3	20CE C18	Structural Analysis II	3	-	-	3	40	60	3
4	20CE C19	Design of Steel Structures - I	3	-	-	3	40	60	3
5	-	PE-2	3	-	-	3	40	60	3
6	-	OE-1	3	-	-	3	40	60	3
7	20CE C20	Transportation Engineering Lab	-	-	2	3	50	50	1
8	20CE C21	Geotechnical Engineering Lab	-	-	2	3	50	50	1
9	20CE M01	Environmental Science (MC)	2	-	-	2	-	50	Non Credit
10	20CE I02	Industrial / Rural Internship	3-4 weeks/ 175 hours						2
Total			**20**	**-**	**4**	**-**	**340**	**510**	**22**
Clock Hours per week: 24									

L: Lecture **T: Tutorial** **P: Practical/Drawing/Seminar/Project**

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

Professional Elective-2 (PE-2)

Subject code	Subject Name
20CE E 05	Applications of Artificial Intelligence in Civil Engineering
20CE E06	Pre-Stressed Concrete
20CE E07	Hazards and Management
20CE E08	Masonry Structures

Open Electives - 1 (OE-1)

20EE O02	Energy Management Systems
20MEO 12	3D Printing
20EC O04	Fundamentals of DSP

20CE C16

TRANSPORTATION ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

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

1) Understand the types of highways, patterns, master plans, alignment finalization and components of highway projects.
2) Apply various IRC Standards for the Geometric design of highways.
3) Organize collection of traffic related data and analyzing the data for different applications
4) Apply the design concepts to flexible and rigid pavements as per IRC standards.
5) Execute construction of pavements as per IRC standards and evaluate of pavement condition to recommend suitable remedial measures.

COs	**POs**												**PSOs**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2
2	1	1	1	1	-	-	-	-	-	-	2	1	-	2	2
3	3	2	3	1	-	-	-	-	-	-	2	1	1	2	2
4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
5	1	1	1	-	-	-	-	-	-	-	-	-	-	1	1
AVERAGE	**2.2**	**1.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**1.6**	**1.8**

UNIT- I:

Highway Alignment: Objectives and phases of highway engineering, history of highway engineering, factors to be considered for highway alignment, engineering surveys, concepts of master plan, road patterns, highway project preparation, and classification as per IRC.

UNIT- II:

Geometric Design: Highway standards (IRC) - carriageway, shoulders, medians, camber, right of way, footpaths, cycle tracks, service roads, frontage roads, sight distance - stopping sight distance, overtaking sight distance, horizontal curves, super-elevation, transition curve, extra widening, gradient, and grade compensation.

UNIT- III:

Traffic Engineering: Objectives of traffic studies, traffic characteristics, volume, speed, density, headways and relationship among them. Traffic volume studies, speed and delay studies, origin and destination studies, intersection delay studies, parking and accident studies, highway capacity and level of service concept as per HCM 2010, intersection improvement studies at grade, and types of grade separated intersections, channelization, rotary planning and design, concept of signal design – Webster's method.

UNIT- IV:

Pavement Design: Various properties of highway materials, pavement types, factors to be considered for pavement design, structural difference between flexible and rigid pavement design. Flexible pavement design (IRC - 37: 2018), design wheel load, ESWL, EALF. IRC cumulative standard axles method.

Rigid pavement design (IRC 58-2015): Concepts -radius of relative stiffness, Modulus of subgrade reaction and other characteristics of concrete, wheel load stresses analysis by Westergaard's temperature stresses and critical combination of stresses. Longitudinal and transverse joints, contraction joints, expansion joints, and construction joints.

UNIT- V:

Pavement Construction and Maintenance: Construction of WBM roads and WMM roads, types of bituminous construction- interface treatment, bituminous surface dressing, seal coat, penetration macadam, built up spray grout, pre-mix methods, bituminous pre-mix carpet, bituminous concrete, bituminous sheet asphalt, mastic asphalt. Construction procedures – surface dressing, penetration macadam, bituminous bound macadam and bituminous concrete. Construction of cement concrete pavements and construction of joints. Pavement distress, failures of flexible and rigid pavements and remedial measures.

Text books:

1) S. K. Khanna, C. E. G. Justo, and A. Veeraraghavan, "*Highway Engineering*", revised 10th Edition, Nem Chand & Bros., 2017.
2) L. R. Kadiyali, "*Traffic Engineering and transport planning"*, Khanna Publishers.2011.
3) S.K. Sharma, "Principles, Practice and Design of Highway Engineering", S. Chand Publishers, 2015.
4) R. Srinivas Kumar, "*Transportation Engineering*", Universities Press, 2020

Suggested Reading:

1) Fred L. Mannering and Scott S. Washburn, "*Principles of Highway Engineering and Traffic Analysis*", 4thEdition, John Wiley, 2007
2) R. Srinivas Kumar," *Pavement Evaluation, Maintenance and Management systems*", Universities Press, 2014.
3) L. A. Garber and N. J. Hoel, K. RamachandraRao, "*Traffic and Highway Engineering*, 5th Edition, 2017. Cengage learning India Pvt. Ltd., New Delhi
4) R. Srinivasa Kumar, "Textbook *of Highway Engineering*", Universities Press, 2011.
5) Dr. L.R. Kadiyali and Dr. N.B. Lal, "Principles and Practices of Highway Engineering", Khanna Publishers, 2018.
6) IRC 37:2018, "Flexible pavement design".
7) IRC 58:2015, "Rigid pavement design".

R20 CE C17

GEOTECHNICAL ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

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

1) Identify various types of soils and determine their properties.
2) Estimate coefficient of permeability, stresses in soils under various soil conditions and compute discharge in soil.
3) Modify the properties of soil by using various compaction methods and compute the settlement of compressible soils.
4) Estimate the shear strength of different soils under various loading conditions.
5) Evaluate earth pressures and slope stability under different field conditions.

COs	**POs**												**PSOs**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
2	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
4	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
5	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
Average	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

UNIT- I:

Physical and Index properties of soils: Introduction about origin and formation of soils, basic definitions from soil three phase diagram (weight ratios & volume ratio), Inter relationships of preliminary properties. Determination of laboratory tests for water content, field density, specific gravity by various methods, Index properties, sieve analysis, consistency limits, Indian soil classification IS-1498-1970.

UNIT- II:

Permeability of soils: Darcy‟s. law of seepage water through soils- Determination of co-efficient of permeability (constant head, variable head permeability tests) – Field tests (Pumping in and pumping out tests) – Equivalent permeability of stratified soils.

Stress in Soils: Total, effective and neutral stress for different soil conditions.

Seepage in Soil: Seepage flow, seepage pressure – Flow nets – Locating phreatic line in a homogeneous earthen dam using Kozeny's parabola – computation of seepage quantity.

Quick Sand Phenomena: Critical Hydraulic gradient.

UNIT- III:

Compaction: Compaction Mechanism, factors affecting compaction. Laboratory determination of compaction characteristics- standard and modified Proctor tests – IS Light and Heavy compaction tests; Field surface compaction: compaction equipment, procedure, quality control.

Consolidation: Spring Analogy, Laboratory consolidation test, calculation of void ratio, compression characters and settlement equation, differential equation for one dimensional consolidation, co-efficient of consolidation – square root & logarithm time fitting method.

UNIT- IV:

Shear strength: Significance of Shear strength of soils – Mohr-Coulomb equation – shear parameters – Laboratory tests for determination of shear strength – Direct shear test, Tri-axial compression tests. (UU, CU and CD), Un-confined compression test, Vane shear test. Factors affecting shear strength of cohesion less and cohesive soils.

UNIT- V:

Earth pressure: States of earth pressure – Active, Passive and at rest condition; Rankine‟s theory; computation of active and passive earth pressure in cohesion less (ø)& Cohesive © soils and c-ø soils; Coulomb‟s Wedge theory; Rebhann‟s graphical solution.

Slope stability: Definition and classification of slopes – types of slope failures- Factors of safety with respect to cohesion, angle of shearing resistance, Height – Analysis of stability of slope using Swedish slip circle method and Taylor‟s stability number.

Text Books:

1) K. R. Arora, “Soil Mechanics and Foundation Engineering”, Standard Publisher Dist.; 7th Edition, 2009
2) B. C. Punmia, A. K Jain, and A. K. Jain “Soil Mechanics and Foundations”, Laxmi Publications; Sixteenth edition, 2017.

Suggested Reading:

1) R. F. Scott, “Principles of Soil Mechanics”, Wesley Educational Publishers Inc., 1st edition, 1963.
2) T. W. Lambe and R. V. Whitman, “Soil Mechanics”, Wiley; 1 7 edition, 2012.
3) GopalRanjan, “Basic and Applied Soil Mechanics”, New Age International Pvt Ltd; Third Edition 2016.
4) C.Venkatramaiah, “Geotechnical Engineering”, New Age Publications, revised Fifth edition, 2017.
5) B. M. Das and K. Sobhan, “Principles of Geotechnical Engineering”, NPTEL study material.
6) IS 2720-11: Methods of test for soils, Part 11: Determination of the shear strength parameters of a specimen tested in unconsolidated undrained triaxial compression without the measurement of pore water pressure..

20CE C18

STRUCTURAL ANALYSIS – II

Instruction:	3L Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	60 Marks
Continuous Internal Evaluation:	40 Marks
Credits:	3

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

1) Develop the ILD's for reactions, shear force and bending moment at a section, determine the maximum SF and BM for various positions of the moving point loads and uniformly distributed loads.
2) Construct the ILD's for forces in the members of trusses and evaluate the maximum forces for various positions of the moving point loads and uniformly distributed loads.
3) Apply slope – deflection method for indeterminate beams with and without sinking of supports subjected to point loads and udl on the entire span and analyse rigid jointed plane frames with and without lateral sway using slope deflection method.
4) Apply moment distribution method for indeterminate beams with and without sinking of supports subjected to point loads and udl on the entire span and analyse rigid jointed plane frames with and without lateral sway using moment distribution method.
5) Apply matrix, flexibility and stiffness method to continuous beams.

