

COURSE STRUCTURE

Bachelor of Technology

Civil Engineering

Under

Choice Based Credit System (CBCS)

Semester I

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	CONTACT HRS/WK
			L	T	P		
THEORY							
1	BMAS 1101	Engineering Mathematics I	3	1	0	4	4
2	BCHS 0101/ BPHS 0001	Engineering Chemistry/ Engineering Physics	3	1	0	4	4
3	BELH 0001	English Language Skills for Communication - I	2	0	0	2	2
4	BMEG 0001	Basic Mechanical Engineering	3	1	0	4	4
5	BCEG 0102	Basic Surveying	2	1	0	3	3
PRACTICALS							
1	BCHS 0801/ BPHS 0801	Engineering Chemistry/ Engineering Physics Laboratory	0	0	2	1	2
2	BELH 0801	English Language Laboratory - I	0	0	2	1	2
3	BMEG 0800	Engineering Workshop Practice Laboratory	0	0	2	1	2
4	BCEG 0802	Surveying Laboratory	0	0	2	1	2
5	BCEG 0803	Geoinformatics Laboratory	0	0	2	1	2
TOTAL			15	4	10	24	29

Semester II

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	CONTACT HRS/WK
			L	T	P		
THEORY							
1	BMAS 1102	Engineering Mathematics II	3	1	0	4	4
2	BPHS 0002/ BCHS 0101	Engineering Physics -I/ Engineering Chemistry	3	1	0	4	4
3	BELH 0002	English Language Skills for Communication - II	2	0	0	2	2
4	BEEG 1001	Basic Electrical Engineering	3	1	0	4	4
5	BCSG 0002	Computer Programming	2	1	0	3	3
6	BCEG 0203	Fundamental of Mechanics	2	1	0	3	3
PRACTICALS							
1	BPHS 0801/ BCHS 0801	Engineering Physics Lab / Engineering Chemistry Lab.	0	0	2	1	2
2	BELH 0802	English Language Lab. - II	0	0	2	1	2
3	BCEG 0800/ BEEG 0800	Electronics Laboratory/ Electrical Engineering Laboratory	0	0	2	1	2
4	BCSG 0801	Computer Programming Lab.	0	0	2	1	2
5	BCEG 0800	Basic CAD Laboratory	0	0	2	1	2
6	APFJ 0001	Field Project	0	0	2	1	2
TOTAL			18	5	10	28	33

NO.	CODE	SUBJECT	TEACHING SCHEME				CREDIT	CONTACT HRS/WK	PREREQUISITE
			L	T	P	J			
1	BCEC 1001	Mechanics of solids	3	1	0	0	4	4	
2	BCEC 0002	Structural analysis	3	1	0	0	4	4	BCEC 0001
3	BCEC 0003	Design of Reinforced Concrete Structures	3	1	0	0	4	4	BCEC 0002
4	BCEC 0004	Design of Steel Structures	3	1	0	0	4	4	BCEC 0001
5	BCEC 0005	Quantity Surveying and Estimation	3	1	0	0	4	4	
6	BCEC 1006	Building Materials and Construction	3	0	0	0	3	3	
7	BCEC 1007	Construction Management and Equipment	3	0	0	0	3	3	
8	BCEC 0101	Mechanics of fluid	2	1	0	0	3	3	
9	BCEC 0202	Open channel hydraulics	2	1	0	0	3	3	BCEC 0101
10	BCEC 0103	Water Resource Engineering	2	1	0	0	3	3	BCEC 0101
11	BCEC 0201	Geotechnical Engineering	3	1	0	0	4	4	
12	BCEC 0301	Transportation Engineering	3	1	0	0	4	4	
13	BCEC 0401	Environmental Engineering	3	1	0	0	4	4	
PRACTICALS									
14	BCEC 0800	Fluid Mechanics Laboratory	0	0	2	0	1	2	
15	BCEC 0802	Structural analysis Laboratory	0	0	2	0	1	2	
16	BCEC 0803	Structural Detailing Laboratory	0	0	2	0	1	2	
17	BCEC 0804	CAD Laboratory	0	0	2	0	1	2	
18	BCEC 0806	Geotechnical Engineering Laboratory	0	0	2	0	1	2	
19	BCEC 0807	Transportation Engineering Laboratory	0	0	2	0	1	2	

20	BCEC 0808	Environmental Engineering Laboratory	0	0	2	0	1	2	
21	BCEC 0811	Channel Hydraulics Laboratory	0	0	2	0	1	2	
TOTAL			30	10	16	0	48	56	

Professional Electives

Bouquet I: Structural Engineering

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDIT	CONTACT HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P	J				
THEORY										
1	BCEE 0001	Advanced Design of Steel Structure	3	1	0	0	4	4	BCEC 0004	
2	BCEE 0002	Bridge Engineering	3	1	0	0	4	4	BCEC 0003	
3	BCEE 1003	Advanced Design of Concrete Structure	3	1	0	0	4	4	BCEC 0003	
4	BCEE 0004	Matrix Analysis of Structure	3	1	0	0	4	4	BCEC 0002	
5	BCEE 0005	Plastic Analysis of Structure	3	1	0	0	4	4	BCEC 0002	
6	BCEE 0008	Construction Engineering	3	0	0	0	3	3		
7	BCEE 0007	Introduction to Earthquake Engineering	3	0	0	0	3	3		
8	BCEE 0011	Pre-Engineered Buildings	3	1	0	0	4	4		
9	BCEE 0012	Concrete Technology	3	0	0	0	3	3		
10	BCEE 0013	Advance concrete	3	0	0	0	3	3		
10	BCEE 0009	Advanced Construction Engineering	3	0	0	0	3	3		BCEE 0801 & BCEJ 0001
11	BCEE 0010	Earthquake Resistant Design	3	0	0	0	3	3		BCEE 0802 & BCEJ 0002
PRACTICAL										

12	BCEE 0801	Construction Engineering Laboratory	0	0	2	0	1	2		
13	BCEE 0802	Computational Laboratory for Seismic Analysis	0	0	2	0	1	2		
14	BCEE 0803	Advanced Construction Engineering laboratory	0	0	2	0	1	2		
15	BCEE 0812	Concrete Technology Laboratory	0	0	2	0	1	2		
PROJECT										
15	BCEE 0109	Construction Engineering Project	0	0	0	8	2	0		
16	BCEE 0110	Earthquake Resistant Design Project	0	0	0	8	2	0		

Bouquet II: Geotechnical Engineering

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDIT	CONTACT HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P	J				
THEORY										
1	BCEE 1101	Foundation Engineering	3	0	0	0	3	3	BCEC 0201	
2	BCEE 0102	Ground Improvement Engineering	3	0	0	0	3	3	BCEC 0201	
3	BCEE 0103	Earth and Earth retaining structure	3	1	0	0	4	4	BCEC 0201	
4	BCEE 0104	Geotechnical Exploration & Measurement Technique	3	1	0	0	4	4	BCEC 0201	
5	BCEE 0105	Advanced Foundation Design	3	1	0	0	4	4	BCEE 0101	
6	BCEE 0106	Advanced Foundation Engineering	3	0	0	0	3	3	BCEC 0201	BCEE 0803 & BCEJ 0003
7	BCEE 0108	Geosynthetic and Reinforced Soil Structures	3	0	0	0	3	3	BCEC 0201	BCEE 0804 & BCEJ 0004
PRACTICAL										
9	BCEE 0804	Geosynthetics Testing Laboratory	0	0	2	0	1	2		
PROJECT										
10	BCEJ 0003	Foundation Engineering Project	0	0	0	8	2	0		

11	BCEJ 0004	Geosynthetic And Reinforced Soil Structures Project	0	0	0	8	2	0		
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Bouquet III: Water Resource Engineering & Environmental Engineering

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDIT	CONTACT HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P	J				
THEORY										
1	BCEE 0214	Engineering Hydrology	3	1	0		4	4		
2	BCEE 0202	Ground Water Management	3	1	0		4	4		
3	BCEE 0203	Hydro Power Engineering	3	1	0		4	4		
4	BCEE 0204	Hydraulic Structures	3	1	0		4	4	BCEC 0103	
5	BCEE 0211	Introductory Rural water Supply	3	0	0		3	3	BCEC 0401	
6	BCEE 0206	Introduction to Climate Change studies	3	0	0		3	3	BCEC 0401	
7	BCEE 0207	Environmental Instrumentation And Analysis	3	1	0		4	4	BCEC 0401	
8	BCEE 0208	Advanced Geoinformatics	3	0	0		3	3		
9	BCEE 0209	Applied Hydrology	3	0	0	0	3	3		BCEE 0805 & BCEJ 0005
10	BCEE 0210	Advanced Climate Change and Modelling	3	0	0	0	3	3		BCEE 0806 & BCEJ 0006
11	BCEE 0212	Advanced Water Treatment Technologies	3	0	0	0	3	3		BCEE 0807 & BCEJ

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PRACTICAL											
10	BCEE 0805	Applied Hydrology Laboratory	0	0	2	0	1	2			
11	BCEE 0806	Experimental Analysis of Climate	0	0	2	0	1	2			
12	BCEE 0807	Advanced Water Treatment Technologies Laboratory	0	0	2	0	1	2			
PROJECT											
13	BCEJ 0005	Applied Hydrology Project	0	0	0	8	2	0			
14	BCEJ 0006	Climate Change Modelling Project	0	0	0	8	2	0			
15	BCEJ 0007	Water Treatment Project	0	0	0	8	2	0			

Bouquet IV: Transportation Engineering & Construction Management

S. NO	CODE	SUBJECT	TEACHING SCHEME				CREDIT	CONTACT HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P	J				
THEORY										
1	BCEE 0301	Railway Engineering	3	1	0		4	4		
2	BCEE 0302	Basics of Transportation System and Planning	3	0	0		3	3		
3	BCEE 0303	Airport Planning and design	2	1	0		3	3	BCEC 0301	
4	BCEE 0304	Basics of Traffic Engineering	3	0	0		3	3	BCEC 0301	
5	BCEE 0305	Construction Technology & Management	2	1	0		3	3		BCEE 0800
6	BCEE 0306	Transportation System and Planning	3	0	0	0	3	3		BCEE 0808 & BCEJ 0008
7	BCEE 0307	Advanced Traffic Engineering	3	0	0	0	3	3		BCEE 0809 & BCEJ 0009
8	BCEE 0314	Traffic Engineering	4	0	0		4	4		
PRACTICALS										
8	BCEE 0800	Computer Aided Estimation & Planning Laboratory	0	0	2	0	1	2		
9	BCEE 0808	Traffic Simulation And Analysis Laboratory	0	0	2	0	1	2		
10	BCEE	Traffic Engineering	0	0	2	0	1	2		

	0809	Laboratory								
PROJECT										
11	BCEJ 0008	Transportation System and Planning Project	0	0	0	8	2	0		
12	BCEJ 0009	Advanced Traffic Engineering Project	0	0	0	8	2	0		

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HRS/WK	PREREQUISITE	COREQUISITE
			L	T	P	J				
1	BCEJ 0962	Industrial Training	0	0	0	0	2	0		
2	BCEJ 0950	Mini Project I	0	0	0	0	2	0		
3	BCEJ 0952	Mini Project II	0	0	0	0	2	0		
3	BCEJ 0971	Minor Project	0	0	0	0	3	0		
4	BCEJ 0972	Project II	0	0	0	0	8	0		
Total			0	0	0	0	17	0		

BCEG 0102: BASIC SURVEYING

Objective: This course aims to introduce the fundamental surveying and geoinformatics theories, techniques and instruments that are used in civil engineering surveys besides providing practical skills that will be useful for the field work.

Credits: 03

L-T-P-J: 2-1-0-0

Module No.	Contents	Teaching Hours
I	<p>Introduction: Basic concepts of surveying -objectives types of surveying unit of measurement and their types.</p> <p>Linear measurements: Direct distance measurement (chaining and taping), Optical distance measurement, EDM, errors in distance measurement and precautions or corrections</p> <p>Angle Measurements: Concept of direction, bearing and azimuths magnetic declination, compass surveying local attraction, theodolite, fundamental characteristics of theodolite and adjustments, measurements of horizontal angle, sources of error.</p> <p>Vertical Control: Levelling principles basic terms and definitions leveling instruments determination of height, booking and reduction of field notes, sources of error and minimization, curvature and refraction effects, types of levelling Trigonometrical levelling contours characteristics methods of contouring principles of stadia systems Subtense bar and tangential methods.</p>	25
II	<p>Position and Control Survey: Control Networks Control Survey Traversing Triangulation, Trilateration, and Triangulation: types field procedure, error minimization, Coordinate systems and datum transformation-Important surfaces in geodesy: earth surface, geo id, MSL, reference ellipsoid, Reference systems 2D and 3D coordinate systems and transformations map projection, UTM projection, plane table surveying</p> <p>Errors and adjustments: Sources of errors, types accuracy and precision, propagation of variance/covariance and adjustment of errors.</p> <p>Curves: Principle of setting out, special instruments for setting out, setting out a highway curve, elements of simple circular curves theory and methods of setting out simple circular curves Transition curves- types and their characteristics, Ideal transition curve, equations of various transition curves introduction to vertical curves.</p> <p>Photogrammetry: Scales relief displacement, flight planning characteristics of photographic image, fundamentals of aerial photo-interpretation, application of photogrammetry, stereoscopy, Stereo- parallax measurements</p> <p>Introduction to Remote Sensing basic concepts of GIS and GPS</p>	25

Text Books:

- K.R, Arora Surveying, Vol. 1 and 2. Standard Book House, New Delhi. (2010).
- S.K. Duggal, Surveying, Vol. 1 and 2, Tata McGraw Hill Education Private Limited, Noida. (2009)
- T.P. Kanetkar, and Kulkarni, S.V. Surveying and Levelling, Vol. 1 and 2, Vidyarthi Griha Prakashan (2008),
- B.C Punmia, Jain, A.K., and A.K. Jain, Surveying and Levelling, Vol. 1 and 2, Standard Publishers, New Delhi. (2005),

Reference Books

- W. Schofield, and M.Breach, Engineering Surveying, Butterworth-Heinemann publisher R. Subramanian, Surveying and Levelling, Oxford University Press, New Delhi. (2007),
- C. Venkatramaiah, Text Book of Surveying, University Press, Hyderabad. (2011),

Focus: This course is employable under CO2 and CO3

Outcome: *At the end of the course the student will be able to*

- CO1: Illustrate earth geometrics, types of scale and linear measurements using direct and electronic distance-measuring techniques.
- CO2: Determine horizontal angles, vertical angles, and height of any point using a compass, theodolite, and total station.
- CO3: Describe leveling and its type along with the curvature and refraction.
- CO4: Explain triangulation, trilateration, errors, and adjustments in surveying.
- CO5: Understand curves, photogrammetry, relief displacements, stereoscopy, and the use of remote sensing, GPS, and GIS in advanced surveying.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO12/PSO2
CO2	PO1,PO2,PO12/PSO2,
CO3	PO1,PO2,PO3,PO12/PSO2
CO4	PO1,PO2,PO12/PSO2, PSO3
CO5	PO1,PO2,PO12/PSO2, PSO4

BCEG 0802: SURVEYING LABORATORY

Objective: To gain knowledge about Survey field techniques.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> • Introduction to surveying techniques • Chain Surveying • Compass Surveying (Prismatic and Surveyor) • Level Surveying(levelling) • Theodolite Surveying • Plane Table Surveying • Total Station Surveying • GPS 	20

Text Books:

- K.R, Arora Surveying, Vol. 1 and 2. Standard Book House, New Delhi. (2010).
- S.K. Duggal, Surveying, Vol. 1 and 2, Tata McGraw Hill Education Private Limited, Noida. (2009)
- T.P. Kanetkar, and Kulkarni, S.V. Surveying and Levelling, Vol. 1 and 2, Vidyarthi Griha Prakashan (2008),
- B.C Punmia, Jain, A.K., and A.K. Jain, Surveying and Levelling, Vol. 1 and 2, Standard Publishers, New Delhi. (2005),

Reference Books

- W. Schofield, and M.Breach, Engineering Surveying, Butterworth-Heinemann publisher R. Subramanian, Surveying and Levelling, Oxford University Press, New Delhi. (2007),
- C. Venkatramaiah, Text Book of Surveying, University Press, Hyderabad. (2011),

Focus: This course is skill development under CO2 and CO3

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic surveying techniques
- CO2: Fundamentals of levelling
- CO3: Develop basic know about theodolite.
- CO4: Understand the Electronic Distance Measuring techniques

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PS01
CO2	PO1,PO2 /PS01
CO3	PO1,PO2 /PS01
CO4	PO1,PO2 /PS01

BCEG 0803: GEOINFORMATICS LABORATORY

Objective: To learn different practical aspects of Remote Sensing, GIS and GPS

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Contents	Teaching Hours
I	<ul style="list-style-type: none"> • Measurement of Coordinates using GPS receiver • Geo-referencing of Satellite Image using GIS software • Shape file creation and Attribute table data entry using GIS software. • Digitization of physical features on a map/image using GIS software. • Classification of Image using Remote Sensing Software. • Land use and Land cover Mapping using Remote Sensing Software • Demonstration and working with Mirror stereoscopes and Aerial photographs. • Visual and Digital Interpretation of standard FCC (False colour composite) using Interpretation keys. 	20

Text Books:

- M. Reddy Anji, *Textbook of Remote Sensing and Geographical Information systems*, BS Publications, Hyderabad. 2011
- M. Thomas Lillesand, W. Ralph Kiefer, W. Jonathan Chipman *Remote sensing and image interpretation* John Wiley & Sons, 2008

Reference Books:

- Kang tsung Chang, *Introduction to Geographical Information System*, Tata McGraw Hill, 7th edition, 2010
- A.M. Chandra and S.K. Ghosh. *Remote Sensing and Geographical Information system*. Narosa Publishing House, New Delhi. 2006

- **Focus:** This course is skill development under CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the different types of software of Geo-Informatics
- CO2: Learn to Digitization, Geo-referencing, and image classification
- CO3: Understand the Practical Use of GPS Receiver
- CO4: Understand the Remote Sensing process
- CO5: Understand the image interpretation using FCC

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,P02 /PS01
CO2	PO1,P02 /PS01
CO3	PO1,P02 /PS01
CO4	PO1,P02 /PS01
CO5	PO1,P02 /PS01

BCEG 0203: FUNDAMENTAL OF MECHANICS

Objective: This course includes basics of mechanics, role of scalars and vectors, equilibrium of forces, friction and their role in civil engineering.