Articulation Matrix:

COs	**PO's**												**PSO's**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
2	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
3	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
4	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
5	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
Average	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**2**	**-**

UNIT– I:

Moving loads: Influence line diagrams for support reactions, shear force and bending moment for a simply supported beam/girder traversed by (i) single point load, (ii) two point loads (iii) uniformly distributed load longer than the span, (iv) uniformly distributed load shorter than the span and (v) several point loads. Determination of maximum values of support reactions, shear force and bending moment at any section for various moving load systems on simply supported beam/ girder.

UNIT– II:

Moving loads on truss girders: Influence lines for forces in the members of statically determinate trusses like Warren truss, Pratt truss, and Curved flange trusses. Determination of maximum forces in truss members due to moving point loads and uniformly distributed loads. Counter bracing.

UNIT– III:

Slope-deflection method: Analysis of Indeterminate beams with and without sinking of supports and Analysis of rigid jointed plane frames with and without lateral sway. Shear force and bending moment diagrams.

UNIT- IV:

Moment distribution method: Analysis of Indeterminate beams with and without sinking of supports and Analysis of rigid jointed plane frames with and without lateral sway. Shear force and bending moment diagrams.

UNIT- V:

Matrix methods of structural analysis: Introduction, Static and Kinematic Indeterminacy, Compatibility and Equilibrium equations.

Flexibility method of Analysis: Introduction, Analysis of continuous beams with static indeterminacy not exceeding three.

Stiffness method of Analysis: Introduction, Analysis of continuous beams with kinematic indeterminacy not exceeding three.

Text Books:

1) B.C Punmia, and A. K. Jain, "SMTS - II Theory of Structures", Laxmi Publications, New Delhi, 2017.
2) S. Ramamrutham, "Theory of Structures", Khanna Publishers, New Delhi, 2018.

Suggested Reading:

1) H. J. Shah, S. B. Junnarkar, "Mechanics of Structures Vol. II [Theory and analysis of structures]", 24th Edition, Charotar Publishing House Pvt. Ltd., 2015.
2) T. S. Thandava Moorthy, "Structural Analysis", 2nd edition, Oxford University Press, 2012.
3) C. S. Reddy, "Basic Structural Analysis", 3rd Ed., Tata McGraw Hill, New Delhi, 2017.
4) D. S. Prakash Rao, "Structural Analysis" - A Unified Approach, University Press, 2012

20CE C19

DESIGN OF STEEL STRUCTURES - I

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation 40 Marks	
Credits	3

Codes required: IS 800 – 2007, IS 875 Part II & Part III and Steel Tables.

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

1) Understand the material properties, loads and design philosophies, design bolted and welded connections.
2) Know, how yielding & buckling takes place, design simple and built-up compression members and column bases
3) Understand the modes of failure of tension members ,design tension members using limit state method ,designtension and compression members using working stress method as per IS: 800-2007
4) Classify structural steel sections, distinguish between laterally supported and laterally unsupported beams, designsimple flexural members including secondary considerations
5) Estimate the loads on roof trusses and design purlins and members of trusses

COs	**POs**												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	1	-	-	-	-	-	-	-	1	3	3	-
2	3	3	3	2	-	-	-	-	-	-	-	1	3	3	-
3	3	3	3	2	-	-	-	-	-	-	-	1	3	3	-
4	3	3	3	2	-	-	-	-	-	-	-	1	3	3	-
5	3	3	3	2	-	-	-	-	-	-	-	1	3	3	-
Average	**3**	**3**	**3**	**1.8**	-	-	-	-	-	-	-	**1**	**3**	**3**	**-**

UNIT – I:

Materials and Specifications: Chemical composition of steel, types of Structural Steel, classification of RolledSteel Sections.

Design Philosophies: Working Stress Method, Limit State Method, Loads and Load Combinations, Partial safetyfactors for materials and loads.

Bolted Connections (Limit State Method):

Bolted Joints -Modes of failure - Design of Bolted joints using ordinary Black Bolts - Lap & Butt joints - ConcentricConnections and Eccentric Connections, Introduction to High Strength Friction Grip Bolted connections.

Welded Connections (Limit State Method): Types of Welds, Lap and Butt Joints- strength of welded joints - designof welded joints - Concentric Connections and Eccentric Connections.

UNIT – II

Design of Compression Members (Limit State Method): Introduction, yielding & Buckling phenomena, Sections used for compression Members. Effective Length of Compression Members, Design of Compression Members with single section and Built-up Sections, Lacing and Battening, Column Splices.

Design of Column Bases: Design of Slab and Gusset Bases.

UNIT – III

Design of tension members (Limit State Method): Introduction to tension members - Applications of tension members, Modes of Failure, Design of Tension Members –Staggered bolting ,Design of Lug Angles.

Working Stress Method as per IS 800-2007: Permissible Stresses, Slenderness Ratio, Design of tension members,Design of Simple Compression Members.

UNIT – IV

Design of Beams (Limit State Method) : Introduction to Plastic Analysis –Plastic Hinge, Plastic moment, Shape factor; Classification of Cross Sections, Phenomenon of Lateral Torsional Buckling; Design of Laterally Supported beams and laterally Unsupported Beams, Secondary considerations - Check for Web crippling, web buckling & deflection.

UNIT – V

Design of Roof trusses (Limit State Method): Types of trusses, Estimation of loads- dead load, live load and wind load, Design of purlins, Analysis of roof trusses and design of its members with angle sections.

Text Books:

1) S. K. Duggal, "Limit State Design of Steel Structures", 3rd Edition, McGraw Hill HED, 2019.

2) N. Subramanian, "Design of Steel Structures, Limit States Method", 2nd Edition, Oxford University Press, 2016

Suggested Reading:

1) M.R. Shiyekar, "Design of Steel Structures, (Limit State Method", Second Edition, PHI Learning Pvt Ltd. 2013.

2) S. S. Bhavikatti, "Design of steel Structures", 3rd Edition, I.K.International Publishing House Pvt. Ltd. 2012.

20CE C20

TRANSPORTATION ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Outcomes: The student will be able to

1) Conduct various tests on bitumen, define its quality and decide its suitability for its use in pavements.
2) Conduct various tests on aggregates, define its quality and decide its suitability for its use in roads.
3) Organize various traffic studies and analyze the data by applying statistical tools.
4) Prepare representative samples for various tests on aggregates.
5) Generate technical report based on the studies carried in the laboratory and field studies.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2	2	-	-	-	-	-	-	-	-	1	-	2
2	2	2	2	2	-	-	-	-	-	-	-	-	1	1	-
3	2	1	1	2	-	-	-	-	-	-	-	-	-	1	2
4	2	1	1	-	-	-	-	-	-	-	-	-	1	1	1
5	2	1	1	2	-	-	-	-	-	-	-	-	1	1	1
Average	**2**	**1.4**	**1.4**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1.5**

A) Tests on bitumen

1. Penetration test
2. Ductility test
3. Softening point test
4. Specific gravity test
5. Viscosity test

B) Tests on road aggregates

6. Aggregate crushing value test
7. Los Angeles abrasion test
8. Aggregate impact value test
9. Aggregate shape test (flakiness & elongation)
10. Water Absorption test

C) Traffic Studies

11. Traffic volume study
12. Spot Speed study

D) Miscellaneous Tests (demonstration only)

13. Determination of CBR.
14. Preparation of representative sample by coning and quartering.
15. Bitumen extraction test
16. Marshall stability concepts and tests.

Suggested Reading:

1) Khanna and Justo, "*Highway materials and Pavement Testing*", Nem Chand & Bros. 2013.
2) R. Srinivasa Kumar, "*Highway Engineering*", Universities Press, 2011
3) IRC codes and specifications

20CE C21

GEOTECHNICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Outcomes: Upon successful completion of this course, students will be able to

1) Identify soils with reference to their characteristics.
2) Evaluate and classify soils according to IS classification.
3) Calculate seepage volume for different soils.
4) Examine methods to improve soil stability of soils.
5) Conduct tests according to IS laboratory standards and procedures

CO	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	2	-
4	3	1	-	-	-	-	-	-	-	-	-	-	-	2	-
5	3	1	1	-	1	-	-	-	-	-	-	-	-	3	-
Average	**3**	**1**	**1**		**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**	**2.33**	**-**

List of Experiments:

1) Grain size distribution by Sieve Analysis.
2) Consistency limits - Liquid limit and Plastic limit using Casagrande's method.
3) Compaction test: Standard Proctor test.
4) Field Density using Sand Replacement method.
5) Field Density using Core Cutter method.
6) Specific gravity of soils.
7) Natural Moisture Content using Pycnometer method.
8) Direct Shear test.
9) Permeability test using Falling-head method.
10) Relative density

Demo Experiments:

1) Consolidation test
2) Triaxial test (UU)
3) Vane Shear test

Suggested Reading:

1) B. C. Punmia, "Soil Mechanics and Foundation Engg", (2005), 16th Edition Laxmi Publications Co., New Delhi.
2) IS : 2720(part-3 1964) for specific gravity, (IS : 2720 (Part 17), 1966) for Sieve analysis IS : 2720 (Part-IV), 1965) for Grain size analysis, IS: 2720 (Part 1) - 1983 for shear strength tests and compaction.
3) T. W. Lambe," Soil Testing for Engineers"-., Wiley Eastern Ltd., New Delhi.
4) K. H. Head K.H."Manual of Soil Laboratory Testing"-., (1986)- Vol. I, II, III, Princeton Press, London.

5) 5. J. E. Bowles J.E", Properties of Soil and Their Measurements",. (1988), - McGraw Hill Book Co. New York.
6) https://smfe-iiith.vlabs.ac.in/List%20of%20experiments.html
7) http://home.iitk.ac.in/~madhav/geolab.html

20CE M01

ENVIRONMENTAL SCIENCE

Instruction	2L Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	0 Marks
Credits	0

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

1) Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and effects of over utilisation.
2) Understand the concept of ecosystems and realise the importance of interlinking of food chains.
3) Contribute for the conservation of bio-diversity.
4) Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5) Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

	POs												**PSOs**		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	-	-	-	-	-	3	-	-	-	-	1	1	-	-
2	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
3	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
4	1	-	-	-	-	1	2	1	-	-	-	1	1	-	-
5	1	-	-	-	-	1	2	1	-	-	-	1	1	-	-
Aver	**1**	**-**	**-**	**-**	**-**	**1**	**2.2**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**

UNIT- I:

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II:

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT – III:

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV:

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT – V:

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1) Y. Anjaneyulu, “Introduction to Environmental Science”, B S Publications, 2004.
2) Suresh K. Dhameja, “Environmental Studies”, S. K. Kataria & Sons, 2009.

Suggested Reading:

1) C. S. Rao,” Environmental Pollution Control Engineering”, Wiley, 1991.
2) S. S. Dara, “A Text Book of Environmental Chemistry &Pollution Control”, S. Chand Limited, 2006

20CE E05

APPLICATION OF ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Outcomes: On Successful completion of this course, student will be able to

1) Recall fundamental knowledge on artificial intelligence.
2) Understand neural networks and their types and apply neural networks in the domain of civil engineering.
3) Understand and apply fuzzy controllers to solve real-world civil engineering problems.
4) Explain basic concepts of support vector machines and choose appropriate techniques relevant to civilengineering.
5) Develop a regression models for civil engineering problems.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-
2	1	1	1	-	2	-	-	-	-	-	-	1	1	-	-
3	1	1	1	-	2	-	-	-	-	-	-	1	1	1	-
4	1	1	1	-	2	-	-	-	-	-	-	1	-	1	-
5	1	1	1	-	2	-	-	-	-	-	-	1	1	1	-
Average	**1**	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**

UNIT I:

Introduction: Introduction and Brief history of intelligent systems: ELIZA, categorization of intelligent systems, components of AI program. Foundations of AI, sub areas of AI, applications, current trends in AI.

UNIT II:

Artificial Neural Networks: introduction, artificial neural networks: neuron model, activation functions, neural network architecture. Single layer feed forward networks, multi-layer feed forward networks, radial basis function networks, design issues of artificial neural networks, recurrent networks. Applications of ANN in civil engineering.

UNIT III:

Fuzzy sets and fuzzy logic: introduction, fuzzy sets, fuzzy set operations, types of membership functions, multivalued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules, fuzzy systems. Applications of fuzzy set and fuzzy logic in civil engineering.

UNIT IV:

Machine learning: introduction, machine learning systems, supervise and unsupervised learning, inductive and deductive learning, clustering, support vector machines. Applications of Machine learning in civil engineering.

UNIT V:

Regression Analysis: Relationship between attributes using Covariance and Correlation, Relationship between multiple variables: Regression (Linear, Multivariate) in prediction. Residual Analysis, Hypothesis testing of Regression Model, R-square and goodness of fit, Multiple Linear Regression, Non-Linear Regression, logistic regression. Applications of Regression analysis in civil engineering.

Text Books:

1) Pijush Samui, Dwarkadas Pralhaddas Kothari, Artificial intelligence in Civil Engineering: AI in Civil Engineering, 2012.
2) Ian Flood, Nabil Kartam, Artificial Neural Networks for Civil Engineers: advanced features and applications, 1998.

Suggested Reading:

1) S.M Yadav, Application of soft computing techniques in civil engineering, 2018.
2) Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2012.
3) Nelson M. Mattos, "An Approach to Knowledge Base Management", Springer Berlin Heidelberg, 1991.

Online Resources:

1. http://nptel.ac.in/courses/106106126/
2. http://nptel.ac.in/courses/106105077/

20CE E06

PRESTRESSED CONCRETE

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course outcomes: At the end of the course, Students will be able to

1) Understand the general mechanism of pre stressed concrete members, types of pre stressing
2) Analyze and understand the behaviour of pre stressed concrete beams.
3) Identify and apply design concepts for the pre stressed concrete beams under flexure and shear.
4) Analyze the stresses in anchorage zones and design the end anchorages.
5) Understand the fundamental concepts of primary and secondary moments in continuous beams.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	-	-	-	-	-	-	-	1	1	1	1
2	2	2	1	1	-	-		-	-	-	-	1	1	1	-
3	2	2	3	2	-	-	-	-	-	-	-	1	1	-	-
4	2	2	3	2	-	-	-	-	-	-	-	1	-	-	-
5	2	2	3	2	-	-	-	-	-	-	-	1	1	1	1
Average	2	2	2.2	1.6								1	1	1	1

UNIT- I:

General Principles of Pre Stressed Concrete:

Introduction: Basic concepts Materials –Need for High strength materials. Advantages and Applications of prestressed concrete. Different methods of Pre stressing. Pre-tensioning and post-tensioning. –

Hoyer System, Freyssinet system, Magnel-Blaton system, Lee Mecal system. Use of IS 1343 code, concepts of pre tensioned and post tensioned elements.

UNIT-II:

Design of Section for Flexure and Shear:

Allowable Stresses**:** Elastic Design and Limit state method of Design of Rectangular and I Section beams for Flexure. Check for ultimate flexural strength as per I S 1343 Codal Provisions. Check for deflections.

Design of Section for Shear: Shear and principal stresses. Factors affecting shear resistance, Cracked and uncracked sections Codal provisions - ultimate shear resistance. Design of shear reinforcement in beams.

UNIT III:

Analysis, Losses and Deflection of PSC beams: Analysis of sections for pre stress and flexure for Straight Concentric, Eccentric, Bent and Parabolic Tendons. Pressure Line Cable, concept of cracking moment of resistance . Load balancing concept.

Losses of Pre stress: Losses in P.S.C. members due to elastic shortening Shrinkage Creep in Concrete Relaxation of Steel Slip in anchorage Frictional Loss –

Deflections of P.S.C members: Importance of deflections - factors influencing deflections, short term and long term deflections IS code requirements for Maximum deflections Computation of short term deflections due to prestressing force Dead and Live loads.

UNIT IV: **Anchorage Zone stress in Post tensioned members**:
Stress distribution in End Block: Analysis by Magnel and Guyon's methods – IS 1343 Code Provisions – Bursting Tensile Force Design of anchorage zone reinforcement.

UNIT-V: **Continuous beams**:
Advantage and Disadvantages – Primary and Secondary moment P and C –lines Linear transformation, Concordant and Non-concordant cable profile – Analysis of Continuous beams

Text Books:

1) N. Krishna Raju, "Prestressed Concrete", Tata Mc Graw Hill, 2018
2) G.S. Pandit and S.P. Gupta, "Prestressed Concrete", CBS Pub., 2009

Reference Books:

1) Arthur H. Nilson by "Design of Prestressed Concrete", John Wiley, 1987
2) T.Y. Lin and Burn, "Design of Prestressed Concrete", Wiley India Private Limited, 2010, 52 53 18CE

20CE E07

HAZARDS AND MANAGEMENT

Instruction	3 L Hours per Week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Outcomes: Upon completion of this course, the student will be able to,

1) Identify and understand the fundamental terminologies in disaster management.
2) Distinguish between the Hydro-meteorological disasters and apply the concepts of structural and non-structural mitigation measures.
3) Categorize different Geographical Disasters and apply the knowledge in utilizing the early warning systems.
4) Analyze various mechanisms and consequences of human induced disasters.
5) Develop an awareness of disaster management phases and formulating effective disaster management plans, ability to understand various participatory roles of stakeholders- Central and State Government bodies at different levels.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	2	2	2	2	1	2	2	2	1	1	1	1
2	1	1	2	2	2	3	3	1	2	1	1	1	1	1	-
3	2	2	2	2	2	2	3	2	1	1	2	1	1	-	-
4	2	2	2	2	3	2	1	1	1	1	1	1	-	-	-
5	2	1	2	1	2	3	1	2	2	2	2	1	1	1	1
Average	**1.8**	**1.4**	**1.8**	**1.8**	**2.2**	**2.4**	**2**	**1.4**	**1.6**	**1.4**	**1.6**	**1**	**1**	**1**	**1**

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and manmade; Introduction to Disaster management cycle; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA) Objectives.

UNIT- II:

Natural Disasters: **Hydro meteorological disasters**: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Applications. Case studies related to various hydro-meteorological disasters.

UNIT- III:

Geographical based disasters: Causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various geographical based disasters.

UNIT- IV:

Human Induced Disasters: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas leakage; Management of chemical terrorism disasters and biological disasters; Case studies related to power break downs, fire accidents, traffic accidents, oil spills and stampedes, building failure disasters, Impact of COVID 19 at national and international level

UNIT- V:

Concept of Disaster Impacts and Management: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects, gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

Disaster management cycle and its phases, risk analysis, vulnerability and capacity assessment; Post-disaster environmental response water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India.

Text Books:

1) Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003
2) B.K. Singh, "Handbook of Disaster Management: Techniques & Guidelines", Rajat Publication, 2008

Suggested Reading:

1) Ministry of Home Affairs, Government of India, National Disaster Management Plan, Part I and II
2) K.K. Ghosh, "Disaster Management", APH Publishing Corporation, 2006
3) http://www.indiaenvironmentportal.org.in/files/file\disaster_management_india1.pdf
4) http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
5) Hazards, Disasters and your community: A booklet for students and the community, Ministry of Home Affairs.
6) Disaster Medical Systems Guidelines, Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.
7) Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings, Geneva: IASC.
8) http://ndma.gov.in/ (Home page of National Disaster Management Authority)

20CE E08

DESIGN OF MASONRY STRUCTURES

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OUTCOMES:

At the end of the course, the students will be able to,

1) Explain engineering properties, uses of masonry units, defects, crack in masonry and its remedial measures and factors affecting compressive strength of masonry units.
2) Explain the different masonry elements, permissible stresses, design considerations and criteria as per IS: 1905 and SP-20.
3) Design different types of masonry walls subjected to axial loads ; UDL and concentrated axial loads.
4) Design different types of masonry walls subjected to eccentric loads, lateral loads and transverse loads
5) Design infill walls of frames and implement the design principles and detailing aspects to ensure seismic safety of unreinforced and reinforced masonry walls

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
2	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
3	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
4	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
5	2	2	1	1	-	3	-	1	-	-	-	1	2	2	1
Average	**2**	**2**	**1**	**1**	-	**3**	-	**1**	-	-	-	**1**	**2**	**2**	**1**

UNIT I

Masonry Units, Materials, types and masonry construction: Bricks, Stone and Block masonry units-strength, modulus of elasticity and water absorption of masonry materials – classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding and repairing cracks

Strength and Stability: Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.