Credits: 03

L-T-P-J: 2-1-

0-0

Module No.	Content	Teaching Hours
I	Introduction: Scalars and Vectors, Vectors addition of Forces, Addition of Coplanar forces, Cartesian Vectors, Position Vectors, Forces along a line, Dot product Equilibrium: Equilibrium of a Particle and Free –Body Diagrams, Coplanar Force System, Three-Dimensional Force Systems, Cross Product, Moment of a Force and Principle of Moments, Moment about an axis, Moment of a Couple Dry Friction: Dry Friction, Problems Involving Dry Frictions Center of Gravity and Centroid for Composite Bodies, Moment of Inertia for Areas, Parallel –Axis Theorem, Moment of Inertia for Composite Areas.	20
II	Beams: Supports, types of beams, Different Loading, Equilibrium of a Rigid Body, Internal Forces, Shear and Moment Equations Trusses: Simple trusses, The Method of Joints, Zero Force Members, The Method of Sections. Kinematics: Types of Motion, Kinematics for rigid body, Relative velocity, D’Alembert’s Principle and Dynamic Equilibrium	20

Text Books:

- Beer, F.P and Johnston Jr. E.R., “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
- Vela Murali, “Engineering Mechanics”, Oxford University Press (2010)

Reference Books:

- Bhavikatti, S.S and Rajashekarappa, K.G., “Engineering Mechanics”, New Age International (P) Limited Publishers, 1998.
- Hibbeler, R.C and Ashok Gupta, “Engineering Mechanics: Statics and Dynamics”, 11th Edition, Pearson Education 2010.
- Irving H. Shames and Krishna Mohana Rao. G., “Engineering Mechanics – Statics and Dynamics”, 4th Edition, Pearson Education 2006.
- Meriam J.L. and Kraige L.G., “ Engineering Mechanics- Statics – Volume 1, Dynamics- Volume 2”, Third Edition, John Wiley & Sons,1993.
- Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

Focus: This course is skill employability under C03 and C04

Outcome: After completion of course, the student will be able to:

- CO1: Illustrate scalars and vectors, vector addition, vector multiplication etc.

- CO2: Determine Equilibrium of a Particle and Free –Body Diagrams, Coplanar and three-dimensional Forces, Cross Product, Moment of a Force and Principle of Moments, Moment about an axis, Moment of a Couple.
- CO3: Calculate Forces and couple Systems, Equilibrium of a Rigid Body, Simple trusses, The Method of Joints, Zero Force Members, The Method of Sections.
- CO4: Explain Shear Force and Bending Moment and their diagrams for different loadings.
- CO5: Compare dry friction, center of gravity, centroid for Composite Bodies, Moment of Inertia for Areas, Parallel –Axis Theorem.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO2
CO2	PO1,PO2 /PSO2
CO3	PO1,PO3 /PSO2
CO4	PO1,PO3 /PSO2
CO5	PO1,PO2 /PSO2

BCEC 1001: MECHANICS OF SOLIDS

Objective: To provide basic knowledge in mechanics of materials so that the students can solve real engineering problems and design engineering systems.

Credits: 04
0-0

L-T-P-J: 3-1-

Module No.	Content	Teaching Hours
I	Stress and Strain: Introduction, Properties of Materials, Stress, Strain, Hook's law, Poisson's Ratio, Stress – Strain Diagram for structural steel and nonferrous materials, Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Elongation due to self – weight, Thermal stresses. Composite section, Volumetric strain, expression for volumetric strain, Elastic constants, relationship among elastic constants, Thermal stresses (including thermal stresses in compound bars). Strain Energy & Impact loading. Compound Stresses: Introduction, Stress components on inclined planes, General two-dimensional stress system, Principal planes and stresses and Mohr's circle of stresses. Stresses in Beams: Review of Pure Bending, Shear Stresses in Beams due to Transverse Loading, Composite Beams. Review of Torsion Combined Bending and Torsion of Solid, Hollow circular Shafts, Strain energy due to torsion	20
II	Bending moment and shear force in beams: Introduction, shearing force in beam, bending moment, Sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, SFD and BMD with salient values for cantilever beams, simply supported beams and overhanging beams considering point loads, UDL, UVL and Couple. Bending and shear stresses in beams. Deflection of Beams: Equation of Elastic Curve, Slope and Deflection method, Double Integration Method, Moment Area Method, Conjugate Beam Method. Columns and Struts: Combined Bending and Direct Load on Short Column, Middle Third and Middle Quarter Rules, Euler's theory for Long Columns, Rankine-Gordon Formula, and Simple Cases of Beam Columns. Strain Energy: Strain energy of deformable systems, Maxwell's reciprocal and Betti's theorem, Castigliano's first theorem, Unit load method	20

Text Books:

- J.P Singh, "A Textbook of Mechanics of Solids", New Delhi, Khanna Publishers, 2000.
- Rattan, Strength of Materials, 2e McGraw Hill Education India, 2011
- S.Jose, Sudhi Mary Kurian, Mechanics of Solids, Pentagon, 2015

Reference Books:

- J.M. Gere, and S.P Timoshenko, "Mechanics of Materials", New Delhi, CBS Publishers, 2004.
- R.C. Hibbeler, "Mechanics of Materials", New Delhi, Pearson Education Limited, 2007.
- M. Merriman, , "Mechanics of Materials", New York, USA, John Wiley and Sons, 2010.
- A. Pytel, and J. Kiusalaas, , "Mechanics of Materials", New Delhi, Cengage Learning, 2003.
- G.H Ryder, "Strength of Materials", New Delhi, Macmillan India Limited, 2002.
- J.P. Singh, , "A Textbook of Mechanics of Solids", New Delhi, Khanna Publishers, 2000.

Focus: This course focuses on employability aligned with CO3 and CO4

Course Outcomes:

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

- CO1: Understand the static equilibrium equation; its use to find out the forces and stresses
- CO2: Discuss the theory of elasticity including strain/displacement and Hooke's law relationships
- CO3: Solve torsion problems in bars and thin walled members;
- CO4: Apply various failure criteria for general stress states at points

- C05: Obtain solutions to column buckling and plate problems;
- C06: Analyze solid mechanics problems using classical methods and energy methods

	POs / PSOs
C01	P01, P02/PS02
C02	P01, P02/PS02, P03
C03	P01, P02/PS02, P03
C04	P01, P02/PS02, P04,
C05	P01, P02/PS02, P03, P04, P05
C06	P01, P02/PS02, P03, P04, P05

BCEC 0002: STRUCTURAL ANALYSIS

Objectives:

- To impart the principles of elastic structural analysis and behavior of indeterminate structures
- To impart knowledge about various methods involved in the analysis of indeterminate structures
- To apply these methods for analyzing the indeterminate structures to evaluate the response of structures
- To make the student familiar with latest computational techniques and software used for structural analysis

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Contents	Teaching Hours
I	<p>Introduction: Analysis of Complex and Compound trusses.</p> <p>Rolling Loads and Influence Lines: Rolling loads, Cases of single concentrated load, Uniformly distributed load, Several concentrated loads, Influence lines for beams and trusses, Absolute maximum bending moment, Muller-Breslau's principle and its application to determinate structures.</p> <p>Influence Lines: Indeterminate Structures using Muller-Breslau's principle</p>	20
II	<p>Analysis of Three-Hinged Arches: Three hinged parabolic and circular arch, Spandrel braced arch, Influence lines for three-hinged arch, Linear arch, Eddy's theorem.</p> <p>Analysis of Two-Hinged Arches: Analysis of horizontal thrust, Bending moment, Normal thrust, and Radial shear, Influence lines.</p> <p>Analysis of Indeterminate Structures: Slope-Deflection method, Moment Distribution method, Strain Energy method for Fixed beams, Continuous beams, Propped cantilevers and Simple frames with or without joint displacement.</p>	20

Text Books:

- C.S Reddy, *Basic Structure Analysis*, New Delhi: Tata McGraw-Hill; 2005.
- T. S Thandavamoorthy, *Analysis of Structures: Strength and Behaviour*, New Delhi: Oxford University Press; 2005.

Reference Books:

- R. Hibbeler, *C. Structural Analysis*, New Delhi: Pearson Publishers; 2008.
- A.K. Jain,, *Theory and Analysis of Structures, Vol. I and II*, Roorkee: Nem Chand & Bros; 2009.
- C.H. Norris and J.B. Wilbur, *Elementary Structural Analysis*, New Delhi: Tata McGraw Hill; 2007.
- V.N. Vazirani, M.M. Ratwani, and S.K. Duggal, *Structural Analysis of Structures*, Vol. 1 and 2, 17th edition, New Delhi: Khanna Publishers; 2000.
- C.B Kukreja, *Indeterminate Structural Analysis* New Delhi: Standard Publishers Distributors; 2000.
- O.P. Jain, and B.K. Jain, *Theory and Analysis of Structures, Vol. I and II* Roorkee: Nem Chand and Bros; 2009.

Focus: This course focuses on employability aligned with CO3 and CO4

Course Outcomes:

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

- CO1: Understand the behavior of structure under the loadings.
- CO2: Discuss how the truss member performance under the loads and by how many ways we can determine the generated forces at the joints.
- CO3: Demonstrate the use of different type of arches in structure
- CO4: Analyze the behavior of bridge decking under the movable loads.
- CO5: Analyze the beams, frames and trusses by different methods.
- CO6: Analyze the indeterminate structures like beams, trusses and frames by various force and displacement methods

	POs / PSOs
CO1	PO1, PO2/PSO2

C02	P01, P02/PS02, P03
C03	P01, P02/PS02, P03
C04	P01, P02/PS02, P04,
C05	P01, P02/PS02, P03, P04, P05
C06	P01, P02/PS02, P03, P04, P05

BCEC 0003: DESIGN OF REINFORCED CONCRETE STRUCTURE

Objective: The objective of this course is to develop an understanding of the basic concepts of RCC design including various design philosophies and the design and analysis of various structural elements, such as beams, columns and slabs in bending and shear, using Limit State Design Method.

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	Introduction: Introduction to various design philosophies, Design of rectangular singly and doubly reinforced sections by Working Stress Method, Limit State Method, Design and analysis of T- Beams, L-Beams by Limit State Design Method. Behavior of RC Beam in Shear: Shear Strength of Beams with and without shear reinforcement, Minimum and Maximum shear reinforcement, Design of beam in shear, Development Length, Anchorage Bond, Flexural Bond, Failure of Beam under Shear, Concept of Equivalent Shear and Moments.	18
II	Design of Slab: Design of One Way and Two Way solid slabs, Circular slab by Limit State Design Method, Serviceability, Control of Deflection, Cracking and Vibrations. Introduction to Flat Slabs. Design of Columns: Limit State Design Method, Effective height of columns, Minimum eccentricity, Short column under axial compression, Requirements for Reinforcement, Column with helical reinforcement, Short column under axial load and uniaxial bending, Design of columns under bi-axial loading by Design Charts.	22

Text Books:

- P. Dayaratnam Limit State Design of Reinforced Concrete Structures New Delhi: Oxford Publishers; 2008.
- M.L Gambhir Fundamentals of Reinforced Concrete Design New Delhi: PHI Publisher; 2009.
- IS: 456:2000 Plain and Reinforced Concrete - Code of Practice New Delhi: Bureau of Indian Standards.
- K. Jai Plain and Reinforced Concrete Vol.1 Roorkee: Nem Chand Brothers;2007.
- A.K. Jain Reinforced Concrete: Limit State Design Roorkee: Nem Chand and Brothers; 2007.

Reference Books:

- K. Raju Pre stressed Concrete New Delhi: Tata McGraw Hill; 2007.
- D. Menon and S. Pillai, Reinforced Concrete Design New Delhi: Tata McGraw Hill; 2007

Focus: This course focuses on employability aligned with CO2 and CO3

Outcome: After completion of course, the student will be able to:

- CO1: Understand design philosophies used for design of singly and doubly reinforced sections.
- CO2: Apply LSM for the design and analysis of RCC beams in bending.
- CO3: Examine the behavior of RCC beams in shear.
- CO4: Describe various Limit States of LSM for the design of one-way and two-way slabs.
- CO5: Determine the effective height, minimum eccentricity and reinforcement requirements for columns

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO2
CO2	PO1,PO2/PSO2
CO3	PO1,PO4/PSO2

C04	PO1/PSO2
C05	PO1,PO2,PO3/PSO2

BCEC 0004: DESIGN OF STEEL STRUCTURES

Objective: To develop the ability to analyze and design steel structural members

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	<p>General Considerations: Introduction, Advantages and Disadvantages of Steel as a Structural Material, Structural Steel, Rolled Steel Sections, Convention for Member Axes. Various loading condition for steel structure</p> <p>Simple Connections: Riveted, Bolted and Pinned</p> <p>Connections: Introduction, Riveted Connections, Patterns of Riveted Joints, Bolted Connections, Types of Bolts, Types of Bolted Joints, Load Transfer Mechanism, Failure of Bolted Joints, Specification for Bolted Joints, Bearing-Type Connections, Tensile Strength of Plate, Efficiency of the Joint, Combined Shear and Tension</p>	20
II	<p>Weld Connections: Types, Symbols, Weld Defects, Inspection of Welds, Assumptions in the Analysis of Welded Joints, Design of Groove Welds, Design of Fillet Welds, Fillet Weld Applied to the Edge of A Plate or Section, Fillet Weld for Truss Members, Design of Intermittent Fillet Welds, Plug and Slot Welds, Stresses Due to Individual Forces, Combination of Stresses, Failure of Welds, Fillet Weld Versus Butt Weld, Welded Jointed Versus Bolted and Riveted Joints.</p> <p>Tension Members: Introduction, Types of Tension Members, Net Sectional Area, Effective Net Area, Types of Failure, Design Strength of Tension Members, Slenderness Ratio, Displacement, Design of Tension Member, Lug Angles, Splices, Gusset Plate.</p> <p>Compression Members: Introduction, Effective Length, Slenderness Ratio, Types of Sections, Types of Buckling, Classification of Cross Sections, Column Formula, Design Strength, Design of Axially Loaded Compression Members. Built-Up Columns: Latticed Columns, Battening system Beams: Introduction, Types of Sections, Behavior of Beam in Flexure, Section Classification, Lateral Stability of Beams, Lateral-Torsional Buckling, Bending Strength of Beams, Laterally Supported Beams, Laterally Unsupported Beams, Shear Strength of Beams, Web Buckling, Bearing Strength, Web Crippling, Deflection, Design Procedure of Rolled Beams, Introduction to Plate Girder, Introduction to Gantry Girder.</p>	20

Text Books:

- S.S. Bhavikatti, "Design of Steel Structures", by Limit State Method as per IS:800-2007, New Delhi I.K. International Pvt. Ltd, 2009.
- S.K. Duggal, "Limit State Design of Steel Structures", New Delhi, Tata McGraw Hill, 2010.

Reference Books:

- R.E. Englekirk, "Steel Structures: Controlling Behavior through Design", New Delhi, John Wiley and Sons Publishers, 1994.
- K.S. Sai Ram, "Design of Steel Structures", New Delhi, Pearson Publishers, 2010.
- N. Subramanian, "Design of Steel Structures", New Delhi, Oxford University Press, 2011.

Focus: This course focuses on employability aligned with CO4 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: Analyze the steel as a structural material.
- CO2: Understand design philosophies and behavior of structural steel.
- CO3: Analyze and design Tension members, Compression members, Flexural members.
- CO4: Apply Design concepts to structural steel fabrication.
- CO5: Design steel structures as per industrial consideration.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01,P02, PO3, PO4/PS01, PS02
C02	P01,P02 PO3, PO4 /PS01, PS02
C03	P01,P02 PO3, PO4/PS01, PS02
C04	P01,P02 PO3, PO4/PS01, PS02
C05	P01,P02 PO3, PO4/PS01, PS02

BCEC 0005: QUANTITY SURVEYING AND ESTIMATION

Objective: To know the importance of preparing the types of estimates under different conditions with different specifications and rate analysis. And to know the basic of contract management and valuation.

Credits:04

L-T-P-J:3-1-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction to estimates: Purpose of estimating; Different types of estimates - their function and preparation; Building estimates: Schedule of rates, Units of measurements, units of works; Road Estimates – Volume of earthwork, Different methods, Earthwork for hill roads; Railway and canal works – Estimates for a new track railway line; earthwork in canals.</p> <p>Analysis of rates: Preparation for analysis of rates. Quantity of materials per unit rate of work, labour estimate.</p>	22
II	<p>Specifications: Necessity, types of specifications, specifications for different civil engineering materials.</p> <p>Contracts: Essentials of contracts, types of engineering contracts – advantages and disadvantages.</p> <p>Tenders: tender forms, tender documents & notices – time limits, necessity.</p> <p>Valuation: Purpose, difference between value and cost, qualifications and functions of a valuer, scrap & salvage value, sinking fund, capitalised value.</p>	18

Text Books:

- M, Chakraborti, *Estimation costing, specifications and valuation in civil engineering* Calcutta: National Halftone Co.; 2005.
- B.N. Dutta, *Estimation and costing in civil engineering: theory and practice* New Delhi: UBS Publishers Distributors Ltd; 2006.

Reference Books:

- G.S. Birdie, - *Estimation and costing in civil engineering* 6thed. New Delhi: Dhanpat Rai Publishing co. Ltd; 2014.
- J. Singh G. Singh, *Estimating Costing and Valuation, Standard Publishers. 2018*

Focus: This course focuses on employability aligned with CO2 and CO3

Outcome: After completion of course, the student will be able to:

- CO1: Gain the ability to learn the various principles of computations related to quantity surveying.
- CO2: Calculate the quantity of materials required for civil engineering works as per specifications.
- CO3: Estimate the calculation of earthwork quantity for roads and canals.
- CO4: Analyze the rates of work quantities and labour.
- CO5: Understand the basic of contract, tender & valuation

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,PO2 /PS01, PS02
C02	PO1,PO2,PO3,PO4,PO5/PS01, PS02,PS04
C03	PO1,PO2,/PS01, PS02, PS04
C04	PO1,PO2,PO3,PO5/PS01,PS02
C05	PO6,PO8,PO11/PS01,PS02,PS03,PS04

BCEC 1006: BUILDING MATERIALS AND CONSTRUCTIONS

Objectives:

The objective of this course is

- Identify various building materials and their structural requirements.
- Discuss about various building services and planning and their characteristics

Credits:03

L-T-P-J: 3-0-0-0

Module No.	Contents	Teaching Hours
I	<p>Building Stones: Classification of Rocks-Geological classification, Chemical Classification, Physical classification, general characteristics of stones-marble, kota stone, granite, sand, trap, basalt stone, lime stone and slate.</p> <p>Brick and Tiles: Introduction to bricks, Raw materials for brick manufacturing and properties of good brick making earth, Manufacturing of bricks, classification and specification of bricks as per BIS:1077, testing of bricks, Brick Masonry- Definition of terms like header, stretcher, queen closer, king closer, frog and quoin, course, bond, facing.</p> <p>Cement: Introduction, raw materials, flow diagram of manufacturing of cement, Various types of Cements, their uses and testing.</p> <p>Lime: Classification and types of lime & properties of lime.</p> <p>Timber: Classification & Identification of Timber, Properties of timber, defects in timber, factors affecting strength of timber, method of seasoning & preservation of timber.</p> <p>Metal: Ferrous Metals- Composition, properties and uses of cast iron, mild steel, HYSD steel, high tension steel as per BIS, Commercial forms of ferrous, metals, Aluminum and Stainless Steel.</p> <p>Concrete: Composition of concrete, manufacturing process, physical properties, Acceptance criteria, Concrete Grades, Test on concrete.</p> <p>Paints and Varnishes.</p>	15
II	<p>Introduction: Definition of a building, classification of buildings based on occupancy, Different parts of a building.</p> <p>Damp Proofing and Water Proofing: Dampness and its ill effects on different material and civil engineering works.</p> <p>Doors and Windows: Types of doors and windows and their uses.</p> <p>Floors: Glossary of terms-floor finish, topping, under layer, base course, rubble filling and their purpose, Types of floor finishes.</p> <p>Roofs: Types of roofs, concept of flat, pitched and arched roofs, Glossary of terms for pitched roofs - batten, eaves, fascia board, gable, hip, lap, purlin, rafter, rag bolt, valley, ridge, rain water gutter, anchoring bolts</p> <p>Arches and Lintels: Meaning and use of arches and lintels- Glossary of terms used in arches and lintels - abutment, pier, arch ring, intrados, soffit, extrados, voussoiers, Springer, springing line, crown, key stone, skew back, span, rise, depth of an arch, haunch, spindle, jambs, bearing, thickness of lintel, effective span, Arches- Types of Arches</p> <p>Stairs: Glossary of terms: Staircase, winders, landing, stringer, newel, baluster, riser, tread, width of staircase, hand-rail, nosing, Classification of staircase on the basis of material.</p>	15