UNIT II

Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses.

Design Considerations: Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars

UNIT III

Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers

Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings.

UNIT IV

Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers.

Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls. Introduction to reinforced brick masonry, lintels and slabs.

UNIT V

In-filled frames: Types – modes of failures – design criteria of masonry retaining walls.

Seismic safety Considerations for Masonry walls : Design principles, detailing aspects and construction features for seismically safe masonry structures (both – unreinforced and reinforced)

Text Books:

1) Dayaratnam P, Brick and Reinforced Brick Structures, Scientific International Pvt. Ltd.
2) M. L. Gambhir, Building and Construction Materials, McGraw Hill education Pvt. Ltd.
3) Henry, A.W., " Structural Masonry" , Macmillan Education Ltd., 1990.

References:

1) IS 1905–1987 "Code of practice for structural use of un-reinforced masonry- (3rd revision) BIS, New Delhi.
2) SP 20 (S&T) – 1991, "Hand book on masonry design an d construction (1 st revision) BIS, New Delhi.
3) A. W. Hendry, B. P. Sinha and S. R. Davies, An introduction to load bearing brickwork design.
4) Sven Sahlin, Structural Masonry, Prentice-Hall Inc., 1971 4. Miha Tomezevic, Earthquake resistant design of masonry buildings, Imperial College Press, 1999, 693.852N99
5) Robert Drysdale and A A Hamid, Masonry structures behaviour and design, Publisher: The Masonry Society, Boulder, Colorado USA, 3rd Ed. 2008

20EE O02

ENERGY MANAGEMENT SYSTEMS

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisites:

Students should have prior knowledge on different energy generation systems, basic idea about audit instruments.

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

1. Know the current Energy Scenario and importance of Energy Conservation.
2. Understand the concepts of Energy Management, Energy Auditing.
3. Interpret the Energy Management methodology, Energy security and Energy Strategy .
4. Identify the importance of Energy Efficiency for Engineers and explore the methods of improving Energy Efficiency in mechanical systems, Electrical Engineering systems
5. Illustrate the Energy Efficient Technologies in Civil and Chemical engineering systems

CO-PO/PSO ARTICULATION MATRIX

	POs												PSOs		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	-	-	1	-	1	2	1	-	-	-	1	-	-	-
2	2	1	1	1	-	1	2	1	-	-	-	1	-	-	-
3	2	2	2	1	-	1	2	1	-	-	-	1	-	-	-
4	2	2	1	2	2	1	2	1	-	-	-	1	-	-	-
5	1	1	2	1	1	1	2	2	-	-	-	1	-	-	-
Average	**1.6**	**1.5**	**1.5**	**1.2**	**1.5**	**1**	**2**	**1.2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

UNIT-I

Various form of Energy and its features: Electricity generation methods using different energy sources such as Solar energy, wind energy, Bio-mass energy, and Chemical energy such as fuel cells. Energy Scenario in India, Impact of Energy on economy, development, and environment sectors of national and international perspective.

UNIT-II

Energy Management-I: Defining Energy Management, need for Energy Management, Energy management techniques, importance of Energy Management, managing the Energy consumption, Energy Audit and Types, Energy Audit Instruments.

UNIT-III

Energy Management-II: understanding Energy costs, bench marking, Energy performance, matching energy use to requirement, optimizing the input, fuel & Energy substitution, material and Energy balance diagrams, Energy pricing, Energy and Environment, Energy Security

UNIT-IV

Energy Efficient Technologies-I: Importance of Energy Efficiency for Engineers, Energy Efficient Technology in Mechanical engineering: Compressed Air System, Heating, ventilation and air-conditioning, Fans and blowers, Pumps and Pumping Systems.

Energy Efficient Technology in Electrical engineering: Automatic Power Factor Controllers, Energy Efficient Motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, space cooling, energy efficiency of lifts and escalator, energy saving potential of each technology.

UNIT-V

Energy Efficient Technologies-II: Energy Efficient Technology in Civil Engineering: Intelligent Buildings, And Various Energy Efficiency Rating Systems for Buildings, Green Buildings Energy Efficiency: management of green buildings, importance of embodied energy in selection of sustainable materials, green building design, waste reduction/recycling, rainwater harvesting, maintenance of the green buildings, green building certification, Renewable energy applications.

Energy Efficient Technology in Chemical Engineering: Green chemistry, Low carbon cements, recycling paper.

Textbooks:

1. Umesh Rathore, 'Energy Management', Kataria publications, 2nd edition, 2014.
2. G Hariharaiyer, “Green Building Fundamentals”, Notion press.com
3. K V Shama, P Venkataseshaiah, "Energy management and conservation", I. K. International Publishing agency pvt. ltd., 2011, ISBN: 978-93-81141-29-8

Suggested Reading:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects
2. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) An Overview of Energy Efficiency Opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland University of Technology.
3. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

20ME O12

3D PRINTING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Objectives:

1. To make students understand the basic concept of digital manufacturing.
2. To teach different processes involved in digital fabrication of products.
3. To demonstrate the STL file generation and manipulations.
4. To demonstrate various post processing techniques.
5. To demonstrate the applications of RP in different fields of engineering.

Outcomes: At the end of the course, the students are able to

1. Understand the concept of 3D printing processes, advantages and limitations.
2. Evaluate real-life scenarios and recommend the appropriate 3D printing technology.
3. Analyze various pre-processing and post processing techniques.
4. Explain current and emerging 3D printing technologies in diversified applications.
5. Identify components required in construction of3Dprinter.

UNIT-I

Introduction to 3D Printing: Introduction to 3D printing, evolution, distinction between 3D printing & CNC machining.
Design considerations: Materials, size, resolution, mass customization. additive vs. subtractive manufacturing, its advantages and limitations

UNIT-II

Photo polymerization processes: Photo polymerization, Stereolithography Apparatus (SLA), Applications, advantages and disadvantages.
Powder bed fusion processes: Introduction, Selective laser Sintering (SLS), Materials, Applications, advantage and disadvantages.
Extrusion-based systems: Fused deposition modeling (FDM), laminated object manufacturing (LOM), Principles, Materials, Process Benefits and Drawbacks.
Material Jetting AM Processes: Evolution of Printing as an Additive Manufacturing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes.

UNIT-III

Pre processing in AM: Modeling and viewing - 3D scanning; Model preparation – STL conversion, STL error diagnostics, STL file Repairs, generic solution, slicing, newly proposed file formats.
Post processing in AM: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non–thermal and thermal techniques.

UNIT-IV

Construction of basic 3D printer: Construction of 3D printing machine – axes, linear motion guide ways, ball screws, motors, bearings, encoders, process chamber, safety interlocks, sensors.

UNIT-V

Applications of AM: Application in aerospace industry, automotive industry, jewelry industry, coin industry. medical and bioengineering applications: planning and simulation of complex surgery, forensic science.

Text Books:

1. Gibson, DW. Rosen and B.Stucker; Additive manufacturing methodologies: Rapid prototyping to direct digital manufacturing, Springer, 2010.
2. Chee Kai Chua, Kah Fai Leong, 3D printing and additive manufacturing: principles and application, 4 th edition of rapid proto typing, World scientific publishing company, 2014.
3.P.K. Venuvinod, Rapid prototyping – Laser based and other technologies, Kluwer, 2004.

Suggested Reading:

1. Jacob, Paul, Rapid tooling: Technologies and industrial applications, Taylor & Francis Group, 2000.
2. Alain Bernard, Georges Taillandier, Additive Manufacturing, Wiley, 2014.

20EC O02

BASICS OF DIGITAL SIGNAL PROCESSING

Instruction	3L Hours per week	
Duration of Semester End Examination	3 Hours	
Semester End Examination		60 Marks
Continuous Internal Evaluation		40 Marks
Credits		3

Prerequisite: Basic concepts of signals are required

Course Objectives:

This course aims to:

1. Learn the advantages of DSP over analog signal processing.
2. Analyze discrete-time signals in the frequency domain using DFT and FFT.
3. Learn the theory of digital filters.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the concept of Discrete time signals and systems
2. Analyze the frequency domain representation of discrete time sequence using DTFT and DFT.
3. Apply FFT to the given sequence.
4. Implementation of FIR filter for the given specifications
5. Design an IIR filter for the given specifications.

Course Articulation Matrix:

COs	POs												PS0s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	03	03	03	02	03	02	-	-	02	02	-	02	03	03	02
2	03	03	03	02	02	02	-	-	02	02	-	02	03	03	02
3	03	03	03	02	03	02	-	-	02	02	-	02	03	03	01
4	03	03	03	02	02	02	-	-	02	02	-	02	03	03	02
5	03	03	03	02	03	02	-	-	02	02	-	02	03	03	02
Aver	**3**	**3**	**3**	**2**	**2.6**	**2**			**2**	**2**		**2**	**3**	**3**	**1.8**

UNIT-I

Discrete Time Signals and Systems: Introduction, basic elements of a digital signal processing system, advantages and disadvantages of Digital Signal Processing over Analog signal processing, sampling theorem, analog to digital and digital to analog conversion. Discrete-Time System: Mathematical representation of Discrete Time Systems, Concept of Impulse response and Transfer function, Linear and Time invariant systems, Concept of causality and stability.

UNIT-II

Frequency Domain Analysis of Discrete Time Sequences: Discrete Time Fourier Transform (DTFT), properties of DTFT, Discrete Fourier Transform (DFT) and its properties, relationship between DFT to the DTFT, circular convolution.

UNIT-III

Fast Fourier Transform (FFT): Introduction, Radix-2 Decimation –In- Time (DIT) and Decimation- In-Frequency (DIF) FFT algorithms, Bit reversal order, In-place computation.

UNIT-IV

FIR Filter Design: Characteristics of FIR filters, Linear phase filters, Design of FIR (LPF, HPF, BPF and BSF) filters using Truncation and Windows, Comparison between FIR and IIR filters.

UNIT-V

IIR Filter Design: Characteristics of IIR filters, Conversion from analog filters to digital filters using Impulse Invariance Method (IIM) and Bilinear Transformation (BLT) methods, prewarping. Realization diagrams-Direct form I & II.

Text Books:

1. Alan V. Oppenheim & Ronald W. Schafer, “Digital Signal Processing,” PHI, 2/e, 2010.
2. John G. Proakis&Dimtris G. Manolakis, “Digital Signal Processing Principles, Algorithms and Application,” PHI, 4/e, 2012.

Suggested Reading:

1. Sanjit K Mitra, " Digital Signal Processing", Tata Mc Graw Hill, Third edition, 2006
2. ChiTsong Chen, "Digital Signal Processing", Indian edition, 2009.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum with effect from AY 2022-23

B.E (Civil Engineering)

SEMESTER – VI

Sl. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week						
			L	T	P	Duration of SEE in hours	Max marks		
							CIE	SEE	
1	20CE C22	Hydrology and Water Resource Engineering	3	-	-	3	40	60	3
2	20CE C23	Estimation, Specification & Costing	3	-	-	3	40	60	3
3	20CE C24	Reinforced Concrete Design - II	3	-	-	3	40	60	3
4	20CE C25	Environmental Engineering	3	-	-	3	40	60	3
5	--	OE - 2	3	-	-	3	40	60	3
6	--	PE- 3	3	-	-	3	40	60	3
7	20CE C26	Environmental Engineering Lab	-	-	2	3	50	50	1
8	20CE C27	Engineering Geology Lab	-	1	2	3	50	50	2
9	20EG C03	Employability Skills	-	-	2	3	50	50	1
		Total	**18**	**1**	**6**	**-**	**390**	**510**	**22**
	Clock Hours per week: 25								

L: Lecture **T: Tutorial** **P: Practical/Drawing/Seminar/Project**

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

Professional Electives (PE-3)

Subject code	Subject Name
20CE E09	Foundation Engineering
20CE E10	River Engineering
20CE E11	Urban Transportation Planning
20CE E12	Basics of Earthquake Engineering

Open Electives - 2 (OE-2)

20BT O02	Biomaterials for Engineering
20ME O06	Nano Materials and Technology
20CS O14	Cloud Technologies

20CE C22

HYDROLOGY AND WATER RESOURCES ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40
Marks	
Credits	3

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

1) Understand the interaction among various processes in the hydrologic cycle and Rain Gauge networks.
2) Analyze hydrograph and different irrigation efficiencies.
3) Estimate different aquifer parameters, yield of an open well, yield and life of a reservoir.
4) Design lined and unlined canals using Kennedy's and Lacey's theory
5) Design gravity dams, earth dams and understand the functioning of spillways.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
2	3	2	1	-	-	-	-	-	-	-	-	1	1	-	1
3	3	1	1	-	-	-	-	-	-	-	-	1	1	-	-
4	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1
5	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1
Average	3	1.8	1.4	-	-	-	-	-	-	-	-	1	1		1

UNIT- I:

Introduction: Hydrologic cycle, water budgeting, scenario of water resources in India, hydrology applications in engineering.

Precipitation: forms, characteristics and measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, depth-duration-frequency relationship, Probable Maximum Precipitation.

Infiltration, infiltration capacity, infiltration indices, factors affecting infiltration, evaporation, and evapotranspiration

UNIT- II:

Runoff: runoff, factors affecting runoff, estimating runoff, flow-duration curve, flow-mass curve, hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph, S- hydrograph and its uses.

Irrigation: Duty, delta and base period of crops, crop water requirements, methods of applying water to the fields, micro irrigation, irrigation efficiencies, soil-water relationship, depth of irrigation, frequency of irrigation, wilting point, water logging, conjunctive use.

UNIT- III:

Ground water: Occurrence of groundwater, groundwater basin, vertical distribution of ground water, types of aquifers, aquifer parameters, specific yield, safe yield, steady radial flow into a confined and unconfined aquifer, Darcy's law, three-dimensional groundwater flow equation.

Reservoirs: Types, selection of suitable site, capacity of reservoirs, yield of reservoir, flood estimation, flood routing through reservoirs, sedimentation and life of reservoir.

UNIT- IV:

Distribution systems –Types of canals, alignment, balancing depth, design of canals, Kennedy's and Lacey's theory, canal losses, lining of canals.

Canal outlets: non-modular, semi-modular and modular outlets.

Introduction to diversion head works and its components, canal regulation works.

UNIT- V:

Gravity dams: Types of dams, forces on gravity dams, causes of failure, stress analysis and design, practical profile and economical height of dam.

Earth dams: Classification, failures of earth dam, design considerations, seepage control and slope protection.

Spillways: Types, components of spillways.

Text Books:

1) P. N. Modi, "*Irrigation Water Resources & Water Power Engineering*", Standard Publishers, 2014
2) S. K. Garg, "*Irrigation Engineering and Hydraulic Structures: Water Resources Engineering - Vol.*II", Khanna Publishers, Delhi, 2017.
3) Raghunath, H.M., Hydrology – Principles, Analysis and Design, 1986, Wiley

Suggested Reading:

1) Ch. S. N. Murthy, "*Water Resources Engineering: Principles and Practice*", New Age International Publishers, Delhi, 2002.
2) G. L. Asawa, "*Irrigation and water Resources engineering",* New Age International Publishers, Delhi, 2005.
3) VenTe Chow, "*Hand book of Applied Hydrology",* McGraw-Hill Book Company, New York, 1964
4) Raghunath, H.M., Groundwater, 1987, Wiley Eastern Ltd., New Delhi

20CE C23

ESTIMATION SPECIFICATIONS AND COSTING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course outcomes: At the end of the course the students should be able to

1) Prepare detailed estimates for load bearing and RCC framed building using long and short wall method.
2) Prepare detailed estimates for load bearing and RCC framed building using centre line method.
3) Prepare the detailed estimate of steel qualities and bar bending schedule for RCC framed works.
4) Estimate the earth work for – bituminous roads, WBM roads, CC roads, irrigation canals and prepare the detailed estimate of single cell rectangular box culvert, septic tank.
5) Do the rate analysis for different items of works of buildings and understand the general and detailed specifications of works.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Average	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

UNIT – I:
Introduction of estimation, object of estimation, types of estimates, detailed estimate for flat roof building (load bearing and RCC framed) using long and short wall method.

UNIT – II:
Detailed estimated for flat roof building (load bearing and RCC framed) using centre line method.

UNIT – III:
Estimation of steel quantities and preparation of bar bending schedule (BBS) for RCC slabs (one way and two way), beams, columns, footings, stair case and retaining wall.

UNIT – IV:
Estimation of earth work for – bituminous roads, WBM roads and CC roads. Detailed estimate of single cell rectangular box culvert, septic tank and earth work of irrigation canals.

UNIT – V:
Preparation of analysis of rates and theoretical requirements of materials and schedule of rates for major items of a building. General and detailed specifications of works. Measurement book and muster roll.

Text Books:

1) B. N. Dutta, "*Estimating and Costing in Civil Engineering – Theory and Practice*", UBS, publishers' distributors (p) ltd.-New Delhi 2012.
2) M. Chakraborti, "*Estimating, Costing, Specifications and Valuation in Civil Engineering"*, Chakraborti 2006.

Suggested Reading:

1) Jagjit Singh, "*Estimating and Costing in Civil Engineering*", Galgotia Publications, New Delhi, 1996.
2) B. S. Patil," *Civil Engineering Contracts and Estimation*", Orient Black swan Private Ltd; Fourth edition 2015.
3) Standard Scheduled Rates and Relevant BIS Codes

20CE C24

REINFORCED CONCRETE DESIGN-II

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation Marks	40
Credits	3

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

1) Develop the plan layout, design and detail rectangular & trapezoidal combined footings.
2) Analyze for stability, design, the various components and detail cantilever and counter fort type retaining walls.
3) Interpret the specifications from relevant codes, determine the design forces, design various components and detail rectangular and circular water tanks including Intze tanks.
4) Understand the clauses from relevant IRC codes, design and detail the various components of Solid slab bridge.
5) Analyze the slab panels using effective width method/ Pigeaud‟s curves, girders using Courbon‟s method and design & detail the various components of T-Beam bridges.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	1	1	1	2	1	3	1	1	2	3	1
2	3	2	3	2	1	1	1	2	1	3	1	1	2	3	1
3	3	2	3	2	1	1	1	2	1	3	1	1	2	3	1
4	3	2	3	2	1	1	1	2	1	3	1	1	2	3	1
5	3	2	3	2	1	1	1	2	1	3	1	1	2	3	1
Average	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**3**	**1**	**1**	**2**	**3**	**1**

UNIT – I:
Combined Footings: Limit state design & detailing of combined rectangular and trapezoidal footings

UNIT – II:
Retaining walls: Limit state design and detailing of cantilever and counterfort type of retaining walls under various conditions of backfill.

UNIT – III:
Water tanks: Elastic Design & Detailing of circular and rectangular ground level and over-head tanks, Design principles of Intze tank.

UNIT – IV:
Bridges: Basic components- Types of bridges -Loads on bridges- IRC standards; Elastic design and detailing of two lanes, simply supported RC Solid Slab Bridge including Kerb.