Text Books:

- S. K. Duggal, "Building Materials", New Age International Publishers 2019
- S. Kumar "Building Materials and construction", Standard Publishers, 20th edition, reprint, 2015
- Dr. B. C. Punmia, Ashok kumar Jain, Arun Kumar Jain, "Building Construction", Laxmi Publications (P) ltd., New Delhi. 2016
- S. C. Rangawala "Engineering Materials||", Charter Publishing House, Anand, India 2017

Reference Books:

- PC Verghese, “Building Construction”, PHI. 2016
- R. Chuddy, “Construction Technology”, Vol 1&2, Longman UK. 2008
- S. Chander, “Basic Civil Engineering”, Jain Brothers.
- M S Shetty; Concrete Technology, S. Chand Publication New Delhi 2018
- P Kumar Mehta, Monteiro; Concrete Technology, Indian Concrete Institute
- A R Santhakumar; Concrete Technology, Oxford University Press 2018
- A.M.Neville; Properties of Concrete, Pearson Education 2002
- M L Gambhir; Concrete Technology, Tata McGraw Hill 2017
- IS 456-2000, IS 269-1989, IS 516-1959, IS 1786-1985, IS 1893-2002, IS 12269-1987, IS 10262-2009

Focus: This course focuses on employability aligned with CO2 and CO3

Outcomes:

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

- C01: Understand properties of different building materials.
- C02: Study quality control tests on Cement and concrete.
- C03: Understand the properties of timber, metal, paints, varnishes, tar and bitumen.
- C04: Study suitable type of flooring and roofing in the construction process.
- C05: Study suitable types of Arches and lintel, and terminology of stair.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,PO3 /PSO3
C02	PO1,PO2,P05 /PSO3
C03	PO1,PO2,P05,P05 /PSO3
C04	PO1,PO2,PO3 /PSO3
C05	PO1,PO2 /PSO3

BCEC 1007: CONSTRUCTION MANAGEMENT AND EQUIPMENTS

Objective: This course provides a comprehensive treatment of the materials and civil engineering principles which results in production and construction of high-quality concrete for buildings and infrastructure

Credits: 03

L-T-P-J : 3-0-0-0

Module No.	Content	Teaching Hours
I	Construction Planning: Introduction, activities involved types of project plan, work breakdown structure. Planning terminologies, Critical path method, forward and backward pass (AOA method), PERT. Project scheduling and resource leveling: Introduction to Resource allocation and leveling for unlimited resources.	15
II	Contracts Estimation and Bidding Strategy: Introduction to determination of bid price. Introduction to excavation and earthmoving equipment, Concreting equipment, Road making equipment: Types and Uses	15

Text Books:

- P.S. Gahlot, and B.M. Dhir, "Construction Planning and Management", New Delhi, New Age International (P) Ltd., Publishers., 2007.
- P. Chandra, Project- Planning, analysis, selection, financing, implementation and review. Tata McGraw-Hill, New Delhi. 2007.
- P. Joy, Handbook of construction management. Macmillan Indian Limited, New Delhi. 2007.

Reference Books:

- G. Ritz, Total construction project management. McGraw-Hill, Singapore. 1994.
- BMPTC. BMPTC Directory of construction equipment and machinery manufactured in India. BMPTC, New Delhi. 2001.
- R. Peurifoy, C. Schexnayder, Construction planning, equipment, and methods. Tata McGraw-Hill, New Delhi. 2002.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcomes: After completion of course, the student will be able to:

- CO1: Understand the principles of project management, resource management and inventory.
- CO2: Prepare work break down plan and estimate resources requirements.
- CO3: Solve problems of resource allocation and leveling using network diagrams.
- CO4: Understand basics of procurement for works, goods, and consulting services.
- CO5: Understand about the various plant and equipment's used in construction operations

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PS04
CO2	PO1,PO2/PS04
CO3	PO1,PO2/PS04
CO4	PO1,PO3/PS04
CO5	PO1,PO2/PS04

BCEC 0101: MECHANICS OF FLUIDS

Objective: This course includes basics of fluid behavior in its static and dynamic conditions. These are required for courses on Channel Hydraulics, Hydrology, and Water Resources Engineering besides other courses in Civil Engineering such as Environmental Engineering, Structural Engineering, Geo-Technical Engineering.

Credits: 03

L-T-P-J: 2-1-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: Fluid, Rheology of Fluids, Continuum Principle, and Physical Properties of Fluids.</p> <p>Fluid Statics: Surface and Body Forces in a Fluid, Basic Equations, Piezometer and Manometer, Buoyancy, Stability of submerged and floating bodies.</p> <p>Fluid Kinematics: Methods of describing fluid motion, Types of fluid flow, Velocity field, Acceleration, Continuity equation, Velocity Potential Function & Stream function.</p>	15
II	<p>Fluid Dynamics: Momentum equation for steady flow, Momentum correction factor, Euler's equations, Bernoulli's equation and its applications, and Energy correction factor.</p> <p>Dimensional Analysis: Dimensional Analysis and its use, Buckingham's Π theorem, Determination of Π parameters and empirical relation for fluid flows, Significance of major dimensionless numbers.</p> <p>Boundary Layer Theory & Viscous Flows: Boundary layer over a flat plate, Laminar and turbulent boundary layers, Boundary layer thicknesses. Laminar flow in Circular Pipes, Stokes's Law, Frictional Head Loss & Minor losses in Circular Pipes.</p>	15

Text Books:

- G.L. Asawa, (2009), Fluid Flow in Pipes and Channels, CBS Publishers and Distributors, New Delhi.
- V. Gupta, and S.K. Gupta, Fluid Mechanics and its Applications, New Age International (P) Limited, Publishers, New Delhi. (1984),

Reference Books:

- B.S. Massey, (revised by John Ward-Smith), Mechanics of Fluids, Chennai Micro Print Pvt Ltd Chennai. 1998
- V.L. Streeter, E.B. Wylie, and K.W. Bedford, , Fluid Mechanics, McGrawHill Companies, Singapore 1998

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the fundamentals of fluid with its properties
- CO2: Determine the basic equations of fluid statics and fluid kinematics
- CO3: Calculate discharge through various flow measurement devices and pipe losses using Bernoulli's equation
- CO4: Explain similarity laws and dimensionless numbers with its law's
- CO5: Compare different types of viscous flows in pipes with its losses
- CO6: Describe boundary layer theory with its applications

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,PO2 /PS01
C02	PO1,PO2 /PS01
C03	PO1,PO2 /PS01

C04	P01,P02 /PS01
C05	P01,P02 /PS01
C06	P01,P02 /PS01

BCEC 0202: OPEN CHANNEL HYDRAULICS

Pre-requisite course: fluid mechanics

Objective:

- This course includes basics of open channel flow required for design of channels for any water resource project.
- Requirement of efficient channel section and design procedure for efficient channel section
- Understand the characteristics of varied flow

Credits: 03

Semester IV

L-T-P: 2-1-0

Module No.	Contents	Teaching Hours
I	<p>Introduction to Free Surface Flow: Types of channels, comparison between pipe and channel flows, Geometric elements of a channel section, Classification of open channel flows, basic equations governing channel hydraulics, Velocity variation in a channel section, Measurement of velocity in a channel.</p> <p>Uniform Flow in Channels: Flow resistance in channel flow, Theoretical and empirical resistance relationships for channel flows, Normal depth and its computation for different channel cross-sections. Most efficient cross-sections for rigid boundary channels.</p> <p>Critical Flow in Channels: Specific energy, Critical depth computations, Applications of critical flow concepts.</p>	15
II	<p>Gradually Varied Flow: Basic equation and its various forms for gradually varied flow (GVF), Characteristics and computation of GVF profiles in prismatic and non-prismatic channels.</p> <p>Rapidly Varied Flow: Hydraulic jump and its types, Applications of Hydraulic Jump.</p> <p>Fluvial Hydraulics: Incipient motion, Regimes of flow</p>	15

Text Books:

- G.L. Asawa, , “Fluid Flow in Pipes and Channels”, CBS Publishers and Distributors, New Delhi. 2009
- R.H. French, , “Open-Channel Hydraulics”, McGraw-Hill Book Company, Singapore. 1994
- C.S.P. Ojha, R, Berndtsson, and P.N. Chandramouli, (2010), “Fluid Mechanics and Machinery”, Oxford University Press, New Delhi.

Reference Books:

- K.G. RangaRaju, (1993), “Flow through Open Channels”, Tata McGraw-Hill, Publishing Company Ltd., New Delhi.
- K. Subramanya, (1996), “Flow in Open Channels”, Tata McGraw-Hill, Publishing Company Ltd., New Delhi.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Differentiate between open channel flow and pipe flow
- CO2: Various forces acting in open channel flow
- CO3: Design of efficient channel section
- CO4: Understand the characteristics of varied flow
- CO5: Uses of hydraulic jump
- CO6: Comprehensive study in fluvial hydraulics

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1

C02	P01,P02 /PS01
C03	P01,P02,P03 /PS01
C04	P01,P02 /PS01
C05	P01,P02 /PS01
C06	P01,P02 /PS01

BCEC 0103: WATER RESOURCE ENGINEERING

Objective: To impart the knowledge of various aspects of water resources engineering

Credits: 03

L-T-P-J: 2-1-0-0

Module No.	Content	Teaching Hours
01	<p>Irrigation: Necessity of Irrigation, Benefits and ill effects of Irrigation, Methods of Irrigation, History of Irrigation development in India.</p> <p>Soil-Water Plant relationship: Soil-water relationships, Crops and Crop Seasons, Evapotranspiration (consumptive use), Command Areas and Intensity, Duty of water and Delta, Factors affecting duty and delta of water, Methods of Improving Duty, Irrigation efficiencies, And Irrigation Requirement of Crops. Canal Irrigation: Planning, alignment, and design discharge of irrigation canal systems, Delivery of water to farms, Management of canal irrigation in India.</p> <p>Diversion Headwork's: Types, location and Components of headwork's, Weir, Barrage, Design of impervious floor for subsurface flow, Bligh's Creep theory, Lane's Weighted Creep theory, Khosla's Theory, Under sluices, Divide wall, Fish ladder, Canal Head regulator, Silt Control Devices.</p>	18
02	<p>Canal regulation structures: Necessity of providing Canal falls, Distributary head regulator, Cross regulator, Sediment control measures in off taking canals.</p> <p>Cross-drainage structures: Types of Cross-drainage structures, Design concepts for aqueducts, siphon aqueduct, level crossing, super passage, and siphon.</p> <p>Canal headworks: Location and different units of headworks, Methods of river training for canal headworks.</p>	12

Text Books:

- G.L. Asawa, "Irrigation and Water Resources Engineering", New Delhi: New Age International (P) Limited, Publishers; 2005
- B.C. Punmia, "Irrigation and Water Power Engineering", New Delhi: Laxmi Publications; 1992

Reference Books:

- R.S. Varshney, "Hydropower Structures including Canal Structures and Small Hydro", Roorkee: Nem Chand and Brothers; 2001
- L.W Mays, "Water resources engineering. John Wiley & Sons. 2010

Focus: This course focuses on employability & Skill development aligned with CO4 and CO5

Outcome: After completion of course, the student will be able to:

- CO1: To impart knowledge about various components of hydrologic cycle that affect the movement of water in the earth
- CO2: Able to understand the basic requirements of irrigation and various irrigation techniques, requirements of the crops
- CO3: To impart knowledge about Distribution systems for canal irrigation and the basics of design of unlined and lined irrigation canals design
- CO4: Able to understand the basic components of river Training works.
- CO5: Apply math, science, and technology in the field of water resource Engineering.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,PO2 /PSO1
C02	PO1,PO2 /PSO1
C03	PO1,PO2 /PSO1
C04	PO1,PO2 /PSO1

C05	P01,P02 /PS01
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BCEC 0201: GEOTECHNICAL ENGINEERING

Objective: To provide students with basic understanding of physical and mechanical properties of soil, together with knowledge of basic engineering procedures to identify factors controlling soil behavior and methods to determine soil properties. Students will be equipped with knowledge of geotechnical engineering to be used in further design and analysis of different types of foundations.

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: Soil Formation, Transport and Deposit of Soil, Soil Composition, Basic Definitions, Phase Relationships, Index Properties, Particle Size Analysis, Shape and Size, Grain Size Distribution Curves, Relative Density, Consistency of Soils, Determination of Important Physical and Index Properties of Soils, Soil Classification Systems with Specific Reference to Unified Soil Classification and IS Soil Classification Systems, Field Identification Tests.</p> <p>Soil Structure: Soil Structure, Single Grained Structure, Honeycomb Structure, Flocculent and Dispersed Structures, Structure of Composite Soils. Role of Soil Structure on the Behavior of Soils.</p> <p>Soil-Water Relations: Soil-Water Systems, Capillarity, Geostatic Stresses, Effective and Neutral Stress, Capillary Flow, Darcy's Law, Permeability, Factors Affecting Permeability, Determination of Permeability in the Laboratory and in the Field,</p>	19
II	<p>Flow through Porous Media: Piping, Quick Sand Condition, Seepage, Governing Differential Equation for Flow through Soils. Different Kinds of Flow: Steady State and Transient Flow, Graphical Method of Solving Steady State Flow Equation (Laplace Equation): Flow Nets and their Uses, Flow through Homogeneous Earth Dams: Two Dimensional Cases, Design of Drainage Filters.</p> <p>Compaction: General Principles, Moisture- Density Relationship, Optimum Moisture Content, Relevant Laboratory and Field Tests, Factors Affecting Compaction, Field Compaction, Compaction Techniques.</p> <p>Compressibility And Consolidation: Fundamentals, 1-D Consolidation, Normally and Over-Consolidated Clays, Void Ratio-Pressure Relationships, Determination of Pre-Consolidation Pressure, Compressibility Characteristics, Terzaghi's One Dimensional Consolidation Theory and Coefficient of Consolidation, Time Rate of Consolidation, Determination of Coefficient of Consolidation in the Laboratory: Curve Fitting Techniques, Primary and Secondary Consolidation and Settlement, Settlement Analysis, 3-D Consolidation, Vertical Sand Drains</p> <p>Shear Strength Of Soil: Mohr-Coulomb Failure Criterion, Direct Shear Test, Unconfined Compression Test, Triaxial Tests: Unconsolidated Undrained, Consolidated Drained and Consolidated Undrained Tests, Vane Shear Test, Shear Strength Of Clays, Critical Void Ratio, Pore-Pressure Coefficients.</p>	21

Text Books:

- K.R Arora "Soil Mechanics & Foundation Engineering" New Delhi: Standard Publishers Distributors; 2009.
- G. Ranjan and Rao A.S.R. "Basic and Applied Soil Mechanics" New Delhi: New Age Publication; 2000.
- C. Venkataramaiah "Geotechnical Engineering" New Delhi: New Age Publications; 2006.

Reference Books:

- V.N.S. Murthy “*Soil Mechanics and Foundation Engineering*” New Delhi: Marcel Dekker Publications; 2010.
- R.F. Craig “*Soil Mechanics*” US: Spon Publications; 1997.
- J.N. Cernica “*Geotechnical Engineering*” Holt, Reinghart & Winston; 1982.

Focus: This course focuses on employability & Skill development aligned with CO1 and CO4

Course Outcome: After completion of this course, student will be able to:

- CO1: Understand the basic properties and structure of soil
- CO2: Learn the relationship between soil and water and its effect on effective stress of soil
- CO3: Apply the concept learned to obtain effect of seepage on hydraulic structures
- CO4: Learn the concept of soil compaction and evaluate the consolidation of soil
- CO5: Understand the shear behavior of soil

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO12/ PS03
CO2	PO1, PO2, PO4, PO12/ PS03
CO3	PO1, PO2, PO3, PO4, PO12 / PS03
CO4	PO1, PO2, PO3, PO4PO5, PO12 / PS03
CO5	PO1, PO2, PO3, PO4, PO5, PO12 / PS03

BCEC 0301: TRANSPORTATION ENGINEERING

Objective: To impart the knowledge of highway design, construction and maintenance.

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	<p>Highway Development and Planning: Role of Transportation, Modes of Transportation, History of Road Development, Nagpur Road Plan, Bombay Road Plan and Lucknow Road Plan, Road Plan 2021, Road Patterns.</p> <p>Highway Geometric Design: Cross Sectional Elements: Design Factors, Carriageway, Camber, Shoulder, Sight Distances, Horizontal Curves, Super Elevation, Extra Widening, Transition Curves and gradient, Vertical curves.</p> <p>Traffic Engineering: Traffic Characteristic, Volume Studies, Speed Study, Capacity, Density, Traffic Control Devices: Road Markings, Signs, Signals, Design of Signals, Island, Intersection at Grade and Grade Separated Intersections, Design of Rotary Intersection.</p>	20
II	<p>Design of Highway Pavements: Types of Pavements, Design Factors, Design of Flexible Pavement by CBR Method (IRC: 37-2001 and IRC: 37-2012), Design of Rigid Pavement, Westergaard Theory, Load and Temperature Stresses, Joints, IRC Method of Rigid Pavement Design (IRC: 58 – 2011).</p> <p>Highway Materials: Tar, Asphalt, Bitumen and Test on Bitumen, Aggregates and their Testing, new highway material, modified binders, PMB, CRMB, Anti-stripping compound (HindCol, Super Bond, Tiki Tar), RBI- Garde 81, Micro surfacing, SMA (Stone matrix asphalt), Super Pave Technology.</p> <p>Highway Construction: Road Construction Methods, Water Bound Macadam, Surface Dressing, Bituminous Carpeting, Bituminous Bound Macadam and Asphaltic Concrete, Cement Concrete Road Construction.</p> <p>Highway Maintenance: Various Type of Failures, Evaluation and Remedial Measures, Overlay Design- Benkleman Beam.</p>	20

Text Books:

- S.K Khanna. and C.E.G. Justo *Highway Engineering* Roorkee: Nem Chand and Brothers; 2011.