UNIT- V:
T-beam bridges: Components of a T-beam bridge- Elastic design and detailing of two lane, Simply Supported, Three girder T-beam bridge- Use of effective width method- Pigeaud‟s curves and Courbon‟s method.

Text Books:

1) N. Krishna Raju, "Advanced Reinforced Concrete Design (IS: 456-2000) ", CBS Publications 2nd Edition,2010.
2) Vazirani and Ratwani," Design Of Concrete Bridges", Khanna Publishers, 1998.

Suggested Reading:

1) D. S. Prakash Rao, "Design Principles and Detailing of Concrete Structures", Tata McGraw-Hill Publishing Co. Ltd., 1998.
2) D. Johnson Victor, "Essentials of Bridge Engineering", paperback, Oxford & IBH, Publishing Co., New Delhi, 6th Edition, 2015.

3). S. Ponnuswamy, "Bridge Engineering", Tata McGraw Hill, Third Edition, 2017.4. N. Krishna Raju, "Design of Bridges", Oxford & IBH Pubs Company New Delhi, Fourth Edition, 200

20CE C25

ENVIRONMENTAL ENGINEERING

Instruction	3L Hours per week	
Duration of Semester End Examination	3 Hours	
Semester End Examination	60 Marks	
Continuous Internal Evaluation		40 Marks
Credits	3	

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

1) Identify an appropriate population forecasting method and estimate quantity of water to be supplied and plan &design conveyance components.
2) Design water treatment units for a water treatment plant.
3) Estimate quantity of sewage and storm water & characteristics of sewage, design sewers and plan sewer appurtenances.
4) Design components of waste water treatment plant and sludge digestion systems.
5) Understand and judge methods for control of particulate matter and gaseous pollutants in the atmosphere, outlinenoise pollution control methods.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	3	-	-	1	-	-	-	-	-	-	1	-	-
2	2	2	3	-	-	-	-	-	-	1	-	-	1	-	-
3	3	2	3	-	-	-	-	-	-	-	-	-	-	-	1
4	2	2	3	-	-	-	-	-	-	-	-	-	1	-	1
5	1	-	2	-	-	1	2	-	-	-	-	-	1	-	-
Average	**2**	**2**	**2.8**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**1**

UNIT – I:

Introduction: Protected water supply, population forecasting methods, design period, types of water demand, factors affecting, fluctuations, fire demand, drinking water standards; sources of water, water quality parameters; intakes, infiltration galleries; Design of distribution systems, pipe appurtenances.

UNIT – II:

Water treatment: Sedimentation principles-design factors; coagulation, flocculation, clarifier, coagulants, feeding arrangements. Filtration theory, working of slow and rapid gravity filters, multimedia filters, design of filters, troubles in operation, comparison of filters, disinfection, theory of chlorination, chlorine demand, other disinfection practices.

UNIT - III:

Characteristics of sewage: Waste water collection, estimation of waste water and storm water, decomposition ofsewage, self purification of rivers, examination of sewage, B.O.D. Equation, C.O.D. Design of sewers, sewer shapes and materials, sewer appurtenances, house drainage, plumbing requirements, sanitary fittings, traps, one pipe and two pipe systems of plumbing.

UNIT – IV:

Waste water treatment: Primary treatment: screens, grit chambers, skimming tanks, sedimentation tanks, principles of design, Biological treatment: Design of trickling filters, Activated Sludge Treatment and oxidation ponds. Sludge digestion: factors affecting, design of digestion tank, septic tanks: working principles and design, soak pits, ultimate disposal of sewage.

UNIT – V:

Air pollution: Meteorological parameters affecting air pollution, atmospheric stability, plume behaviour, control ofparticulates, gravity settlers, cyclone filters, Electrostatic precipitators; Control of gaseous pollutants.
Noise – Basic concept, measurement and various control methods.

Text Books:

1) B.C Punmia, Ashok.K.Jain, Arun K .Jain "*Environmental Engineering I",* Laxmi Publications; 2016.
2) B.C Punmia, Ashok.K.Jain, Arun K .Jain "*Environmental Engineering II*", Laxmi Publications; 2016.
3) Santosh Kumar Garg, "*Water Supply Engineering*", Khanna Publications, 2017.
4) Santosh Kumar Garg, "*Sewage Disposal and Air Pollution Engineering*", Khanna Publications, 2018.

Suggested Reading:

1) H.S Peavy, D. R. Rowe," *Environmental Engineering*", McGraw Hill Education (India) Pvt. Ltd, 2017.
2) Metcalf and Eddy, "*Waste Water engineering*", McGraw Hill, 2015.
3) Mark J Hammar and Mark J. HammarJr," *Water and Waste Water Technology*".Wiley, 2007.
4) "*Manual on Water Supply and Treatment*", Ministry of Urban Development, New Delhi.
5) "*Manual on Sewerage and Sewage Treatment Systems, Part A, B and C*", Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

20CE C26

ENVIRONMENTAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course outcomes: After the completion of the course student should be able to

1) Demonstrate skills to use equipment in conducting the test procedures.
2) Evaluate water quality and summarize the suitability in accordance with IS: 10500- 2012, Drinking Water specifications.
3) Evaluate characteristics of wastewater and summarize the suitability for disposal/reuse as perstandards.
4) Measure air quality and classify the level of pollution based on standards set by Pollution Control Board.
5) Evaluate and analyse bacteriological quality of water.

Practical Work*: List of Experiments*

1) Determination of pH, turbidity
2) Determination of Electrical Conductivity
3) Determination of Total Solids (Organic and inorganic, volatile and fixed)
4) Determination of Alkalinity
5) Determination of Hardness (Total, Calcium and Magnesium Hardness)
6) Determination of Chlorides and sulphates
7) Determination of optimum coagulant Dosage
8) Determination of COD
9) Determination of DO and BOD
10) Determination of Breakpoint chlorination
11) Determination of MPN
12) Measurement of air quality

Suggested Reading:

1) Government of India & Government of The Netherlands –Hydrology Project Technical Assistance,"Standard analytical procedures for water analysis", May 1999
2) D. R. Khanna and R. Bhutiani, "Laboratory Manual of Water and Wastewater Analysis", Daya Publishing House, 2008

20CE C27

ENGINEERING GEOLOGY LAB

Instruction (2P + 1T) Hours per week
Duration of Semester End Examination 3 Hours
Semester End Examination 50 Marks
Continuous Internal Evaluation
50 Marks
Credits 2

Course Outcomes: Upon the Completion of this course students will be able to

1) Identify the minerals, rocks and various
2) Identify structural features like folds, faults and unconformities.
3) Measure the electrical resistivity of rocks, soil etc.
4) Interpret the topographic maps.
5) Identify the geological and geotechnical features of given places

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	-	1	1	-	1	-	-	1	3	2	1
2	3	2	2	1	-	1	1	-	1	-	-	1	3	2	1
3	2	2	2	1	-	3	1	-	1	1	-	1	2	2	3
4	2	2	2	1	-	3	1	-	1	1	-	1	2	2	3
5	3	3	2	1	3	1	1	-	1	-	-	1	1	2	-
Average	**2.6**	**2.2**	**2**	**1**	**1**	**1.8**	**1**		**1**	**1**		**1**	**2.2**	**2**	**2**

List of Experiments:

1) Identification and description of physical properties of minerals.
2) Identification and description of Geotechnical characteristics of Rocks. IS 1123-1975.
3) Study of structural models, folds, faults and unconformities.
4) Measurement of strike and dip of joints in granites using clinometers compass.
5) Measurement of electrical resistivity of rocks, soils and water.
6) Study of geological and Geotechnical map of Telangana, Andhra Pradesh and India.
7) Study of Topographic Maps of Srisailam and Nagarjuna Sagar dams.
8) Study of maps and sections pertaining to the study of folds, faults and unconformities.

Suggested Reading:

1) Suggested Reading: 1. IS 113-1975, "Methodof Identification of natural Building stones", Bureau of Indian Standards.
2) Parbinsingh, "Engineering and general Geology", S.K.Kataria& sons, New Delhi 2010.
3) F. G. Bell, "Fundamentals of Engineering Geology", Aditya Books Pvt. Ltd., New Delhi 2007
4) "Seismo Tectonic Map of India", Geological Survey of India 2005.
5) Kuzin M., Egorov N., "Field Manual of Minerals", Central Books Ltd., 1997.

20EG CO3

EMPLOYABILITY SKILLS

Instruction	2L Periods per week
Duration of SEE	2 Hours
SEE	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	01

Course Objectives: To help the students

1. Learn the art of communication, participate in group discussions and case studies with confidence and to make effective presentations.
2. With- resume packaging, preparing them to face interviews.
3. Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

Course Outcomes: By the end of the course**,** the students will be able to

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to mange time effectively and deal with stress.
4. Mak**e** the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	-	-	-	2	2	2		-	-	-
2	-	-	-	-	-	-	-	-	-	2	-		-	-	-
3	-	-	-	-	-	-	-	-	-	-	-		-	-	-
4	-	2	-	-	-	-	-	2	-	-	2		-	-	-
5	-	-	-	-	-	2	-	-	-	-	-		-	-	-
Average	-	2	-	-	-	2	-	2	2	2	2	-	-	-	-

UNIT 1

Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences- Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

UNIT 2

Group Discussion & Presentation Skills: Dynamics of Group Discussion-Case Studies- Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence. Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language - Preparing an Effective PPT

UNIT 3

Behavioural Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management- **Corporate Culture** – Grooming and etiquette-Statement of Purpose (SOP).

UNIT 4

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT 5

Interview Skills: Cover Letter andRésumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

Suggested Reading:

1. Leena Sen, "Communication Skills", Prentice-Hall of India, 2005
2. Dr. Shalini Verma, "Body Language - Your Success Mantra", S Chand, 2006
3. Edgar Thorpe and ShowickThorpe , "Objective English", 2nd edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010
5. Gulati and Sarvesh, " Corporate Soft Skills", New Delhi: Rupa and Co. , 2006
6. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004
7. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal, 2018
8. Covey and Stephen R, "The Habits of Highly Effective People", New York: Free Press, 1989

20CE E09

FOUNDATION ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course outcomes: At the End of the course the students should be able to

1) Compute the stress distribution in the ground under different loading conditions.
2) Estimate the bearing capacity of different soils for shallow foundation.
3) Design the deep foundation by piles or wells.
4) Deal with the field problems in laying cofferdams and different dewatering techniques and sampling methods.
5) Interpret and implement the Concepts of Coffer dams, Caissons and Timbering of Excavations

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
2	3	1	1	1	-	-	-	-	-	-	-	-	3	1	-
3	3	1	1	1	-	-	-	-	-	-	-	-	3	1	-
4	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
5	3	1	-	1	-	-	-	-	-	-	-	-	3	1	-
Average	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**

UNIT- I:

Stress distribution in Soils: Boussinesq's and Westergaards equations for point load. Application of point load formulae for uniformly distributed load on circular area, Line load, Strip Load, rectangular area. Use of Newmark's chart for different areas using Boussinesq's equation, Contact pressure distribution.

UNIT- II:

Bearing capacity of soils: Terzaghi's equation for bearing capacity in soils –It's modification for continuous, square, rectangular and circular footings, general and local shear failure conditions. Plate load test as per IS specification. Allowable bearing capacity. Standard penetration test and use of N values for estimating soil conditions and bearing capacity.

Settlement Analysis: Computation of pressures before loading and after loading.

Estimation of settlement – ultimate and after any given period.

UNIT- III:

Pile Foundations: Types of piles–Timber, steel, concrete, cast-in situ, precast piles, bearing piles, friction piles, compaction piles, large diameter piles. Pile capacity – Static formulae, dynamic formulae, pile load test, determination of point resistance and skin friction as per IS code. Bearing capacity of pile groups, negative skin friction.

UNIT- IV:

Coffer dams: Earth embankments, cantilever sheet piles, braced coffer dams. Double wall cofferdams, cellular coffer dams – circular, diaphragm type, general description and construction methods.

Caissons: types of caissons–Open caissons, pneumatic caissons, box caissons (floating caissons). General description and construction methods. Dewatering techniques: sumps, ditches. Well points, deep walls. Geotextile methods: Types and uses.

UNIT- V:

Site investigation: Principles of exploration, sampling methods, transportation and storage of samples, boring and drilling methods, log of bore holes, sampling tubes and samplers. Sampling records.

Timbering of excavation: Bracing for shallow and deep excavations. Computation of lateral earth pressure. Reaction of struts.

Text Books:

1) K. R. Arora, "*Soil Mechanics and Foundation Engineering*", 7th Edition, Standard Publishers, 2009.
2) Gopal Ranjan, "*Basic and Applied Soil Mechanics*", 3rd Edition, New Age International, 2016.

Suggested Reading:

1) B.C. Punmia and Ashok Kumar Jain and Arun Kumar Jain, "*Soil Mechanics and Foundations*", Laxmi Publications, 16th Edition, 2017.
2) E. J. Bowles, "*Foundation Analysis and Design*", Tata Mc Graw Hill, 2017.

20CE E10

RIVER ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation Marks	40
Credits	3

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

1) Understand about river morphology
2) Apply knowledge on river aggradation and degradation
3) Evaluate different models of river flow hydraulics
4) Analyse hydraulic geometry and execute river protection and training works
5) Design river training and river bank protection

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
2	2	2	1	-	-	-	-	-	-	-	-	1	1	-	-
3	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1
4	2	2	1	-	-	-	-	-	-	-	-	1	1	-	1
5	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1
Average	**2.6**	**2**	**1.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**

UNIT- I:

River morphology: Behavior of river flow, role of sediments in rivers, changes in regimes. Sediment transport mechanics - bed forms, bed load transport, transport of suspended sediment, critical shear stress, and sediment transport equations.

UNIT- II:

Aggradation and Degradation: Local scour at bridge piers and other hydraulic structures, measurements in rivers - stage measurements, channel geometry, discharge, and sediment samplers and suspended and bed load measurement.

UNIT- III:

Hydraulic modelling of rivers: Hydraulic similitude, physical river models-fixed and movable bed models, sectional models, distorted models, and mathematical models.

UNIT- IV:

River Protection and Training Works: Introduction, classification of river training, types of training works, protection for revetments, dikes, gabions, spurs, bank protective measures and bed control structures.

UNIT- V:

Design of river flood protection structures: Diversion and Cofferdams; River regulations systems; Dredging and Disposal, River restoration.

Text Books:

1) P. Y. Julien, "*River Mechanics*", Cambridge University Press, March 2018
2) S. K. Garg, "*River Engineering*", Khanna Publishers, Delhi, 2021.

Suggested Reading:

1) R.J. Garde and K.G. Ranga Raju, "*Mechanics of sediment transportation and Alluvial stream problems"*, Wiley Eastern limited, 1977
2) Central Board Of Irrigation And Power, "*River Behaviour Management and Training (Vol. I & II)",* New Delhi, 1991
3) U. S. Army Corps of Engineers, "*River Hydraulics*", University Press of the Pacific, 2004

20CE E11

URBAN TRANSPORTATION PLANNING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

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

1) Apply the fundamental knowledge for forecasting and creating the transportation infrastructure facilitiesscientifically and ethically by collecting the appropriate sample data.
2) Identify the procedures for collecting the traffic related data for generating and validating transport demandmodels.
3) Apply four stage transportation demand modelling by creating mathematical models to understand the travelpattern and behavior of road users.
4) Apply the mathematical knowledge in solving the transportation planning related problems by analyzingtransportation data.
5) Evaluate highway projects by using different economic methods and understand the role of computer applications in transportation planning.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	-	-	-	-	-	-	-	-	2	1	1
2	3	2	1	-	-	-	-	-	-	-	-	-	-	1	1
3	3	2	-	-	-	-	-	-	-	-	-	-	-	1	1
4	3	2	1	-	-	-	-	-	-	-	-	-	1	1	1
5	3	2	1	-	-	-	-	-	-	-	-	-	1	1	1
Average	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.33**	**1**	**1**

UNIT - I:

Introduction of concepts of Transportation planning process, Interdependence of the land use and traffic, systems approach to transportation planning, stages in transportation planning, survey and analysis of existing conditions, forecast analysis of future conditions and plan synthesis, evaluation, program adoption and implementation.

UNIT - II:

Transportation Surveys – Introduction, definition of the study area, zoning, types of surveys, home interview, commercial vehicle, taxis, roadside interview, registration number of vehicle plate, tags on vehicles, mass transport, and analyzing the data from samples.

UNIT - III:

Trip Generation – Introduction and definition, trip purpose, factors governing trip production and attraction rates, regression methods – multiple linear regression analysis. Trip Distribution – concepts of trip distribution, methods of trip distribution, uniform (constant) factor method, average factor method, Fratar method, Furness method, advantages and disadvantages of growth factor methods, the gravity model.

UNIT - IV:

Modal split – General considerations, factors affecting modal split, modal split in the transportation planning process. Traffic Assignment – purpose of traffic assignment, general principles, assignment techniques, all or nothing assignment, multiple route assignment, capacity restraint assignment, diversion curves.

UNIT - V:

Economic evaluation of highway projects – need, basics principles, methods - benefit cost ratio, net present value, First year rate of return and internal rate of return - comparison. Computer applications in Transportation planning.

Text books:

1) B. G. Hutchinson, "*Principles of Urban Transport Systems Planning*", McGraw –Hill, Newyork, 1974.
2) C. S. PapacostasandP. D. Prevedouros, "*Transportation Engineering and Planning*", Pearson educationIndia, 2015.

Suggested Reading:

1) L.R. Kadiyali "*Traffic Engineering and Transportation Planning*" Khanna Publishers, 2011.
2) Sarkar, Pradip Kumar, Maitri, Vinay, Joshi, G.J. "*Transport Planning: Principles, Practice and Policies*"PHI Learning, 2017.

20CE E12

BASICS OF EARTHQUAKE ENGINEERING

Instruction:	3L Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	60 Marks
Continuous Internal Evaluation:	40 Marks
Credits:	3

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

1) Apply the fundamentals of engineering seismology; classify the characteristics and effects of strong motionearthquakes
2) Develop the concepts of damped and un-damped vibrations in single and multi-degrees of freedom systems.
3) Estimate the seismic loads on structures and analyse using seismic coefficient and response spectrum methods
4) Examine the causes of damages of urban and rural buildings and interpret the design provisions from IS-1893 part - I (2016) and IS - 13920(2016).
5) Asses the use of various earthquake resistant devices; apply suitable construction techniques for retrofitting

Articulation Matrix:

CO	PO's												PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	-	-	-	-	-	-	-	-	1	3	3	-
2	3	3	-	-	-	-	-	-	-	-	-	1	3	3	-
3	3	3	2	-	-	-	-	-	-	-	-	1	3	3	-
4	2	2	3	-	-	-	-	-	-	-	-	1	3	3	-
5	2	2	3	-	-	-	-	-	-	-	-	1	3	3	-
Average	**2.4**	**2.4**	**2.25**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**-**

UNIT – I:

Engineering Seismology& Elements : Causes of Earthquakes–Geological faults, Tectonic Plate theory – Elastic Rebound theory –Focus - Epicenter – Hypocenter, Seismic waves –Primary and Secondary waves, Seismogram - Magnitude, Intensity and Energy release during earthquakes – Magnitude & Intensity Scales, Characteristics of strong earthquake ground motions – Effect of soil properties – Liquefaction of soils.

UNIT – II:

Theory of Vibrations: Introduction to Vibrating Systems – mass, stiffness and damping parameters – Concept of inertia, elastic restoring force and damping –types of damping, difference between static forces and dynamic excitation.

Single Degree of Freedom (SDOF) Systems – SDOF idealization - Formulation of Equation of motion(for mass as well as base excitation) and response for free, damped & undamped vibrations.