Reference Books:

- P. Chakraborty and A. Das *Principles of Transportation Engineering*, New Delhi: PHI Learning Publications 2009.
- L.R. Kadiyali and N.B. Lall 2009, *Highway Engineering* New Delhi: Khanna Publishers; 2009.
- L.R. Kadiyali *Traffic Engineering and Transportation Planning* New Delhi: Khanna Publishers; (2011).
- C.J. Khisty and B.K. Lall *Transportation Engineering: An Introduction* New Delhi: PHI Learning Publications 2009.
- C.S. Papacostas and P.D. Prevedouros *Transportation Engineering and Planning* New Delhi: PHI Learning Publications; 2009.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the role of highway development and planning in nation building.
- CO2: Describe highway geometric design parameters.
- CO3: Describe traffic characteristics, traffic surveys, traffic control devices and use of Materials in highway construction.
- CO4: Design of highway pavements based upon latest IRC code (IRC 37 and IRC 58).
- CO5: Evaluate the pavement for maintenance and recommend required remedy to it.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P02, P06, P07, P012 / PS04

C02	P01, P02, P012 / PS04
C03	P01, P01, P02, P03, P04 / PS04
C04	P01, P02, P03, P06, P012 / PS04
C05	P01, P02, P03, P04, P05, P06, P010, P012/ PS04

BCEC 0401: ENVIRONMENTAL ENGINEERING

Objective: To Learn water supply and waste water management process

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: Introduction and Scope, Water Demand for Domestic Use, Factors Affecting Water Consumption, Design Periods, Population Forecasting Methods.</p> <p>Sources of Water: Kinds of Water Sources and Their Characteristics, Collection and Quality of Surface and Ground Water, Factors Governing the Selection of a Source of Water Supply, Intakes and Their Design for Lakes, Streams, Canals and Rivers, Impounding Reservoir and Determination of Its Capacity.</p> <p>Wastewater Collection: Types of Sewers, Flow in Full and Partially Full Sewers, Design of Sewers, Types, Materials, and Construction of Sewers, Joints and Sewer Appurtenances, Layout and Construction of Sewer Lines, Planning of Sewerage Systems, Construction & Maintenance, Storm water Sewers.</p> <p>Water & Wastewater Characteristics: Physical, Chemical, and Bacteriological Examination of Water & Wastewater, Indian and Global Standards of Water Quality. Effluent Standards.</p> <p>Water Treatment: Conventional Surface Water Treatment Using Coagulation, Flocculation, Settling, Filtration and Disinfection, Domestic Water Purifiers.</p>	20
II	<p>Wastewater Treatment: On Site and Centralized Treatment Systems, Septic Tank, Soakage Pit and Dispersion Trench.</p> <p>Pre-and Primary Treatment: Screens, Grit Removal, Primary Settling.</p> <p>Secondary Treatment: Theory of Organic Matter Removal, Aerobic and Anaerobic Treatment Processes, Activated Sludge Process, Conventional and Extended Aeration Systems, Trickling Filters, Aerated Lagoons, Waste Stabilization Ponds, Oxidation Ditches, R.B.C., Up-Flow Anaerobic Sludge Blanket (USAB) Process. MBBR Technique.</p> <p>Tertiary/ Advanced Wastewater Treatment Processes: Removal of Nitrogen and Phosphorus.</p> <p>Sludge Management: Thickening of Sludge, Anaerobic Digestion of Sludge, Sludge Drying and Final Disposal.</p> <p>Transmission of Water: Various Types of Conduits, Laying and Testing of Water Supply Pipelines, Pipe Materials, Joints, Appurtenances and Valves, Leakages and Control, Boosters, Safety and Relief Measures, Water Hammer and Its Control Measures.</p> <p>Storage and Distribution of Water: Methods of Distribution, Pressure and Gravity Distribution Systems, Concept of Service and Balancing Reservoirs, Capacity of Distribution Reservoirs, Hardy-Cross Methods of Pipe Network Analysis.</p> <p>Disposal of Wastewater: Standards of Wastewater Disposal, Disposal of Treated Sewage on Land and in Surface Waters, Do Sag Curve</p>	20

Text Books:

- S.K. Garg *Water Supply Engineering (Environmental Engineering Vol.-I)* New Delhi: Khanna Publisher; 2008.
- S.K. Garg *Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol.-II)* New Delhi: Khanna Publishers; 2008

Reference Books:

- M. L. Davis and D. A. Cornwell "*Introduction to Environmental Engineering*", 4th Edition, Boston: McGraw-Hill; 2008.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand the sources and characterization of drinking water
- CO2: Develop basic know about the transmission, storage and distribution of water
- CO3: Understand the Different aspects of Waste water collection, transportation and treatment
- CO4: Understand key current environmental problems
- CO5: Emphasize the need for sludge separation, thickening and volume reduction.
- CO6: Describe the design criteria for the suspended and attached growth biological wastewater

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1
CO6	PO1,PO2 /PSO1

BCEC 0800: FLUID MECHANICS LABORATORY

Objective: To enrich the concept of fluid mechanics. Demonstrate the classical experiments in fluid mechanics. At present it is equipped with hydraulic equipment's to carry out experiments like determination of Metacentric height of a floating vessel, verification of the Bernoulli's energy equation, study of transition from laminar to turbulent flow, determination of coefficient of discharge for obstruction flow meter (venturi meter/orifice meter). Correlate various flow measuring devices such as Venturi meter, orifice meter and notches etc.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> • Surface Tension of a Liquid • Met centric Height of a Ship Model • Verification of The Bernoulli's Equation • Verification of The Momentum Principle • Coefficients of Discharge, Velocity, and Contraction for an Orifice. • Coefficient of Discharge of a Orifice Meter or Venture Meter • Stokes' Law • Transition from Laminar to Turbulent Flow • Velocity Distribution in A Pipe • Frictional Head Loss for Commercial Pipes 	20

Text Books:

- G.L. Asawa, Fluid Flow in Pipes and Channels, CBS Publishers and Distributors, New Delhi. 2009

Reference Books:

- G.L. Asawa, "Laboratory Work in Hydraulic Engineering", New Age International (P) Limited, Publishers, New Delhi 2006
- Streeter, V.L., Wylie, E.B., and Bedford, K.W. Fluid Mechanics, McGraw Hill Companies, Singapore 1998d

Focus: This course focuses on employability & Skill development aligned with CO3 and CO1

Outcome: After completion of course, the student will be able to:

- CO1: Learn the basic properties of fluid
- CO2: Understand the engineering applications involving fluid
- CO3: Calculate discharge through various flow measurement devices and pipe losses using Bernoulli's equation

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1

BCEC 0802: STRUCTURAL ANALYSIS LABORATORY

Objective:

- To introduce the students to the concept of theory of structural analysis and methods in structural analysis.
- Ability to analyze statically determinate and indeterminate structures

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Contents	Teaching Hours
I/II	<ul style="list-style-type: none"> • To determine Flexural Rigidity (EI) of a given beam • To verify Maxwell's Reciprocal theorem. • To find horizontal thrust in a three-hinged arch and to draw influence line diagrams for Horizontal Thrust end Bending moment. • To find horizontal thrust in a two hinged arch and to draw influence line diagrams for horizontal Thrust and bending moment. • To find deflection of curved members. • To find bar forces in a three members structural frames with pin jointed bar • To find Critical load in Struts with different end conditions. • To find deflections in Beam having unsymmetrical bending. 	20

Reference Books:

- R. C. Hibbeler "Structural Analysis" 9TH ed. Noida: Pearson Education; 2014.
- N.K. Raju; Prestressed Concrete; Tata McGraw-Hill Education 2018.

Focus: This course focuses on Skill development aligned with CO2 and CO4

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

- CO1: Distinguish between statically determinate and indeterminate structures.
- CO2: Apply equations of equilibrium to structures and compute the reactions
- CO3: Draw the shearing force and bending moment diagrams
- CO4: Calculate the internal forces in cable and arch type structures
- CO5: Evaluate and draw the influence lines for reactions, shears, and bending moments in beams and girders due to moving loads.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	POs / PSOs
C01	PO1, PO2/PSO2
C02	PO1, PO2/PSO2, PO3
C03	PO1, PO2/PSO2, PO3
C04	PO1, PO2/PSO2, PO4,
C05	PO1, PO2/PSO2, PO3, PO4, PO5
C06	PO1, PO2/PSO2, PO3, PO4, PO5

BCEC 0803: STRUCTURAL DETAILING LABORATORY

Objective: The objective of this laboratory is to enable the learners to draw the working drawings of various structural elements using drafting software and detailing of buildings and water tanks for earthquake loadings.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Contents	Teaching Hours
I/II	Preparation of working drawings for the following using any drafting software <ul style="list-style-type: none"> • Slabs. • RC Beams- Simply supported, Continuous, Cantilever • T – beam / L-beam floor • Slabs – Simply supported, Continuous, One way and 2- way slabs. • Columns – Tied Columns and Spirally reinforced columns without eccentricity. • Columns – Tied Columns and Spirally reinforced columns with eccentricity • Isolated footings for RC Columns. • Combined rectangular and trapezoidal footings. • Detailing of Buildings with respect to Earthquake Resistant Design • Detailing of Rectangular Water tank resting on ground • Detailing of Circular Water tank resting on ground • Detailing of Flat Slab 	20

Reference Books

- G. Omura Mastering AUTOCAD: John Wiley & Sons; 2012.
- Shaw, Kale and Patki Building Drawing with an Integrated Approach to Built Environment: McGraw Hill; 2002.
- A. Jefferis & K. D Smith Commercial Drafting and Detailing: Cengage Learning; 2010.
- Karve S.R Design of reinforced concrete buildings; 2010.
- K. Raju N Structural Design and Drawing Hyderabad: University Press (India), Pvt. Ltd; 2005.

Focus: This course focuses on Skill development aligned with CO3 and CO5

Course Outcomes:

- Understand about the alignment of reinforcement in different building elements
- Describe the codal provision for the provision of diameter of reinforcement bars and spacing
- Learn to read the detail drawing of a building plan
- Prepare a working drawing for beam, column, slab, staircase, balcony for a 3BHK building etc.
- Draw and detail the water tanks resting on ground

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO5 /PSO2
CO2	PO1,PO5/PSO2
CO3	PO1,PO5/PSO2
CO4	PO1,PO5/PSO2
CO5	PO1,PO5/PSO2

BCEC 0804: CAD LABORATORY

Objective: To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design, analysis of building and Computer Aided Engineering Analysis.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Teaching Hours
I	<ol style="list-style-type: none"> 1. Introduction on various softwares for analysis and design of structures 2. Analysis of simple beam with different loading and support conditions 3. Analysis of simple column with different loading and support conditions. 4. Analysis of simple steel frame with different loading and support conditions. Analysis and design of RCC Slab. 5. G+3 RC and steel building modeling. 6. Analysis of G+3 RC building without earthquake load. 7. Analysis of G+3 RC building with earthquake load. 8. Analysis of G+3 steel building without earthquake load. 9. Analysis of G+3 steel building with earthquake load. 10. Analysis of Circular Water Tank. 11. Analysis of Staircase 	20

Text Books

- P. Gunthar, An Introduction to Excel for Civil Engineers, Createspace Independent Pub; 2016.
- B. Held, Excel Functions and Formulas, BPB Publications; 2015.
- S. Tickoo, Learning Bentley Staad. Pro V8i for Structural Analysis, Dreamtech Press; 2015.

Reference Books:

- S. Tickoo, Exploring Bentley STAAD.Pro V8i, BPB Publications; 2015.
- Staad Pro V8i, Technical Reference Manual.

Focus: This course focuses on employability & Skill development aligned with CO1

Outcome: After completion of course, the student will be able to:

CO1: In this lab, students will be able to learn abilities and capabilities in developing and applying computer software and hardware to civil-structural design.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO3/PSO1,PSO3

BCEC 0807: TRANSPORTATION ENGINEERING LABORATORY

Objective: To impart knowledge of testing of highway material in laboratory and to interpret results.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Teaching Hours
I/II	<p>Tests on aggregate</p> <ul style="list-style-type: none"> • Crushing Value. • Los Angeles Abrasion Value • Aggregate Impact Value. • Flakiness Index and Elongation Index of Aggregate. • Soundness Test. <p>Tests on bitumen</p> <ul style="list-style-type: none"> • Penetration Value of Bitumen. • Softening Point Value. • Ductility Value. • Flash and Fire Point of Bitumen. • Specific Gravity of Bitumen. • Stripping Test of Bituminous Sample. • Viscosity test of Bitumen. 	20

Text Books:

- Khanna, S.K. and Justo, C.E.G.. *Highway Material Testing Laboratory Manual*, Nem Chand and Brothers, Roorkee; 2010.

Focus: This course focuses on Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the significance of laboratory tests performed on highway materials
- CO2: Study about the desired properties of highway materials
- CO3: Study and perform various lab tests procedures and safety precautions to be taken care of while performing tests
- CO4: Interpret the lab results keeping in mind the real life scenarios

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6, PO9, PO12 /PSO4
CO2	PO1, PO6, PO9, PO12 /PSO4
CO3	PO1, PO6, PO9, PO12 /PSO4
CO4	PO1, PO6, PO9, PO12 /PSO4

BCEC 0808: ENVIRONMENTAL ENGINEERING LABORATORY

Objective: To learn different laboratory experiment of Water and waste water analysis

Credits: 01

L-T-P-J :0-0-2-0

Module No.	Content	Teaching Hours
	<ul style="list-style-type: none"> • Determination of Turbidity • Determination of pH. • Determination of Hardness. • Determination of Residual Chlorine • Determination of Most Probable Number of Coli forms • Measurement of Air Pollutants with High Volume Sampler • Determination of Total Suspended and Dissolved Solids • Determination of BOD • Determination of COD • Determination of Kjeldahl Nitrogen • Determination of Fluoride • Determination of Conductivity • Determination of Chlorides • Determination of Alkalinity and Acidity • Determination of Dissolved Oxygen 	20

Text Books:

- Garg S. K. "Water Supply Engineering" [Vol. I & II] New Delhi: Khanna Publishers; 2008.

Reference Books:

- Davis M. L. and Cornwell D. A. "Introduction to Environmental Engineering" 4th Ed. Boston: McGraw-Hill; 2008.
- Garg S. K. "Water Supply Engineering" [Vol. I & II] New Delhi: Khanna Publishers; 2008.

Focus: This course focuses on Skill development aligned with CO1 and CO2

Outcome: After completion of course, the student will be able to:

- CO1: Understand the sources of water and characterization of water including
- CO2: Physical, chemical and biological water quality parameters.
- CO3: Develop basic know about the transmission, storage and distribution of water.
- CO4: Understand the Different aspects of Waste water characterization, transportation and Planning
- CO5: Understand the basics of Waste water treatment process and its Design.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 /PSO1
CO3	PO1, PO2 /PSO1
CO4	PO1, PO2 /PSO1
CO5	PO1, PO2 /PSO1

BCEC 0811: CHANNEL HYDRAULICS LABORATORY

Objective: To determine the various parameters related to fluid flow in channels, investigate the uniform flow condition in open channel flow and to verify the manning's equation. Develop skills for analyzing experimental data and working in teams.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> • Uniform Flow in a Channel • Velocity Distribution in a Channel • Vertical Contraction in a Channel • Horizontal Contraction in a Channel • Hydraulic Jump in a Channel • Coefficient of Discharge of a Triangular/Rectangular Sharp-Crested Weir • Submerged Hydraulic Jump • Broad crested weir 	20

Text Books:

- Asawa, G.L., Fluid Flow in Pipes and Channels, CBS Publishers and Distributors, New Delhi; 2009.

Reference Books:

- Asawa, G.L., "Laboratory Work in Hydraulic Engineering", New Age International (P) Limited, Publishers, New Delhi; 2006.

Focus: This course focuses on Skill development aligned with CO3 and CO1

Outcome: After completion of course, the student will be able to:

- CO1: *Understand the nature of velocity distribution in a channel*
- CO2: *Differentiate between uniform flow and non-uniform flow*
- CO3: *Determination of discharge in vertical contraction and horizontal contraction of a channel*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1, PO2 /PS01
C02	PO1, PO2 /PS01
C03	PO1, PO2 /PS01

BCEC-0001: ADVANCED DESIGN OF STEEL STRUCTURES

Objective: The objective of this course is to develop the ability to analyze and design steel structures of advanced level like transmission Towers, Industrial Sheds, etc.

Credits: 04

L-T-P-J: 4-1-0-0

Module No.	Content	Teaching Hours
I	Introduction to the use of light gauge steel sections with application to flat slab, grid and orthotropic plates. Design of Aluminum structures. Design of transmission line towers, concept of TV and guyed towers. Buckling of steel columns.	20
II	Beam column and their designs. Rigid, Semi-Rigid and Flexible connections. Plastic methods of Structural Analysis of frames. Design of Industrial trussed bents. Pressed steel construction	20

Reference Books:

- 1. Design of steel structures- Bresler Lin & Scalzi(2000).
- 2. Steel building analysis and design- Crawley & Dhillon(1993).
- 3. Design of steel structures- S. K. Duggal(2010).
- 4. Design of steel structures- Arya&Ajmani(1972).

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Design advanced steel structures as per industrial consideration.
- CO1: Analyze and design of Aluminum Structures
- CO2: Developing the understanding of fundamentals of design of Light Gauge Steel.
- CO3: Analyze Structural frames Using Plastic methods.
- CO4: Design of Industrial trussed bents. Pressed steel construction

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01,P02, P03, P04/PS01, PS02
C02	P01,P02 P03, P04 /PS01, PS02
C03	P01,P02 P03, P04/PS01, PS02
C04	P01,P02 P03, P04/PS01, PS02
C05	P01,P02 P03, P04/PS01, PS02

BCEE 0002: BRIDGE ENGINEERING

Objective: To impart knowledge on important types of bridge structures, their selection and planning, structural configurations, assessment of loads and perform design.

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: History of Bridges; Components of a Bridge and its definitions; Classification of Road Bridges, related structures, span length, Classical Examples of each type; Selection of Site and Initial Decision Process, Survey and Alignment; Geotechnical Investigations and Interpretations.</p> <p>River Bridge: Selection of Bridge site and planning; Collection of Bridge design data; Hydrological calculation; Waterway calculation; Scour calculation; Depth of foundation; Freeboard.</p> <p>Road Bridge: Selection of Bridge site and planning; Collection of Bridge design data; Vertical clearance; Standard Loading for Bridge Design as per different codes: IRC, BS code, AASHTO code. Dead load, Live load, Impact factor, Centrifugal force, Wind loads, hydraulic forces, Longitudinal forces, Seismic forces; Earth pressure; Buoyancy; Lane concept, equivalent loads, traffic load; Width of Roadway and Footway; Influence lines for statically; determinate structures. I.L. for statically indeterminate structures; Transverse distribution of Live loads among deck longitudinal; Load combinations for different working state and limit state designs; Railway Bridges; Loadings for Railway Bridges; Railroad data; Pre-design considerations; Railroad vs. Highway bridges; Box Girder Bridge (Straight/ Skew).</p> <p>Superstructures: Selection of main bridge parameters, design methodologies; Choices of superstructure types; Orthotropic plate theory, load distribution techniques; Grillage analysis; Finite element analysis (Preferable); Different types of superstructure (RCC and PSC);</p>	20
II	<p>Longitudinal Analysis of Bridge: Slab bridge and voided slab bridge; Beam-Slab bridge; Box Girder Bridge.</p> <p>Transverse Analysis of Bridge: Slab bridge and voided slab bridge; Beam-Slab bridge; Box Girder Bridge; Temperature Analysis; Distortional Analysis; Effects of Differential settlement of supports; Reinforced earth structures; Typical Details: Slab Bridge; Slab-Girder Bridge (Straight/Skew).</p> <p>Substructure: Pier; Abutment; Wing walls; Importance of Soil-Structure Interaction; Types of foundations; Open foundation; Pile foundation; Well foundation; Examples - Simply supported bridge, Continuous Bridge; Bearings and Deck Joints: Different types of bridge bearings and expansion joints; Design of bearings and joints; Parapets and Railings for Highway Bridges: Definitions; Classification of Highway Bridge parapets.</p>	20

Text Books:

- Jagadish T.R. & M.A. Jayaram, "Design of Bridge Structures", 2nd Edition; 2009
- J. victor D, "Essentials of Bridge Engineering", 7th Edition, Oxford, IBH publishing Co., Ltd; 2006.
- N.K. Raju " Prestressed Concrete Bridges" CBS Publishers; 2012.