Multi Degree of Freedom (MDOF) Systems - Equation of Motion–undamped free vibration, Modal Analysis - Natural frequencies - generation of modal frequencies and mode shapes, Construction of Response Spectrum.

UNIT – III:

Estimation of Seismic Loads on Structures: –Determination of earthquake forces on structures – Seismic Co-efficient and Response Spectrum Methods. Response Reduction factor - Concepts of over strength, Ductility and Redundancy.

UNIT – IV:

Seismic Performance of Buildings: Case Studies of damages to urban and rural buildings during some past earthquakes – Damage Patterns in structural and non –structural elements – Soft storey effect, Ductile detailing as per IS – 13920(2016).

UNIT – V:

Earthquake Resistant Devices &Construction Techniques: Vibration Control Devices - Base isolators, Energy dissipating devices – Dampers, Lateral Displacement Control - Bracing Systems, Shear Walls.

Seismic Retrofitting: Principles of repair, rehabilitation and retrofitting. Retrofitting Techniques for RCC and Masonry buildings

Text Books:

1) Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India Pvt.Ltd, 2011.
2) S.K Duggal, "Earthquake Resistant Design of Structures", Oxford Higher Education, Second Edition, 2013.

Suggested Readings:

1) A.K. Chopra, "Dynamics of Structures", Pearson Education, Fifth Edition, 2017.
2) Jai Krishna, A.R Chandrasekaran, Brijesh Chandra, "Elements of Earthquake Engineering", South Asian Publishers Pvt. Ltd, Second Edition, 2014.
3) Steven L Kramer, "Geo-Technical Earthquake Engineering", Pearson Education Ltd, 2013.

20BT O02

BIOMATERIALS FOR ENGINEERS

Instruction	3LHoursperweek
Duration of SEE	3Hours
SEE	60Marks
Continuous Internal Evaluation	40Marks
Credits	3

Prerequisites: Undergraduate First year basic concepts of physics and chemistry are required

Course Objectives:

Students are made to understand the following concepts during their course of time:

1) To learn the types and trends of Biomaterials.
2) To recognize the procedures for manufacturing of Metallic Biomaterials.
3) To be aware of the types of ceramic Biomaterials.
4) To elaborate the detailed features of polymer and composite Biomaterials.
5) To learn the applications of Biomaterials.

Course outcomes:

By the end of the course the students are able to

1) Explain types and properties of Biomaterials.
2) Compare the techniques for manufacture of metallic Biomaterials and their use in health care industry.
3) Outline the physiological properties and various techniques for manufacture of ceramic biomaterials.
4) Illustrate the preparation of polymer and composite Biomaterials.
5) Apply the different type of Biomaterials in health industry.

Mapping of Course Outcomes with Program Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	2	1	-	2	2	1	-	1	-	3
2	1	1	2	1	-	2	2	1	-	-	-	3
3	1	1	2	2	-	2	1	2	-	-	-	3
4	1	2	2	2	-	1	1	1	1	1	-	3
5	1	1	2	2	-	1	2	1	1	1	-	3
Average	**1**	**1.2**	**2**	**1.6**	**-**	**1.6**	**1.6**	**1.2**	**1**	**1**	**-**	**3**

UNIT-I

Introduction to Biomaterials: Introduction and importance of biomaterials; Types of biomaterials: metallic, ceramic, polymeric and composite biomaterials; Future trends in biomaterials.

UNIT-II

Metallic Biomaterials: Properties of metallic biomaterials; Stainless steels; CoCr alloys; Ti alloys; Corrosion of metallic implants; Manufacturing of implants. Dental implant and their biocompatibility

UNIT-III

Ceramic Biomaterials: Properties of ceramic biomaterials;Classification according to physiological response of ceramic biomaterials: bioinert, bioactive and bioresorbable ceramics;Deterioration of ceramics;Bio ceramicmanufacturing techniques

UNIT-IV

Polymeric and composite biomaterials: Polymerization and basic structure;Polymers used as biomaterials; Properties of polymeric and composite biomaterials; Sterilization;Surface modifications for improving biocompatibility;Surface-protein interactions.

UNIT-V

Applications of Biomaterials: Applications of biomaterials in tissue engineering; Drug delivery; Biosensing; Diagnostics.

Text Books:

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E An Introduction to Materials in Medicine, (Elsevier Academic Press, ISBN: 0-12-582463-7),2002.
2. 2.J.B. Park and J.D. Bronzino. Biomaterials: Principles and Applications. CRC Press. 2002. ISBN: 0849314917
3. K.C. Dee, D.A. Puleo and R. Bizios. An Introduction to Tissue-Biomaterial Interactions. Wiley 2002. ISBN: 0-471-25394-4.

Reference Books

1. T.S. Hin (Ed.) Engineering Materials for Biomedical Applications. World Scientific. 2004. ISBN 981-256-061-0
2. B. Rolando (Ed.) Integrated Biomaterials Science. Springer. 2002. ISBN: 0-306-46678-3.

20ME O06

NANO MATERIALS AND TECHNOLOGY

Instruction	3L	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
Continuous	40	Marks
Credits	3	

Objectives:

1. Nanotechnology approach and challenges.
2. Materials and characterization procedures.
3. Zero and one dimensional nanostructures.
4. Various fabrication techniques.
5. Special nano materials and nano biomaterials.

Outcomes: At the end of the course, the students are able to

1. Understand the basic concepts, developments and challenges in nanotechnology.
2. Describe the methods of evaluating magnetic and electronic properties, microstructure by spm and atomicforce microscopy.
3. Apply heterogeneous methods and characterization techniques of zero & one dimensional nanostructures.
4. Evaluate various nano material fabrication techniques.
5. Analyze nano materials and nano bio materials for obtaining solutions to societal problems.

UNIT - I

Introduction: Nanoscale, properties at nanoscale, advantages and disadvantages, importance of nanotechnology, bottom-up and top-down approaches, challenges in nanotechnology.

UNIT - II

Materials of Nanotechnology: Introduction, Si-based materials, Ge-based materials, ferroelectric materials, polymer materials, GaAs &InP (HI-V) group materials, nano tribology and materials, characterization using scanning Probe microscope, AFM.

UNIT - III

Nano structures: Zero dimensional nanostructure, synthesis procedure by heterogeneous method, characterization techniques, properties and applications of nano particles

One dimensional nanostructures: Synthesis procedure, characterization procedure and principles involved,properties and applications of nanowires .

UNIT - IV

Nano fabrication: Introduction, basic fabrication techniques by lithography and doping, MEMS fabricationtechniques, nano fabrication techniques by E-beam, nano-imprint fabrication, epitaxy and strain engineering.

UNIT - V

Special nano materials: Introduction, synthesis procedure by metal-polymer, characterization procedures, applications.

Nano biomaterials: Introduction, biocompatibility, anti-bacterial activity, applications.

Text Books:

1. Dieter Vollath, Nanomaterials: An introduction to Synthesis, properties and applications, Wiley, 2013.
2. Guozhong Cao, Nanostructures and Nano Materials, Synthesis properties and applications, Imperial College Press, 2004.
3. Carl C Koch, Nano materials Synthesis, Properties and applications, Jaico Publishing House, 2008.

Suggested Reading:

1. WilliaTllsey Atkinson, Nano Technology, Jaico Publishing House, 2009.
2. George W. Hanson, Fundamentals of Nano electronics, Pearson Education, 2009.

20CS O14

CLOUD TECHNOLOGIES

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Data communication and computer networks.

Course Objectives: The objectives of this course are,

1. To understand the significance services of cloud computing.
2. To understand about the cloud infrastructure and Technologies.
3. To learn the security implementation features in cloud computing.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Understand the need of cloud technology and terminology.
2. Identify and understand the cloud infrastructure.
3. Write scripts for the automation of infrastructure and software deployment
4. Design solutions for the automation and migration of manual data centers.
5. Develop scripts for the automation of cloud services

UNIT – I

Era of Cloud Computing – Motivation, Elastic Computing and advantages- Multi-Tenant clouds, Elastic computing, Virtualized servers uses, Business model for Cloud Providers. Types of Clouds and Cloud Providers, Multi-Cloud, Hyperscalers, advantages of clouds; **Data Centre Infrastructure**- racks, aisles, pods, power and cooling, air cooling, thermal containment and hot/cold aisles, exhaust Ducts, lights-out data centers, smart network interfaces.

UNIT – II

Virtualization and Containers -Virtual machines, hypervisor, approaches to virtualization, advantages and disadvantages of VMs, Virtual I/O devices, VM migration; Traditional apps and elasticity on demand, isolation facilities in an OS, Linux namespaces for isolation, container approaches, Docker.

UNIT – III

Virtual Networks – Goals of a data center network, Network hierarchies, capacity, Fat Tree Designs. Link aggregation, VLANS, VXLAN, NAT, Managing virtualization and mobility, SDNs, openflow protocol, Programming networks; **Virtual Storage**: NAS, SAS, mapping virtual disks to physical disks.

UNIT – IV

Automation and Cloud Programming - Need of automation, levels, AIops, automation tools, automation of manual data center practices, evolution of automation; **Orchestration:** legacy of automating procedures,

larger scope of automation, Kubernetes MapReduce, Microservices, Serverless computing, event processing, DevOps, Edge Computing and IIoT.

UNIT – V

Cloud security and Privacy – cloud specific problems, zero trust security model, identity management, privileged access management(PAM), AI technologies and their effects on their security,
Protection of remote access and privacy in a cloud environment, back doors, side channels and other concerns, firewalls.

Text Books:

1. Douglas Comer "The Cloud Computing Book: The Future of Computing Explained", Chapman and Hall/CRC, 1st Edition Kindle Edition, 2021.
2. Anthony T Velte, Toby J, Robert Elenpeter, "Cloud Computing – A Practical Approach", McGra Hill, 2010.
3. https://www.amazon.in/Cloud-Computing-Book-Future-Explained/dp/0367706806?asin=B097N7NKJD&revisionId=&format=4&depth=1