Reference Books:

- Krishna Raju N., “Design of Bridges”, 4th Edition, Oxford and IBH Publishing Co., Ltd., 2008
- Ponnuswamy, “Bridge Engineering”, 4th Edition, McGraw-Hill Publication, 2008.
- Swami Saran, “Analysis and Design of sub-structures”, 2nd Edition, Oxford IBH Publishing co ltd., 2006.
- Vazirani, Ratvani&Aswani, “Design of Concrete Bridges”, 5th Edition, Khanna Publishers, 2006.

Focus: This course focuses on employability aligned with CO4 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand about components, classifications and choice of bridge type along with the investigation for bridges in detail.
- CO2: Recognize various types of sub-structures and foundations, bearing, joints and appurtenances required for bridges.
- CO3: Implement various standard specifications for road bridges
- CO4: Estimate responses of Single and Multi Degree of Freedom System
- CO5: Analyze R.C.C. and steel bridge and their types also.
- CO6: Able to learn about methods of construction and maintenance of bridges along with causes of bridge failure

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
C01	P01, P02/PS02
C02	P01, P02/PS02, P03
C03	P01, P02/PS02, P03
C04	P01, P02/PS02, P04,
C05	P01, P02/PS02, P03, P04, P05
C06	P01, P02/PS02, P03, P04, P05

BCEE 1003: ADVANCED DESIGN OF CONCRETE STRUCTURE

Objective: The subject aims to develop an understanding of design and detailing of domes, various types of combined footings, Design of flat slab. Subject also covers the design concepts of water retaining and earth retaining structures.

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	<p>Design of flat slab Nature of Stresses in flat slabs with and without drops, coefficient for design of flat slabs, reinforcement in flat slabs. (IS Code Method).</p> <p>Design of reinforced concrete footing Structural behavior of footings, design of footing for a wall and a single column, combined rectangular and trapezoidal footings, Design of strap footing.</p> <p>Design of retaining wall Structural behavior of retaining wall, stability of retaining wall against overturning and sliding, Design of T-shaped retaining wall, Concept of Counter fort retaining wall</p>	20
II	<p>Design of water tank Design criteria, material specifications and permissible stresses for tanks, design concept, of circular and rectangular tanks situated on the ground / underground, design of overhead tanks.</p> <p>Prestressed Concrete Design Concept of pre-stressed concrete, Methods of pre-stressing: pre-tensioning and post-tensioning, Advantages and disadvantages of pre-stressing, Losses in pre-stress</p>	20

Text Books:

- IS : 456 – 2000, “ Code of Practice for Plain and Reinforced Concrete”, Bureau of Indian Standards, New Delhi; 2004.
- Jain, A.K., “Reinforced Concrete : Limit State Design”, Nem Chand & Bros., Roorkee; 2012.
- Dayaratnam, P, “Limit State Design of Reinforced Concrete Structures” Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi; 2017.
- Jain, O. P. & J. Krishna, “ Plain and Reinforced Concrete”, Vol. I & II, Nem Chand & Bros., Roorkee; 2007.
- Park, R. and T. Pauley, “ Reinforced Concrete Structures”, John Wiley & Sons; 1975.

Reference Books:

- Gambhir, M L, “Fundamentals of Reinforced Concrete”, Prentice Hall of India; 2010.
- U. Pillai, S. & D. Menon, “ Reinforced Concrete Design”, Tata Mc-Graw Hill Company Limited; 2017.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Analyze and Design the flat slab
- CO2: Analyze and design of beams curved in plan
- CO3: Analyze and design of retaining wall
- CO4: Analyze and design of culvert
- CO5: Understand the concept of prestress

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	PO1, PO2/PSO2
CO2	PO1, PO2/PSO2, PO3
CO3	PO1, PO2/PSO2, PO3
CO4	PO1, PO2/PSO2, PO4,
CO5	PO1, PO2/PSO2, PO3, PO5

BCEE 0004: MATRIX ANALYSIS OF STRUCTURES

Objective:

- Learn the fundamental concepts of matrix structural mechanics, such as the stiffness method.
- The concepts of structural analysis learnt in mechanics of solids and structures course.
- Understanding the analysis of statically determinate and indeterminate structures such as trusses, beams, frames and plane stress problems.
- Learn the concepts of the stiffness method and apply it to a variety of structural problems involving trusses, beams, frames, and plane stress

Credits:04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction of Matrix methods of analysis – Properties of Matrices, singular matrix, Rank of a Matrix and Rank deficiency- Static indeterminacy and Kinematic indeterminacy – Degree of freedom – Structure idealization- stiffness and flexibility methods – Suitability</p> <p>Generation Element stiffness matrix for truss element, beam element and torsional element- Element force – displacement equations.</p> <p>Stiffness method for beam Elements – Element and global stiffness equation – coordinate transformation and global assembly – structure stiffness matrix equation – analysis of continuous beams</p>	20
II	<p>Stiffness method for plane trusses and Grid elements – development of stiffness matrix – coordinate transformation. Examples of pin jointed trusses and simple grid problems.</p> <p>Space trusses and frames – Member stiffness for space truss and space frame– Transformation matrix from Local to Global – Analysis of simple trusses, beams and frames.</p>	20

Text Books:

- Asslam,K.,“*MatrixAnalysisofStructures*”,Brooks/ColePublishingCo.,USA; 1999.
- Hibbeler,R.C.,“*StructuralAnalysis*”,PearsonEducationPublishers,NewDelhi; 2008.
- Jain,A.K.,“*TheoryandAnalysisofStructures*”,Vol.IandII,NemChandandBrothers,NewDelhi; 2009.
- Menon,D.,“*AdvancedStructuralAnalysis*”,NarosaPublishingHouse,NewDelhi;2009.

Reference Books:

- Reddy, C.S., “*Basic Structural Analysis*”, Tata McGraw Hill, NewDelhi; 2005.
- Vazirani,V.N.andRatwani,“*M.M.AnalysisofStructures:Theory&Design,Vol.1and2*”,17thedition, KhannaPublishers,NewDelhi; 1994.
- Weaver, W. and Gere,J.M.,“*MatrixAnalysisofFramedStructures*”,CBSPublishers,NewDelhi; 2004.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Analyse framed structures using flexibility and stiffness method.
- CO2: Calculate deflections, reactions, internal forces of trusses, beams and frames using matrix methods
- CO3: Develop computer programs for analysis of framed structure.
- CO4: Explain Internal forces due to thermal expansion and lack of fit, Application to symmetrical structures using displacement method
- CO5: Comparison between stiffness and flexibility methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	P01, P02/PS02
CO2	P01, P02/PS02, P03
CO3	P01, P02/PS02, P03
CO4	P01, P02/PS02, P04,
CO5	P01, P02/PS02, P03, P04

BCEE 0005: PLASTIC ANALYSIS OF STRUCTURE

Objectives: Plastic analysis derives from a simple mode failure in which plastic hinges form actually the ultimate load is found from the strength of steel in plastic range. This method of analysis is quite rapid and has rational approach for analysis of structure.

Credits:04

L-T-P-J: 3-1-0-0

Module No.	Contents	Teaching Hours
I	Introduction: Historical Review, Plastic Failure, Plastic Moment, Capacity of a Cross-Section, Shape Factor, Concept of Load Factor, Plastic Hinge and Collapse Mechanisms, Analysis of Beams and Frames, Moment Curvature Relationships for Rectangular and I-Section. Basic Theorems: Uniqueness, Lower Bound and Upper Bound, Static Method and Mechanism Method for Collapse Load Analysis,	20
II	Plastic Moment Distribution for Beams, Portals, Multi-Storey and Multi-Bay Frames. Deflection At Collapse: Analysis for Deflections at Collapse, Effect of Axial Force and Shear on Plastic Moment Capacity or Rectangular and I-Section.	20

Text Books:

- B. Wong, M. "Plastic Analysis and Design of Steel Structures" New York, USA: Butterworth-Heinemann Publishers; 2008.
- Hodge, P.G. "Plastic Analysis of Structures" New York USA: McGraw Hill Book Company; 1998.

Reference Books:

- Jirasek, M. and Bazant, Z.P. "Inelastic Analysis of Structures" New York USA: John Wiley and Sons Limited; 2002.
- Neal, B.G. "Plastic Methods of Structural Analysis" New York, USA: John Wiley and Sons Limited; 2008.

Focus: This course focuses on employability aligned with CO2 and CO1

Outcome:

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

- Understand the micromechanical behavior of plasticity and fracture mechanism of steel.
- Interpret the difference between elastic and plastic behavior of structural members.
- Differentiate the yield mechanisms and ultimate strength of structures.
- Analyze deflection in Plastic beams and frames, Load deflection relations for simple structures.
- Design structures by plastic method.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
C01	PO1, PO2/PSO2
C02	PO1, PO2/PSO2, PO3
C03	PO1, PO2/PSO2, PO3
C04	PO1, PO2/PSO2, PO4,
C05	PO1, PO2/PSO2, PO3, PO4, PO5
C06	PO1, PO2/PSO2, PO3, PO4, PO5

BCEE 0007: INTRODUCTION TO EARTHQUAKE ENGINEERING

Objective: To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

Credits:03

L-T-P-J: 3-0-0-0

Module No.	Contents	Teaching Hours
I	<p>Introduction to Dynamic Loads: Introduction to Dynamic Loads Static Load v/s Dynamic Load, Types of Dynamic forces, Force Control and Displacement Control</p> <p>Basics of Seismology: Earth and its interior, Plate Tectonics, Convection Currents, The Earth quake, Inter Plate Earthquake (Convergent Boundaries, Divergent Boundaries and Transform Boundaries), Intra Plate Earthquake (Faults and Types of Faults), Seismic Waves, Basic Terminology, Measuring Units and Instruments</p> <p>Fundamentals of Earthquake Vibrations of Structures: Equation of Motion (By Newton's Law and By D'Alembert's Principle),</p>	15
II	<p>Degrees of Freedom, Simplified Single Degree of Freedom, Mathematical Modeling, Equation of Motion for Free Vibration for Damped and Un damped System (Single Degree of Freedom System), Equation of Motion for Forced Vibration for Damped and Un damped System(Single Degree of Freedom System), Logarithmic Decrement</p> <p>Earthquake Load Analysis on Structures: Introduction to methods of Earthquake Load Analysis (Linear Static, Linear Dynamic, Non Linear Static, Non Linear Dynamic) Analysis of Structure by Linear Static Method (Seismic Coefficient Method) Analysis of Structure by Linear Dynamic Method (Random Response Method)</p>	15

Text Books:

- Agarwal, P. and Shrikhande, M., Earthquake Resistant of Design of Structures, PHI Publications; 2007.
- Biggs, J.M., Introduction to Structural Dynamics, McGraw Hill Publications, New York, USA; 2004.
- Chopra, A.K., Dynamics of Structures, Pearson Education, New Delhi;2004.
- Duggal, S.K., Earthquake Resistant of Design of Structures, Oxford University Press, New Delhi; 2008.
- IS: 1983, Criterion for Earthquake Resistant Design, Bureau of Indian Standards, New Delhi; 1984.
- Paz, M., Structural Dynamics - Theory and Computation, Springer, New York, USA;1997.

Reference Books:

- Duggal, S.K., Earthquake Resistant of Design of Structures, Oxford University Press, New Delhi;2008.
- IS: 1983, Criterion for Earthquake Resistant Design, Bureau of Indian Standards, New Delhi;1984.
- Paz, M., Structural Dynamics - Theory and Computation, Springer, New York, USA;1997.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome:

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

- CO1: To understand the Earthquake Engineering concepts which are applied in field Structural Engineering
- CO2: The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.
- CO3: To implement a coherent development to the students for the courses in sector of earthquake engineering

- C04: To gain the experience in the implementation of engineering concepts which are applied in field of earthquake engineering
- C05: To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
C01	P01, P02/PS02
C02	P01, P02/PS02, P03
C03	P01, P02/PS02, P03
C04	P01, P02/PS02, P04,
C05	P01, P02/PS02, P03, P04, P05
C06	P01, P02/PS02, P03, P04, P05

BCEE 0004: PRE-ENGINEERED BUILDINGS

Objective: *The objective of this course is to develop fundamentals of analysis and design Pre-Engineered Buildings*

Credits: 04

L-T-P-J: 4-1-0-0

Module No.	Content	Teaching Hours
I	Introduction to PEB, Basics of PEB Design, IS design code requirements, industry practice design criteria, design loads and other design consideration for PEB followed in the design, Designing process of PEB, Design of PEB using TEKLA structural designer software.	20
II	Loads calculation, Modelling the PEB Application of loads, Step by step process of modelling columns, beams, stringers, bracing, applying dead loads, product loads, thermal loads, wind loads. Assigning properties to the structural steel members, assigning the releases and supports. Analyse and assign the design commands. Optimization of the structure as per the industry standards.	20

Reference Books:

- Technical Hand Book, Kirby Building Systems-INDIA.LTD.
- Bhavikatti S.S, “Design of steel structures by limit state method as per IS 800-2007”, I.K.International publishing house Pvt.Ltd. New Delhi, (2010).
- Duggal S.K, “Limit State Design of steel Structural” Tata McGraw Hill education private limited, New Delhi, (2010).
- Parth Thakker “Conventional steel buildings v/s Pre-engineered buildings”.
- Shiyekar. M.R, “Limit State Design in Structural Steel”, PHI learning private limited, New Delhi (2011).
- Subramanian. N, “Pre- Engineered buildings selection of framing system, roofing and wall materials” The Master builder, July, 2008, pp 48-62.

Outcomes:

- CO1: Analyze Pre-engineered buildings.
- CO2: Design of Pre-engineered buildings members.
- CO3: Design of Pre-engineered buildings.
- CO3: Optimization of the structure as per the industry standards.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01,P02, P03, P04/PS01, PS02
C02	P01,P02 P03, P04 /PS01, PS02
C03	P01,P02 P03, P04/PS01, PS02
C04	P01,P02 P03, P04/PS01, PS02
C05	P01,P02 P03, P04/PS01, PS02

BCEE 0012: CONCRETE TECHNOLOGY

Objective: The objective of this course is to develop an understanding of the basic concepts of concrete technology along with the process of manufacture of concrete. This course also aims at developing an understanding of the various properties of concrete and the method of design mix of concrete.

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: Definition and ingredients of concrete, Properties of cement, aggregates and water used in concrete.</p> <p>Admixtures: Definition and classification of admixtures, Properties of admixtures, Effects of admixture on concrete properties.</p> <p>Manufacture of Concrete: Methods of manufacture of concrete, Manufacturing process: Batching, Mixing, Transportation, Placing, Compaction and Finishing.</p>	18
II	<p>Fresh Stage Properties of Concrete: Workability, Segregation and Bleeding.</p> <p>Hardened stage Properties of Concrete: Strength, elasticity, creep, shrinkage and durability</p> <p>Mix Design of Concrete: Methods of mix design, Concept of mix design, Mix design for cement concrete, Fly ash cement concrete and pumpable concrete, sampling and acceptance criteria.</p>	22

Text Books:

- Shetty M.S. and Jain A.K., Concrete Technology: Theory and Practice S. Chand Publication; 2018
- Gambhir M.L Concrete Technology: Theory and Practice, TMH Publisher; 2013.
- Bhavikatti S.S., Concrete Technology; Dreamtech Press; 2019

Reference Books:

- Neville A.M and Brooks J.J., Concrete Technology: Second Technology, Pearson India Education Services Pvt Ltd.; 2020
- IS: 456:2000 Plain and Reinforced Concrete - Code of Practice New Delhi: Bureau of Indian Standards.
- IS: 10262:2019 Concrete Mix Proportioning-Guidelines (Second Revision); Bureau of Indian Standards.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the role of ingredients in cement concrete.
- CO2: Discuss about the functions of the various types of admixtures in concrete
- CO3: Describe the process of manufacture of concrete.
- CO4: Explain fresh and hardened stage properties of concrete.
- CO5: Design concrete mix based on the codal provisions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
C01	PO1 /PSO2
C02	PO1,PO2/PSO2
C03	PO1,PO4/PSO2
C04	PO1/PSO2
C05	PO1,PO2/PSO2

BCEE 0013: ADVANCE CONCRETE

Objective: The objective of this course is to develop an understanding of the advanced concepts of concrete technology along with the basic concepts. This course also aims at developing an understanding of the roles of admixtures in concrete and the various types of special concrete and their importance in construction.

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	Introduction: Definition and ingredients of concrete, Hydration of cement compounds, Alkali aggregate reaction, water requirement in concrete and curing of concrete. Chemical Admixtures: Definition, types and effect of chemical admixtures on concrete, Detailed study of Plasticizers, Superplasticizer, New generation superplasticizer and Air entraining admixtures, Curing compounds and its types. Mineral Admixtures: Definition and types, Effect of Fly ash, Silica fume and Ground granulated blast furnace slag on concrete properties.	18
II	Properties of concrete: Segregation and Bleeding, strength, elasticity, creep, shrinkage and durability. Concrete Mix Design: Methods of mix design, Concept of mix design, Mix design for cement concrete, Fly ash cement concrete and pumpable concrete, sampling and acceptance criteria. Special Concrete: Light weight concrete, No fines concrete, Fiber reinforced concrete, Roller compacted concrete, Self compacting concrete and Bacterial concrete.	22

Text Books:

- Shetty M.S. and Jain A.K., Concrete Technology: Theory and Practice S. Chand Publication; 2018
- Gambhir M.L Concrete Technology: Theory and Practice, TMH Publisher; 2013.
- Bhavikatti S.S., Concrete Technology; Dreamtech Press; 2019

Reference Books:

- Neville A.M and Brooks J.J., Concrete Technology: Second Technology, Pearson India Education Services Pvt Ltd.; 2020
- IS: 456:2000 Plain and Reinforced Concrete - Code of Practice New Delhi: Bureau of Indian Standards.
- IS: 10262:2019 Concrete Mix Proportioning-Guidelines (Second Revision); Bureau of Indian Standards.

Outcome: After completion of course, the student will be able to:

- CO1: Understand the role of ingredients in cement concrete.
- CO2: Discuss about the functions of the various types of admixtures in concrete
- CO3: Explain fresh and hardened stage properties of concrete.
- CO4: Design cement and Fly ash based concrete using IS Code.
- CO5: Describe the need and importance of special concrete in construction

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
CO1	PO1 /PSO2
CO2	PO1,PO2/PSO2
CO3	PO1,PO4/PSO2
CO4	PO1/PSO2
CO5	PO1,PO2/PSO2

BCEE 0008: CONSTRUCTION ENGINEERING

Objective: To recognizing the good building materials for construction work.

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	<p>Cement: Portland cement, chemical composition, Hydration, Setting of cement, Structure of hydrate cement, Test on physical properties, Different grades of cement.</p> <p>Admixtures: Types of admixtures, mineral and chemical admixtures.</p> <p>Aggregates: Classification of aggregate, Particle shape & texture, strength & other mechanical properties of aggregate, Specific gravity, Bulk density, porosity, adsorption & moisture content of aggregate, Bulking of sand, Deleterious substance in aggregate, Soundness of aggregate, Alkali aggregate reaction, Thermal properties, Sieve analysis, Fineness modulus Grading curves, Grading of fine & coarse Aggregates, Gap graded aggregate, Maximum aggregate size.</p> <p>Fresh Concrete: Workability, Factors affecting workability, Measurement of workability by different tests, Setting times of concrete, Effect of time and temperature on workability, Segregation & bleeding, Mixing and vibration of concrete, Steps in manufacture of concrete, Quality of mixing water.</p>	15
II	<p>Hardened Concrete : Water / Cement ratio, Abram's Law, Gels pace ratio, Nature of strength of concrete, Maturity concept, Strength in tension & compression, Factors affecting strength, Relation between compressive & tensile strength, Curing. Testing Of Hardened Concrete: Compression tests, Tension tests, Flexure tests, Splitting tests, Pull-out test.</p> <p>Non-destructive testing methods: codal provisions for NDT. Elasticity, Creep & Shrinkage, Modulus of elasticity, Dynamic modulus of elasticity, Poisson's ratio, Creep of concrete, Factors influencing creep, Relation between creep & time, Nature of creep, Effects of creep, Shrinkage: types of shrinkage.</p> <p>Mix Design: Factors in the choice of mix proportions, Durability of concrete, Quality Control of concrete, Statistical methods, Acceptance criteria, Proportioning of concrete mixes by- BIS method and ACI mix design.</p>	15

Text Books:

- M. Neville *Properties of Concrete* 5th ed. Noida UP: Pearson Education Ltd; 2016.
- M. S. Shetty *Concrete Technology* New Delhi: S. Chand & Co; 2004.
- Job Thomas *Concrete Technology* Delhi: Cengage learning India Pvt Ltd; 2015.

Reference Books:

- M.L. Gambhir. *Concrete Technology* 3rd ed. New Delhi: Tata Mc. Graw Hill Publishers; 2006.
- P. K. Mehta and J. M. Monteiro *Concrete: Micro structure, Properties and Materials* 4th ed. Noida UP: McGraw Hill Publishers; 2014.

Focus: This course focuses on employability & Skill development aligned with CO4 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand the behavior of fresh and hardened concrete
- CO2: Study in construction material are intended to make structural, Transportation and Foundation Engineers aware of the fundamental properties of materials they use.
- CO3: Construction Equipment introduction and its uses in civil engineering projects at site.
- CO4: To check the fundamental properties and engineering behavior of materials to performing the different test which are performed in the laboratory of that subject?
- CO5: Describe the characteristics and basic parameter of materials according to construction requirements.

- CO6: Overview about the advance construction materials, which are required in construction industry.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01, P02/PS01,PS02
C02	P01, P02/PS01,PS02,PS03, PS04
C03	P05, P06/PS03,PS04
C04	P01, P04, P05, P06/ PS01, PS03,PS04
C05	P04, P05, P06/ PS01, PS03,PS04
C06	P06, P07/ PS01, , PS02,PS03

BCEE 0011: STRUCTURAL DYNAMICS

Objective: The objective of this course is to develop fundamentals about various dynamic problems of complex nature and response of structures to these conditions.

Credits: 04

L-T-P-J: 4-0-0-0

Module No.	Contents	Teaching Hours
I	<p>Introduction: Types of dynamic loads, Basic background of methods available and motivation for structural dynamics</p> <p>Dynamics of Single Degree-of-Freedom Structures: Dynamic equation of equilibrium, Free vibration of single degree of freedom systems, Forced vibration: harmonic and periodic loadings, Dynamic response functions, force transmission and vibration isolation, SDOF response to arbitrary functions</p> <p>Numerical Evaluation of Dynamic Response of SDOF Systems: Time domain analysis: finite difference methods, Frequency domain analysis: basic methodology</p> <p>Earthquake Response of SDOF Systems: Earthquake excitation, response history and construction of response spectra, Response spectrum characteristics, tripartite plot, and design spectrum.</p> <p>Multi Degree of Freedom Systems - Basics: Dynamic equations of equilibrium, static condensation, Symmetric plan and plan-asymmetric systems.</p>	20
II	<p>Free Vibration Response of MDOF Systems: Un damped systems: natural modes and their properties, Numerical solution for the eigen value problem, Solution of free vibration response for un damped systems, Free vibration analysis of systems with damping.</p> <p>Dynamic Analysis of Linear MDOF Systems: Introduction, modal analysis, Response-history for earthquake excitations using modal analysis, Response spectrum analysis for peak responses, Concept of Caughey damping as a general type of proportional damping.</p> <p>Generalized Single Degree of Freedom Systems: Basic concepts, mass-spring system, Lumped mass systems, Systems with distributed mass and elasticity, Rayleigh's method, shape function selection.</p>	20

Text Books:

- J. M. Biggs, Introduction to Structural Dynamics;2010.
- J. Krishna and A. R. Chandra Sekharan, Elements of Earthquake Engineering;1976.
- S. Prakash, Soil Dynamics, McGraw Hill;1981.

Reference Books:

- R.W. Clough & J. Penzien, Dynamics of Structures;2003.
- P. Agarwal & M. Srikhande "Earthquake Resistant Design of Structure";2006.
- Mario Piaz, Structural Dynamics;2013.
- A.K. Chopra, Dynamics of Structure;2011.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome:

After completing this course the students will be able to

- CO1: Recall the fundamental knowledge of dynamics and its application in the field of structures.
- CO2: Establishing dynamic equilibrium, the equation of motion
- CO3: Develop the background required for design of structures subjected to various forms of dynamic loadings including Earthquake and Blast.
- CO4: Implement of the establishment of dynamic equilibrium, the equation of motion

- C05: Examine the eigen value problem and knowledge to its properties.
- C06: Demonstrate degrees of freedom for single and multi degree of freedom systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
C01	P01, P02/PS02
C02	P01, P02/PS02, P03
C03	P01, P02/PS02, P03
C04	P01, P02/PS02, P04,
C05	P01, P02/PS02, P03, P04, P05
C06	P01, P02/PS02, P03, P04, P05

BCEC 0009: ADVANCED CONSTRUCTION ENGINEERING

Objective: To enable the student learn theoretical and practical aspects of advancements in the field of construction engineering.

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	<p>Cement production, composition and cement chemistry: Importance of Bogue's compounds, Structure of a Hydrated Cement Paste, Volume of hydrated product, porosity of paste and concrete, transition Zone, Elastic Modulus, factors affecting strength and elasticity of concrete</p> <p>Aggregates for concrete: Review of types and classification; chemical composition; origin and manufacture; actions and interactions; usage; effects on properties of concretes</p> <p>Chemical admixtures: Mechanism of chemical admixture, Plasticizers and super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh cone test for optimum dosage of super plasticizer, retarder, accelerator, Air-entraining admixtures, new generation superplasticizer.</p> <p>Mineral admixtures: Fly ash, Silica fume, GCBS, and their effect on concrete property in fresh state and hardened state.</p> <p>Fresh concrete: Rheology of concentrated suspensions, pastes, mortars and concretes; workability, segregation and bleeding. Theory and principles governing the correct placing and compaction of concrete.</p>	20
II	<p>Hardened Concrete: Water / Cement ratio, Abram's Law, Gels pace ratio, Nature of strength of concrete, Maturity concept, Strength in tension & compression, Factors affecting strength, Relation between compressive & tensile strength, Curing. Testing Of Hardened Concrete: Compression tests, Tension tests, Flexure tests, Splitting tests, Pull-out test.</p> <p>Durability of concrete: Durability concept; pore structure and transport processes; reinforcement corrosion; fire resistance; frost damage; sulfate attack; alkali silica reaction; delayed Ettringite formation; methods of providing durable concrete; short-term tests to assess long-term behaviour.</p> <p>Non-destructive testing methods: codal provisions for NDT. Elasticity, Creep & Shrinkage, Modulus of elasticity, Dynamic modulus of elasticity, Poisson's ratio, Creep of concrete, Factors influencing creep, Relation between creep & time, Nature of creep, Effects of creep, Shrinkage: types of shrinkage.</p> <p>Mix Design: Factors in the choice of mix proportions, Durability of concrete, Quality Control of concrete, Statistical methods, Acceptance criteria, Proportioning of concrete mixes by- BIS method and ACI mix design.</p>	20

Text Books:

- M. Neville *Properties of Concrete* 5th ed. Noida UP: Pearson Education Ltd; 2016.
- M. S. Shetty *Concrete Technology* New Delhi: S. Chand & Co; 2004.
- Job Thomas *Concrete Technology* Delhi: Cengage learning India Pvt Ltd; 2015.

Reference Books:

- M.L. Gambhir. *Concrete Technology* 3rd ed. New Delhi: Tata Mc. Graw Hill Publishers; 2006.
- P. K. Mehta and J. M. Monteiro *Concrete: Micro structure, Properties and Materials* 4th ed. Noida UP: McGraw Hill Publishers; 2014.

Focus: This course focuses on employability & Skill development aligned with CO4 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand the behavior of fresh and hardened concrete
- CO2: Study in construction material are intended to make structural, Transportation and Foundation Engineers aware of the fundamental properties of materials they use.
- CO3: Construction Equipment introduction and its uses in civil engineering projects at site.

- CO4: To check the fundamental properties and engineering behavior of materials to performing the different test which are performed in the laboratory of that subject?
- CO5: Describe the characteristics and basic parameter of materials according to construction requirements.
- CO6: Overview about the advance construction materials, which are required in construction industry.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2/PSO1, PSO2
CO2	PO1, PO2/PSO1, PSO2, PSO3, PSO4
CO3	PO5, PO6/PSO3, PSO4
CO4	PO1, PO4, PO5, PO6/ PSO1, PSO3,PSO4
CO5	PO4, PO5, PO6/ PSO1, PSO3,PSO4
CO6	PO6, PO7/ PSO1, , PSO2,PSO3

BCEE 0010: EARTHQUAKE RESISTANT DESIGN

Objective: The aim of this course is to impart the knowledge of basics of earthquake and its causes. This course also includes the structural modeling and dynamics with design of structures and earthquake resistant design features.

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	<p>Engineering Seismology: Earthquake ground motion- causes and classifications, Theory of plate tectonics, Seismic waves, Magnitude and intensity of earthquakes, local site effects, Seismic zoning map of India and geological considerations for construction of building project in seismic area .</p> <p>Seismic Design Parameters: Types of earthquakes, Earthquake ground motion characteristics, Response spectra and design spectrum.</p> <p>Structural Modelling: Response of structure to earthquake motion, Modelling of structures, Dynamics of single degree of freedom system,</p>	15
II	<p>Dynamics of multi degree of freedom system, Idealization of structures,</p> <p>Earthquake Resistant Design: Code based seismic design methods, Equivalent lateral force method, Response spectrum method, Time history method.</p> <p>Design Features: Reinforced concrete buildings, Material Properties, Codal provisions, Base Isolation, Seismic evaluation and retrofitting methods.</p>	15

Text Books:

- Agarwal, P. and Shrikhande, M., Earthquake Resistant of Design of Structures, PHI Publications; 2007.
- Biggs, J.M., Introduction to Structural Dynamics, McGraw Hill Publications, New York, USA; 2004.
- Duggal, S.K., Earthquake Resistant of Design of Structures, Oxford University Press, New Delh; 2008.
- IS:1983, Criterion for Earthquake Resistant Design, Bureau of Indian Standards, New Delhi; 1984.

Reference Books:

- Chopra, A.K., Dynamics of Structures, Pearson Education, New Delhi; 2004.
- Paz, M., Structural Dynamics – Theory and Computation, Springer, New York, USA; 1997.

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand and apply the basics of structural dynamics in analysis of structures subjected to earthquakes.
- CO2: Explain basic terminology in seismology, seismicity and will be able to perform simple calculations on recorded earthquake ground motions.
- CO3: Discuss the ground motion magnitude, intensity, and frequency.
- CO4: Estimate responses of Single and Multi Degree of Freedom System
- CO5: Apply the basic codal provisions for earthquake resistant design of structures as per Indian standards.
- CO6: Understand the concepts of Base Isolation, Seismic evaluation and retrofitting methods..

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs / PSOs
CO1	P01, P02/PS02
CO2	P01, P02/PS02, P03
CO3	P01, P02/PS02, P03
CO4	P01, P02/PS02, P04,
CO5	P01, P02/PS02, P03, P05
CO6	P01, P02/PS02, P03, P04, P05

BCEE 0801: CONSTRUCTION ENGINEERING LABORATORY

Objective: The objective of this laboratory is gain practical idea about the behavior of construction materials especially cement, aggregates, bricks and concrete.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Contents	Teaching Hours
I	A) Three experiments on each building material 1. Cement Tests (2 turns) Normal consistency of cement. Initial & final setting time of cement Compressive strength of cement Fineness of cement by air permeability and LeChatalier's Test 2. Coarse Aggregate Tests (2 turns) 3. Fine Aggregate Tests (2 turns) 4. Bricks Tests (2 turns) Water absorption. Dimension tolerances Compressive strength Efflorescence B) Test on Concrete: (4 turns) Workability test of concrete- Slump test. Design of concrete mix (as per IS method). Cube test of concrete (nominal mix).	20

Reference Books

- .M.L. Gambhir Concrete Technology, McGraw Hill Education, 2006.
- .B.L. Gupta Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
- A.M. Neville, Properties of Concrete, Prentice Hall, 1995, London.
- A.R. Santhakumar "Concrete Technology", Oxford University Press, 2007.
- M.S. Shetty, Concrete Technology, S.Chand and Company Ltd. Delhi, 2003

Focus: This course focuses on Skill development aligned with CO3 and CO4

Course Outcomes:

- CO1: Outline the importance of testing of cement and its properties
- CO2: Describe tests on coarse and fine aggregates
- CO3: Understand various parameters of brick testing
- CO4: Summarize the concept of workability and testing of concrete

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO5/PSO2
CO2	PO3/PSO2
CO3	PO4/PSO2
CO4	PO5/PSO2

BCEE 0803: ADVANCED CONSTRUCTION ENGINEERING LABORATORY

Objective: To develop the understanding of modernized testing practices of construction facilities

Credits: 01

L-T-P-J: 2-1-0-0

Module No.	Contents	Teaching Hours
I	<ol style="list-style-type: none"> 1. Rebound hammer test-RH test 2. Ultrasonic pulse velocity- UPV test 3. Combined UPV & RH test 4. Core extraction for compressive strength test 5. Ingredient analysis of concrete core 6. Surface hardness test 7. Penetration and pullout techniques 8. Magnetic and electrical methods 9. Water permeability test 10. Chloride permeability test 11. Air permeability tests 	20

Text Book:

- M. L. Gambhir and Neha Jamwal, " Building and Construction Materials: Testing and Quality Control "McGraw Hill, 2017

Focus: This course focuses on Skill development aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understanding of modern Testing methods in of construction materials in engineering.
- CO2: Understanding of use of modern Testing equipment's in field of construction.
- CO3: Application of modern Testing methods in of construction materials in engineering.
- CO3: Interpretation of the test data obtained from modern non-destructive testing methods
- CO5: Analyze the quality of construction with the help scientific and Non-destructive testing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01,P02, P03, P04/PS01, PS02
CO2	P01,P02 P03, P04 /PS01, PS02
CO3	P01,P02 P03, P04/PS01, PS02
CO4	P01,P02 P03, P04/PS01, PS02
CO5	P01,P02 P03, P04/PS01, PS02

BCEE 0812: CONCRETE TECHNOLOGY LABORATORY

Objective: *The objective of this laboratory is gain practical idea about the behavior structural element made of construction material especially concrete and steel and design these material as per given strength criteria.*

Credits: 01

L-T-P: 0-0-2

Module No.	Contents	Teaching Hours
I	<ul style="list-style-type: none"> • Design of Concrete mix by IS Code Method • Stress strain curve for concrete • Correlation between cube strength and cylinder strength • Determination of split tensile concrete • Relation between compressive and modulus of rupture • Behavior of beams under flexure • Durability studies on concrete (RCPT, Water Absorption, Sorpitivity, Sulphate Attack). • Tensile strength of different types of steel rebars, rolled steel sections. • Study of crack pattern developed in a simply supported beam under single point load. • Non-destructive tests on concrete – Rebound hammer and ultrasonic concrete test and penetration test 	20

Reference Books

- Gambhir.M.L. Concrete Technology, McGraw Hill Education, 2006.
- Gupta.B.L. Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
- Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
- Santhakumar.A.R."Concrete Technology", Oxford University Press, 2007.
- Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2003

Focus: This course focuses on Skill development aligned with CO3 and CO4

Course Outcomes:

- Outline the importance of testing of cement and its properties
- Summarise the concept of workability and testing of concrete
- Describe the preparation of green concrete
- Describe the properties of hardened concrete
- Understand the non-destructive testing procedures on concrete.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO3 /PSO2
CO2	PO3/PSO2
CO3	PO4/PSO2
CO4	PO3/PSO2
CO5	PO5/PSO2

BCEE 1101: FOUNDATION ENGINEERING

Objective: The course provides a comprehensive learning of different type foundations and enable student to apply the knowledge gained of soil mechanics in analysis and design of foundation.

Credits:03

L-T-P: 3-0-0

Module No.	Contents	Teaching Hours
I	<p>Stresses Due to Superimposed Loading: Stresses in Soils, Boussinesq's and Westergaard's Theory for Determination of Stresses within Soils under Superimposed Loads and their Uses, Stresses due to Vertical and Horizontal Line Loads, Circular, Rectangular and Trapezoidal Loading, Stress Isobars and their Engineering Significance, Newmark's Influence Chart, Equivalent Point Load Method, Contact Pressure.</p> <p>Soil Exploration: Methods of Soil Exploration, Boring Methods, Sampling Methods, Penetration Tests (SPT, CPT and DCPT), Correlations between Penetration Resistance and Soil Design Parameters.</p> <p>Earth Pressure: Plastic Equilibrium of Soil, Rankine's Theory, Coulombs Wedge Theory, Earth Pressure on Retaining Walls.</p>	15
II	<p>Stability Of Slopes : Stability Analysis of Infinite and Finite Slopes, Planer and Circular Slip Surfaces, Culmann's Method, Taylor Stability Number and Stability Charts, Method Of Slices, Fellenius and Bishop's Method Of Stability Analysis.</p> <p>Types of Foundations : Shallow Foundation and Deep Foundation</p> <p>Bearing Capacity: Bearing Capacity of Shallow Foundation, Basic Definitions, Rankine's Analysis, Terzaghi's Analysis, Meyerhof's Analysis, Vesic's Bearing Capacity Equation, Effect of Water Table on Bearing Capacity, Effect of Inclination and Eccentricity of the Applied Load on Bearing Capacity, Plate Load Test and Provisions of Indian Standard Code of Practice.</p> <p>Pile Foundations: Types of Piles, Analysis of Single and Group of Piles, Pile Capacity, Negative Skin Friction.</p> <p>Settlement Analysis: Immediate and Consolidation Settlement Analysis of Foundations, Time-Settlement Predictions, Construction Loading and Settlement Analysis, De Beer and Schmertman's Methods of Settlement Analysis.</p>	15

Text Books:

- Arora K.R. "Soil Mechanics & Foundation Engineering" New Delhi: Standard Publishers Distributors; 2009.
- Bowles J.E. "Analysis and Design of Foundation" New York, USA: McGraw Hill Higher Education; 2001.
- Das B.M. " Principles of Foundation Engineering" New Delhi: Global Engineering Publishers; 2003.
- Murthy V.N.S "Soil Mechanics and Foundation Engineering" New Delhi: Marcel Dekker Publications; 2010.

Reference Books

- Peck, R.B. & Hanson, W.E., and Thornburn. "Foundation Engineering" New York, USA : John Wiley and Sons; 1974.
- Ranjan, G. and Rao, A.S.R "Basic and Applied Soil Mechanics" New Delhi: New Age Publication; 2000.
- Venkataramaiah C. "Geotechnical Engineering" New Delhi: New Age Publications; 2006.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

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

- C01 Understand the behavior and response of soil under vertical stress imposed by applied load
- C02 Familiarize with the investigation techniques used in subsurface exploration
- C03 Assess the response of retaining walls under lateral earth pressure
- C04 Learn the stability behavior of slopes
- C05 Identify and analyze different types of foundation

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1, PO2, PO4, PO12/ PS03
C02	PO1, PO2, PO4, PO5, PO12/ PS03
C03	PO1, PO2, PO4, PO12 / PS03
C04	PO1, PO2, PO3, PO4, PO12 / PS03
C05	PO1, PO2, PO4, PO12 / PS03

BCEE 0102: GROUND IMPROVEMENT ENGINEERING

Objective: The course provides a comprehensive learning of ground improvement techniques. This course will address the need of ground improvement and the techniques to achieve it.

Credits:03

L-T-P-J: 3-0-0-0

Module No.	Contents	Teaching Hours
I	<p>Ground Improvement And Modification: Introduction to Ground Improvement, New Technologies, Overview Of Various Techniques, Processes Of Modification and their Effect on Soils: Improvement by Excavation and Replacement, Mixing Additives : Chemicals, Lime, Cement, Ash, Slag, Bitumen, Electro Kinetic Process, Compaction Piles, Grouting: Principles, Techniques, Process, Control of Grout and Grouting Operation, Application</p> <p>Reinforced Earth: Reinforced Earth Principles and Advantages, Design Methods, Material Specification, Geo-synthetics: Geo-textiles, Geo-grids, Geonets, Geo-membranes, Geo-composite, Deep Compaction of Granular Soils, Vibro floatation, Vibro compaction, Blasting and Dynamic Compaction.</p>	20
II	<p>Stabilization Of Soil: Stabilization of Soil with Lime and Stone Columns, Principles, Laboratory and Field Investigations, Control, Design and Construction, Applications, Ground Anchors and Soil Nail Principles, Technology, Construction Process, Structural Elements, Pull-Out Capacity Estimates, Application Criteria, Design of Anchored Walls and Nailed Soil-Retaining Structures.</p> <p>Sand Drains And Their Design: Principles, Installation, Design and Application of Sand Drains.</p> <p>Preloading: Principles: Installation, Design and Application of Preloading With or Without Sand Drains.</p>	20

Text Books:

- Bell F.C. "Engineering Treatment of Soils" London: Chapman and Hall;1993
- Fang, H.Y. "Foundation Engineering Hand Book" New Delhi: CBS Publishers;2004.
- Hausmann M.R. "Engineering Principles of Ground Modification" New Delhi: McGraw Hill; 1990.
- K. Rao N.S.V "Vibration Analysis and Foundation Dynamics" New Delhi: S. Chand Publications;2006.

Reference Books:

- Koerner R.M. "Designing with geosynthetics" London: Prentice Hall;1997.
- Swami Saran, "Reinforced Soil and Its Engineering Applications" New Delhi: I. K. International Publishers; 2010.
- Srbulov, M. "Ground Vibration Engineering" New USA: Springer Publishers,2010.

Focus: This course focuses on employability aligned with CO3 and CO5

Course Outcomes:

After completion of this course, student will be able to:

- CO1 Identify the need of ground improvement
- CO2 Learn different chemical and mechanical techniques to improve ground
- CO3 Understand the concept of reinforced earth
- CO4 Understand the basics of soil stabilizations
- CO5 Asses the functionality of sand drains

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO12/ PSO3
CO2	PO1, PO2, PO3,PO4, PO5, PO12/ PSO3

C03	P01, P02, P03, P04, P012 / PS03
C04	P01, P02, P04, P012 / PS03
C05	P01, P02, P03, P04, P05, P012 / PS03

BCEE 0103: EARTH AND EARTH RETAINING STRUCTURE

Objective: The course provides a comprehensive learning of the need of earth retaining structures. It will equipped the student with the knowledge of different earth retaining structures and enables them to perform analysis

Credits:04

L-T-P-J: 3-1-0-0

Module No.	Contents	Teaching Hours
I	<p>Earth And Rock Fill Dams: Earth and Rock Fill Dams, Types, Material, Foundation, Safety Requirements of Earth Dams, Seepage Analysis, Mechanically Stabilized Earth Retaining Walls, General Considerations, Backfill and Reinforced Materials, Construction Details, Design Method, Stability.</p> <p>Soil Nailing: Soil Nailing, Applications, Advantages, Limitations, Methods of Soil Nailing, Case Histories, Analysis and Design.</p>	21
II	<p>Reinforced Soil: Introduction, Basic Components, Strength Characteristics, Soil-Reinforcement Interface Friction, Reinforced Earth Wall, Stability Analysis, Construction Procedure, Drainage, Design Procedure, Foundation on Reinforced Soil Bed, Pressure Ratio, Analysis of Strip, Isolated, Square and Rectangular Footing on Reinforced Soil Bed, Ultimate Bearing Capacity of Footing on Reinforced Earth Slab, Fiber Reinforced Soil.</p>	19

Text Books:

- Bell F.C. "Engineering Treatment of Soils" London: Chapman and Hall;1993.
- Bowles J.E. "Analysis and Design of Foundation" New York, USA:McGraw Hill Higher Education; 2001.
- Hausmann M.R. "Engineering Principles of Ground Modification" New Delhi: McGraw Hill; 1990.

Reference Books:

- Koerner R.M. "Designing with geosynthetics" US: Prentice Hall; 1997.
- Murthy V.N.S. "Soil Mechanics and Foundation Engineering" New Delhi: Marcel Dekker Publisher; 2010.
- S. Saran" Reinforced soil and its Applications" New Delhi: Gyan Books Pvt. Ltd.; 2011.

Focus: This course focuses on employability aligned with CO5 and CO4

Course Outcomes:

After completion of this course, student is able to:

- CO1 Identify the need of retaining the earth
- CO2 Assess the functioning of retaining structures made of earth
- CO3 Understand the basics of Earth dams
- CO4 Recognize the concept of soil nailing and learn its suitability
- CO5 Learn the basics of reinforced earth and discuss the concept of MSE

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO12/ PS03
CO2	PO1, PO2,PO4, PO12/ PS03
CO3	PO1, PO2, PO4, PO12 / PS03
CO4	PO1, PO2, PO3, PO4, PO12 / PS03
CO5	PO1, PO2, PO3, PO4, PO12 / PS03

BCEE 0104: GEOTECHNICAL EXPLORATION & MEASURING TECHNIQUE

Objective: To study the field soil exploration method for geotechnical investigations

Credits:04

L-T-P-J: 3-1-0-0

Module No.	Contents	Teaching Hours
I	<p>Introduction: Necessity and Importance of Soil Exploration, Method of Sub Surface Exploration Test Pits, Trenches, Caissons, Tunnels and Drifts, Wash Boring, Percussion Drilling, Rotary drilling, Factors Affecting the Selection of a Suitable Method of Boring. Extent of Boring, Factors Controlling Spacing and Depth of Bore Holes, Spacing and Depth of Various Civil Engineering Structures.</p> <p>Indirect Method of Exploration- Seismic method, Electrical resistivity, Resistivity Sounding and Profiling, Qualitative and Quantitative Interpretation of Test Results, Comparison of Resistivity and Seismic surveys, Shortcomings.</p> <p>Different Method of Stabilization of the Bore Holes, their Relative Merits and Demerits.</p> <p>Ground Water Observation: Different Method of Ground Water Observation: Time Lag in Observation, Sampling of Ground Water.</p>	19
II	<p>Sampling: Source of Disturbance and their Influence. Type of Sampler, Principle of Design of Sampler, Representative and Undisturbed Sampling in Various Types of Soils. Surface Sampling, Amount of Sampling, Boring and Sampling Record, Preservation and Shipment of Sample Preparation of Bore Log.</p> <p>Penetration tests: Standard Penetration Tests, Dynamic Cone Penetration Tests with and without Bentonite Slurry, Static Cone Penetration Tests, and Factor Affecting the Penetration Tests. Various Corrections in the Test Results. Interpretation of Test Result for Design and Determination of Modulus of Deformation. Small Size Penetrometers. Correlation among Various Test Results.</p>	21

Text Books:

- Kurien N.P. "Design of Foundation Systems: Principles & Practices" New Delhi: Narosa; 1992.
- Bowles J.E. "Analysis and Design of Foundation" New York, USA: McGraw Hill Higher Education; 2001.
- Murthy V.N.S "Soil Mechanics and Foundation Engineering" New Delhi: Marcel Dekker Publishers; 2010.
- Ranjan G. and Rao A S R "Basic and Applied Soil Mechanics" New Delhi: New Age international Publishers; 2016.

Reference Books:

- Murthy V.N.S "Soil Mechanics and Foundation Engineering" New Delhi: Marcel Dekker Publishers; 2010.
- Ranjan G. and Rao A S R "Basic and Applied Soil Mechanics" New Delhi: New Age international Publishers; 2016.

Focus: This course focuses on employability aligned with CO3 and CO1

Outcomes:

After completion of this course, student will able to:

- C01: Understand types of sub soil exploration for Determining the nature of soil at the site and its stratification
- C02: Necessity and types of indirect approach for subsoil exploration for larger area. Techniques for borehole stability technology to maintain a stable borehole, both during and after drilling
- C03: Understand determination of the elevation of the ground surface at each monitoring location.
- C04: Develop Information on the physical properties of soil and rock around a site to design foundation for proposed structures. Also give a clear idea about sampling methods.
- C05: Understand Idea regarding different types of penetration test on field and correlation regarding accessing properties.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,P05 /PS03
C02	PO1,P02,P05/PS03
C03	PO1,P05 /PS03
C04	PO1,P02,P05 /PS03
C05	PO1,P05 /PS03

BCEE 0105: ADVANCED FOUNDATION DESIGN

Objective: To study the shallow and deep foundation, and analyses soil stability design for geotechnical application.

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Contents	Teaching Hours
I	<p>Stress Distribution In Soils: Elastic Solutions: Point Load, Line Load, Strip Load: Uniform, Triangular and Trapezoidal Variation of Load, Uniform Load on Circular, Rectangular, Irregular Areas. Approximate Methods, Applications to Real Problems.</p> <p>Bearing Capacity And Settlement Analysis Of Shallow Foundations: Types of Bearing Capacity Failures, Meyerhoff and Hansen's Bearing Capacity Equations, BIS Bearing Capacity Equation, Immediate and Consolidation Settlements in Cohesive Soil, Skempton-Bjerreum Settlement Correction, De-Beer and Schmertman's Methods of Settlement Prediction in Non-Cohesive Soil.</p> <p>Piles And Pile Groups: Classification of Piles, Construction and Installation of Piles, Load Carrying Capacity of Single Piles in Clay, Silt and Sand by Dynamic and Static Methods, Pile Load Test, Pile Group, Negative Skin Friction, Settlement of Pile Group, Foundation on Expansive Soil, Construction on Expansive Soil, Alteration of Soil Condition, Under-Reamed Piles.</p>	20
II	<p>Well Foundation: Elements of Well Foundation, Shape, Depth Of Scour, Well Sinking, Tilt, Shift and Their Prevention. Design Principles.</p> <p>Stability Of Slopes: Limit Equilibrium Method, Method of Slices, Rigorous and Simplified Bishop Method, Spencer's Method, Stability Charts, Janbu's Generalized Procedure of Slices.</p> <p>Machine Foundation: Classification, Definitions, Types of Machine Foundations, Free and Forced Vibrations, Design Principle, Barkan's Method.</p>	20

Text Books:

- Arora K.R. "Soil Mechanics and Foundation Engineering" New Delhi: Standard Publishers; 2009.
- Bowles J.E. "Analysis and Design of Foundation" New York: McGraw Hill Higher Education's; 2001.
- Das B.M "Principles of Foundation Engineering" New Delhi: Global Engineering Publishers; 2003.
- Murthy V.N.S. "Soil Mechanics and Foundation Engineering" New Delhi: Marcel Dekker Publishers; 2010.
- Poulos H.G. & Davis E. H. "Pile Foundation Analysis and Design" John Wiley & Sons; 1980.
- Tonilinson M.J. "Design and construction" Longman Higher Education; 1996.
- C. Venkataramaiah "Geotechnical Engineering" New Delhi: New Age Publishers; 2006.

Reference Books:

- H.G. Poulos & E. H. Davis "Pile Foundation Analysis and Design" John Wiley & Sons; 1980.
- M.J. Tonilinson "Design and construction" Longman Higher Education; 1996.
- C. Venkataramaiah "Geotechnical Engineering" New Delhi: New Age Publishers; 2006.

Focus: This course focuses on employability aligned with CO5 and CO6

Outcome:

After completion of this course, student will be able to:

- CO1: Develop concept of Stress distribution methods to estimate the stress distribution of soil for an applied load.

- C02: Design approach to access allowable bearing capacity and settlement for cohesive and cohesionless soil.
- C03: Analysis and design approach of pile foundation and construction approach.
- C04: Design and construction approach of well foundation, Idea of scouring that required for bridge design and in other constructions purposes.
- C05: Assessment of the stability of slopes under both short-term and long-term scenarios using different types of mechanism which essential for simulation in limit equilibrium approach and finite element analysis.
- C06: Understand design criteria of Machine foundation for Design considering static load and kinetic forces.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
C01	P01,P03 /PS03
C02	P01,P02,P03,P05 /PS03
C03	P01,P02,P03 /PS03
C04	P01,P02,P03 /PS03
C05	P01,P02 /PS03
C06	P01,P02,P03 /PS03

BCEE 0106: ADVANCED FOUNDATION ENGINEERING

Objective: To study the shallow and deep foundation, and analyses soil stability and designing retaining wall for geotechnical application.

Credits:03

L-T-P-J: 3-0-0-0

Module No.	Contents	Teaching Hours
I	<p>Selection of foundation and Sub-soil exploration/investigation: Types of foundation, Factors affecting the selection of type of foundations, steps in choosing types of foundation based on soil condition, Objectives and planning of exploration program, methods of exploration-wash boring and rotary drilling-depth of boring, soil samples and soil samplers-representative and undisturbed sampling, field penetration tests: SPT, SCPT, DCPT. Introduction to geophysical methods, Bore log and report writing, data interpretation.</p> <p>Shallow Foundation: Introduction, significant depth, design criteria, modes of shear failures Detail study of bearing capacity theories (Prandtl, Rankine, Terzaghi, Skempton), bearing capacity determination using IS Code, Presumptive bearing capacity. Settlement, components of settlement & its estimation, permissible settlement, Proportioning of footing for equal settlement, allowable bearing pressure. Bearing capacity from in-situ tests (SPT, SCPT, PLATE LOAD), Factors affecting bearing capacity including Water Table., Bearing capacity of raft/mat foundation as per I.S. code provisions, Contact pressure under rigid and flexible footings. Floating foundation. Types of pavements & its design.</p> <p>Pile foundations: Introduction, load transfer mechanism, types of piles and their function, factors influencing selection of pile, their method of installation and their load carrying characteristics for cohesive and granular soils, piles subjected to vertical loads- pile load carrying capacity from static formula, dynamic formulae (ENR and Hiley), penetration test data & Pile load test (IS 2911).</p> <p>Pile group: Carrying capacity, efficiency and settlement. Negative skin friction</p>	20
II	<p>Foundations on problematic soil & Introduction to Geosynthetics: Significant characteristics of expansive soil, footing on such soils, Problems and preventive measures. Under-reamed pile foundation-its concept, design& field installation. Significant characteristics of silt and loess, problems & remedial measures footing on such soils, introduction to geosynthetics-types and uses.</p> <p>Retaining walls: Types (types of flexible and rigid earth retention systems: counter fort, gravity, diaphragm walls, sheet pile walls, soldier piles and lagging).</p>	10

Text Books:

- P. Purushothama Raj *Soil Mechanics and Foundation Engineering* Chennai: Pearson Education; 2007.
- B.C. Punmia *Soil Mechanics & Foundation Engineering* New Delhi: Laxmi Pub. Pvt. Ltd.; 2017.
- Alam Singh *Soil Mechanics & Foundation Engineering* New Delhi: CBS Publishers & Distributors; 2009.
- D.W. Taylor *Fundamentals of Soil Mechanics* Mumbai: Asia Publishing House; 1955

Reference Books:

- V. N. S. Murthy *Soil Mechanics & Foundation Engineering* Sai Kripa Bangalore: Technical Consultants; 2018.
- Gopal Ranjan, A.S.R. Rao *Basic and applied soil mechanics* New Delhi: New Age int. (P) Ltd; 2016.
- K.R. Arora *Soil Mechanics and Foundation Engineering* New Delhi: Standard Pub.; 2009.
- M Das Braja *Principles of Geotechnical Engineering* New Delhi: Cengage Learning; 2001.

IS Codes:

- Code of practice for determination of bearing capacity of shallow foundation IS:6403
- Code of practice for design and construction of pile foundation- IS:2911 (Part I to IV)
- Method for standard penetration test for soil- IS:2131
- Code of practice for subsurface investigation for foundation- IS:1892
- Code of practice for structural safety of buildings: Shallow Foundations- IS:1904
- Code of practice for calculation of settlement of foundations- IS:8009

Focus: This course focuses on employability & Skill development aligned with CO3 and CO6

Outcome:

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

- C01: Understand appropriate soil investigation/testing technique/method and get true sub soil parameters used for selection of type of foundation as per Indian Standard guidelines.
- C02: Understand Bore log details, Select and design appropriate/suitable foundation system (shallow/Deep) for different structures, that satisfy the allowable bearing capacity. Calculation of bearing capacity and Settlement calculation for different footing condition
- C03: Analyzed Design deep foundation satisfying bearing capacity and settlement requirements.
- C04: Understand study the effect of pile group in practical field.
- C05: Understand the engineering behavior of expansive soils and selection of suitable foundation type for such soils. Selection of alternate materials, like geosynthetics and its application, in foundation problems.
- C06: Design and analysis of retaining walls and sheet piles under static loads.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,PO3 /PS03
C02	PO1,PO2,P05 /PS03
C03	PO1,PO2,P05,P05 /PS03
C04	PO1,PO2,PO3 /PS03
C05	PO1,PO2 /PS03
C06	PO1,PO2,PO3 /PS03

BCEE 0108: GEOSYNTHETIC & REINFORCED SOIL STRUCTURES

Objective: To study Reinforced soil wall design as per Morth Specification and IRC: SP guideline.

Credits:03

L-T-P-J: 3-0-0-0

Module No.	Contents	Teaching Hours
I	<p>Introduction to Ground Improvement: Introduction to Ground Improvement Techniques, Processes of Soil Modification and their Effect on Soils.</p> <p>Introduction to Geosynthetics: Introduction and need of geosynthetics, Historical background, early applications, basic principle of reinforced soil, Types of geosynthetics and their applications, Manufacturing of geosynthetics. Strength of reinforced soils, Testing of Geosynthetics</p> <p>Earth Retaining Structures: Different Types of Soil Retaining Structures, Construction Aspects of Geosynthetic Reinforced Soil Retaining Walls, Design Codes for Reinforced Soil Retaining Walls</p> <p>Stability Analysis: External Stability Analysis of Reinforced Soil Retaining Walls, Seismic Loads and Internal Stability Analysis of Reinforced Soil Walls, Testing Requirements for Reinforced Soil Retaining Walls. infinite and finite slopes, Stability analysis of reinforced soil slopes resting on soft foundation soils, Stability analysis of reinforced soil slopes resting on strong foundation soil. bilinear wedge analysis, Design of Embankments supported on Load Transfer Platforms, Reinforced soil for supporting shallow foundations</p>	15
II	<p>Design of Reinforced Soil Retaining Walls: simple geometry , sloped backfill soil , Design of reinforced soil retaining walls supporting a bridge abutment</p> <p>Application of Geosynthetics: Accelerated consolidation of soft clays using geosynthetics , Geosynthetic encased stone columns for load support , Drainage application of geosynthetics , Filtration Applications of Geosynthetics , Erosion control using geosynthetics , Natural geosynthetics and their applications , Geosynthetics for construction of municipal and hazardous waste landfills</p>	15

Text Books:

- F.C. Bell “ *Engineering Treatment of Soils*” London: Chapman and Hall;1993
- H.Y Fang. “ *Foundation Engineering Hand Book*” New Delhi: CBS Publishers; 2004.

Reference Books:

- M.R Hausmann. “*Engineering Principles of Ground Modification*” New Delhi: McGraw Hill; 1990.
- N.S.V Kameswara Rao “*Vibration Analysis and Foundation Dynamics*” New Delhi: S. Chand Publications; 2006.

Focus: This course focuses on employability & Skill development aligned with CO6 and CO4

Outcome:

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

- C01: Develop basic idea about ground improvement Engineering and its requirement
- C02: Develop idea about geosynthetic material, its working principle, characteristics
- C03: Design approach of geosynthetic reinforced soil structure and related codes
- C04: Design approach of external and internal stability of reinforced soil structure
- C05: Analyze the stability of earth retaining structures and earth slopes.
- C06: Understand the wide area of application of geosynthetics

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,P03 /PS03
C02	PO1,P02,P05 /PS03
C03	PO1,P02,P05,P012 /PS03
C04	PO1,P02,P03 /PS03
C05	PO1,P02 /PS03
C06	PO1,P02,P03 /PS03

BCEE 0804: GEOSYNTHETIC TESTING LABORATORY

Objective: To study the geosynthetic testing and to assess the performance of geosynthetics

Credits:02

L-T-P: 3-0-0

Module No.	Contents	Teaching Hours
I/II	<ul style="list-style-type: none"> Physical Properties: Mass per unit area, thickness, specific gravity of geosynthetic Mechanical Properties: Drop cone test; Puncture resistance, Grab strength contd. and triaxial test, Direct Shear and Pull-out test, Tensile strength and trapezoidal tear strength Hydraulic Properties Permittivity and transmittivity Endurance Properties Abrasion test; Ultraviolet degradation and Gradient Ratio, Tests on Geofabric: Density of geofabric, Water absorption test, Compressive Properties; Tensile properties 	26

Text Books:

- D.G.Devshikar, J.N.Mandal "A Guide to Geotextiles Testing Paperback" New Age International Private Limited, 2002.
- Robert M. Koerner "Designing with Geosynthetics" - 6Th Edition Vol. 1", Xlibris US

Reference Books:

- ASTM D4354 "Standard Practice for sampling of Geosynthetics for Testing"
- IS standard code for geosynthetic properties
- ISO standard for Geosynthetic sampling and preparation of test sample

Focus: This course focuses on Skill development aligned with CO1 and CO4

Outcome:

After completion of this course, student will able to:

- C01: Understand types of properties of geosynthetic
- C02: Understand mechanical properties of geosynthetic
- C03: Understand hydraulic properties of geosynthetic
- C04: Determination of properties of Geofabric

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01,P05 /PS03
C02	P01,P02,P05/PS03
C03	P01,P05 /PS03
C04	P01,P02,P05 /PS03

BCEE 0214: ENGINEERING HYDROLOGY

Objective: To build on the student's background in hydrology and hydraulics and understanding of water resources systems and to develop the skills in modeling of flood flows and flood routing and also to develop skills in the ground water flow, type of aquifer and yield from the well.

Credits: 03

L-T-P-J: 2-1-0-0

Module No.	Content	Teaching Hours
I	Introduction: History of Hydrology, Hydrological Cycle, World Water Quantities, Applications of Hydrology in Engineering. Precipitation: Forms of precipitation, Measurement of precipitation, Average Depth of rainfall over area, Mean Annual Rainfall, Rain gauge Network, Consistency of Rainfall data.	15
II	Hydrological Abstractions: Evaporation, Transpiration and Evapotranspiration, Runoff, Factors affecting runoff, Infiltration process, Infiltration capacity curve. Stream Flow: Factors affecting stream flow, Measurement of stream flow, Hydrograph analysis, Preparation of unit hydrograph, Synthetic hydrograph, Instantaneous unit hydrograph.	15

Text Books:

- G.L. Asawa, "Irrigation and Water Resources Engineering", New Delhi New Age International (P) Limited, Publishers. (2005)
- C.S.P. Ojha, R. Berndtsson, and P. Bhunya, "Engineering Hydrology", New Delhi Oxford University Press, (2008)

Reference Books:

- V.P. Singh, "Elementary Hydrology", New Delhi Prentice-Hall. (1992)
- K. Subramanya, "Engineering Hydrology", New Delhi Tata McGraw-Hill Publishing Company Limited. (1994),
- D.K. Todd, and L.W. Mays, "Groundwater Hydrology, 3rd Edition", U.S.A. John Wiley & Sons, Inc., (2004)

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Analyze hydro-meteorological data
- CO2: Estimate abstractions from precipitation
- CO3: Compute yield from surface and subsurface basin
- CO4: Develop rainfall-runoff models
- CO5: Formulate and solve hydrologic flood routing models

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

BCEE 0202: GROUND WATER MANAGEMENT

Objective: To comprehend differential equations governing ground water flow in polar coordinates and to develop basic know about the management of ground water.

Credits: 03

L-T-P-J: 2-1-0-0

Module No.	Content	Teaching Hours
I	Introduction: Ground Water Occurrence and Its Role in Hydrologic Cycle, Vertical Distribution of Ground Water, Ground Water Bearing Formations, Aquifer and Its Classification, Flow and Storage Characteristics of Different Types of Aquifers, Storage Release Mechanisms of Aquifers. Equations for Flow Through Porous Media: Darcy's Law and Differential Equations Governing Ground Water Flow.	15
II	Ground Water Management: Ground Water Exploration Methods, Types of Wells, Construction of Wells, Well Completion and Development, Well Protection, Contamination of Ground Water. Well Hydraulics: Differential Equations Governing Ground Water Flow in Polar Coordinates, Well Hydraulics, Well Interference, Wells Near Boundaries, Test Pumping Analysis.	15

Text Books:

- D.K. Todd, "Ground Water Hydrology", New York John Wiley and Sons. (2001),
- A.I. Kashef, "Ground Water Engineering", New York McGraw-Hill Book Company, (1987),

Reference Book:

- H.M. Raghunath, "Ground Water", New Delhi New Age International (P) Limited, Publishers, (1990),

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: learn how ground water can store and in how many ways we can store water for further use.
- CO2: Understanding the role of hydrological cycle in recharge of ground water.
- CO3: To develop and design of well and monitor recharge capacity as well as efficiency of well.
- CO4: understand the occurrence of ground water, different types of aquifers and the flow of ground water using various equations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,P02 /PS01
CO2	PO1,P02 /PS01
CO3	PO1,P02 /PS01
CO4	PO1,P02 /PS01

BCEE 0203: HYDROPOWER ENGINEERING

Objective: to design a hydroelectric plant utilizing optimal energy in the water, with minimum submergence and economic costs, considering seasonal variation in power generation to meet the region's demand during all seasons.

Credits: 03

L-T-P-J: 2-1-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: Sources of Energy, Comparison of Hydropower With Other Sources of Power, Hydropower Potential in India, Basin-Wise Development of Hydropower in India, Constraints in Hydropower Development.</p> <p>Types of Hydropower Plants: Base and Peak Load Hydropower Plants, Run-of-River Plants, Valley Dam Plants, Diversion Canal Plants, High Head Diversion Plants, Pumped-Storage Power Plants,</p> <p>Stream Flow Data For Hydropower Potential: Flow and Load Duration Curves, Primary and Secondary Power, Storage and Pondage, Load Factor, Capacity Factor, Utilization Factor, Diversity Factor.</p>	15
II	<p>Conveyance System: Power Canal and Its Alignment; Surges in Power Canals, Types, Design, and Layout of Penstocks, Economical Diameter of Penstock.</p> <p>Hydraulic Transients: Functions, Types, Location, and Design of Surge Tanks.</p> <p>Turbines: Types, Characteristics, Efficiency, and Selection Criteria For Turbines, Cavitation, Casing, Draft Tubes, Tail Race.</p>	15

Text Book:

- R.S. Varshney, "Hydropower Engineering", Roorkee Nem Chand and Brothers, (2001),

Reference Book:

- C.C. Warnick, "Hydropower Engineering", New Delhi Prentice Hall (1984),

Focus: This course focuses on employability aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Identify types of hydropower plants
- CO2: Estimate hydropower potential
- CO3: Design of penstocks and surge tank
- CO4: Plan the layout of a hydropower plant

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 /PSO1
CO3	PO1, PO2, PO3 /PSO1
CO4	PO1, PO2 /PSO1

BCEE 0204: HYDRAULIC STRUCTURES

Objective: This course is designed to study the fundamental concept, design and maintenance of hydraulic structures. Also to provide basic understanding of heavy structures like dam have to study. To give the basic idea of canal regulation, canal headwork and cross-drainage.

Credits: 03

L-T-P-J: 2-1-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: Various Kinds of Hydraulic Structures for Water Resource Projects.</p> <p>Embankment Dams: Types and Advantages of Embankment Dams, Design and Safety Considerations, Factors Influencing Design of Embankment Dams, Analysis and Control of Seepage Through Embankment Dams, Stability Analysis of Embankment Dams.</p> <p>Gravity Dams: Forces and Load combination on a gravity dam, Stress analysis, Mode of failure of gravity dams , Elementary and practical profile of a gravity dam, method of design of gravity dams.</p>	15
II	<p>Buttress and Arch Dams: Buttress dam. Types and forces on buttress dam, Advantages and disadvantages of buttress dams, Arch dams, Types and forces on Arch Dams.</p> <p>Spillways: Types, Spillways Capacity, Components of spillways, Energy dissipaters.</p>	15

Text Books:

- G.L. Asawa, "Irrigation and Water Resources Engineering", New Delhi New Age International (P) Limited, Publishers, (2005).
- B.C. Punmia, "Irrigation and Water Power Engineering", New Delhi Laxmi Publications, (1992)

Reference Books:

- R.S. Varshney, "Hydropower Structures including Canal Structures and Small Hydro", Roorkee Nem Chand and Brothers, (2001).

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Analyze factors effecting selection of regulatory works such as canals ,spillways
- CO2: Understand about the types of fall in canals and its application which have designed in the all cases.
- CO3: Deals the causes of failure of the canals and spillways.
- CO4: design of canals, diversion; storage head works by the Bligh's and khosla's theory.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,PO2 /PSO1
C02	PO1,PO2 /PSO1
C03	PO1,PO2 /PSO1
C04	PO1,PO2,PO3 /PSO1

BCEE 0211: INTRODUCTORY RURAL WATER SUPPLY

Objective: To understand the techniques and methods for rural drinking water Management

Credits: 03

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	Introduction: Fundamentals of Rural Water Supply: Issues of rural water supply – Various techniques for rural water supply, National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies. Low Cost Water Treatment, Specific contaminant removal systems Sources of Water: Traditional Sources of Water in Rural Areas, Different Types of Wells, Sanitary Aspects in Well Construction, Water Harvesting Techniques.	15
II	Water Treatment: Disinfection of Rural Water Sources, Fluoride and Its Removal, Diatomaceous Earth Filter, Cloth Filter, Slow Sand Filter. Rural Sanitation: Biogas, Collection and Disposal of Wastes, Community Awareness and User Participation, Planning of Communication Support in Rural Supply and Sanitation Projects. Solid Waste Management in rural areas: Disposal of Solid Wastes- Composting- land filling, Incineration, Biogas plants, Other specific issues and problems encountered in rural sanitation.	15

Text Books:

- S.K. Garg Water Supply Engineering (Environmental Engineering Vol.-I) New Delhi: Khanna Publisher; 2008.
- S.K. Garg Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol.-II) New Delhi: Khanna Publishers; 2008.
- H.T. Mann and D. Williamson, Water Treatment and Sanitation – Simple Method for Rural Area London: UK Intermediate Technology Publications; 1982.
- B.C Punmia. Water Supply and Wastewater Engineering Vol. I and II New Delhi: Laxmi Publications; 2010.

Reference Books:

- D. Srinivasan Environmental Engineering New Delhi: PHI Learning Pvt. Ltd; 2009.
- E.W. Steel and T.J. McGhee Water Supply and Sewerage New York, USA; McGraw-Hill; 1991.
- E.G. Wanger and J.N. Lanoix Water Supply for Rural Areas and Small Communities Geneva: WHO; 1991.

Focus: This course focuses on employability aligned with CO5 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand water quality concepts and their effect on treatment process selection for rural areas
- CO2: Differentiate between options for centralized and urban systems versus decentralized and rural systems
- CO3: Understand the importance of water treatment for rural water supply systems
- CO4: Understand the available techniques and methods for rural drinking water treatment
- CO5: Learn about the different methods available for rural sanitation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,PO2 /PSO1
C02	PO1,PO2 /PSO1
C03	PO1,PO2 /PSO1
C04	PO1,PO2 /PSO1
C05	PO1,PO2 /PSO1

BCEE 0206: INTRODUCTION TO CLIMATE CHANGE STUDIES

Objective: To understand the process of climate change and global warming

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	Introduction to Climate system; Earth's Climate System: Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification. Global Wind Systems – Trade Winds - Cloud Formation and Monsoon Rains – Storms and Hurricanes, Hydrological Cycle, Global Ocean Circulation – El Nino and its Effect - Solar Radiation, The Earth's Natural Green House Effect ,Green House Gases and Global Warming, Carbon Cycle.	15
II	Energy balance models: Energy balance models and glacial cycles, Global atmospheric circulation. Impacts of climate change on Freshwater Resources, Terrestrial and Inland Water Systems (Ecosystems), Ocean Systems, Human Health. Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change. Climate Change Regulation: Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC –Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling	15

Text Books:

- Neelin JD *Climate Change and Climate Modeling* New Delhi: Cambridge University Press; 2010.
- JP Peixoto and AH Oort. *Physics of Climate* NY: American Institute of Physics; 1992.
- C.J. Jepma and M. Munasinghe *Climate Change Policy – Facts, Issues and Analysis* New Delhi: Cambridge University Press; 1998

Reference Book:

- Sushil Kumar Dash *Climate Change – An Indian Perspective* New Delhi: Cambridge University Press India Pvt. Ltd; 2007.

Focus: This course focuses on employability aligned with CO3 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand the basic of Energy balance modeling
- CO2: Evaluate the various factors that shape climate
- CO3: Understand the basics of Climate Change Modeling
- CO4: Learn the basics of Climate change and its effect
- CO5: Understand the process of climate change and global warming
- CO6: Learn the techniques of climate change mitigation

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

C06	P01,P02 /PS01
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BCEE 0207: ENVIRONMENTAL INSTRUMENTATION AND ANALYSIS

Objective: To learn about different Instruments used for the environmental analysis

Credits: 04

L-T-P-J: 4-0-0-0

Module No.	Content	Teaching Hours
I	Spectrometry and Photometry: UV-Vis Spectrophotometer, Flame Photometer, Infrared Spectrophotometer, Atomic Absorption Spectrophotometer (AAS), Mass Spectrometry (MS), Fourier transform infrared spectroscopy (FTIR), Nuclear Magnetic Resonance (NMR), Inductively coupled plasma spectrometry (ICPMS).	20
II	Chromatography: Basic theory and types of chromatography, Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC), Ion Chromatography (IC). Ion Selective Electrodes: Operating principle, Primary components, Applications in environmental analysis. Polarography and cyclic voltametry. Total Organic Carbon Analysis: Operating principle and primary components	20

Text Books:

- HH Willard, LL Merritt, and JA Dean Settle. Instrumental Methods of Analysis (6th ed.) - CBS Publishers, New Delhi, 1986.
- DA Skoog, DM West, T Holler Fundamentals of Analytical Chemistry (6th ed.) - Saunder's Publication, 1992.

Reference Books:

- RL Recsok, LD Shields, John Wiley & sons Modern Methods of Chemical Analysis - Inc, 1990.
- GW Ewing, McGraw Hill Book Company Instrumental Methods of Chemical Analysis – Inc. 1975
- CN Banwell, Fundamentals of Molecular Spectroscopy –McGraw Hill, NY, 1990.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: learn the basics of Environmental Instruments and its Process
- CO2: Depict the information about various Chemical Analysis Technique
- CO3: Learn basics of Spectrometry and Photometry
- CO4: Understand the basic theory and types of chromatography
- CO5: Learn the need of Environmental Analysis of various pollutants

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,PO2 /PS01
C02	PO1,PO2 /PS01
C03	PO1,PO2 /PS01
C04	PO1,PO2 /PS01
C05	PO1,PO2 /PS01

BCEE 0208: ADVANCED GEOINFORMATICS

Objective: To understand the concept of GIS and Remote Sensing Process

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	<p>Photogrammetry: Aerial Photographs- Basic terms & Definitions, scales, relief displacements, Flight Planning, Stereoscopy, Characteristics of photographic images, Fundamentals of aerial photo-interpretation.</p> <p>Remote Sensing: Fundamentals of remote sensing, Remote sensing satellites and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution. Airborne and satellite borne RADAR –SAR –LIDAR, High Resolution Sensors</p>	15
II	<p>Satellite Image - Characteristics and formats, Introduction to Image rectification & Image Enhancement, Unsupervised and Supervised Classification, basic characteristics of image elements – interpretation keys (selective and elimination) – visual interpretation of natural resources. Applications of remote sensing.</p> <p>Geographical Information system: Introduction to GIS - Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Types of data – Spatial, Attribute data- types of attributes – geospatial analysis. Applications of GIS</p> <p>Global Positioning system: Global Navigation Satellite System (GNSS) GPS, GPS Segment: Space segment, Control segment, User segment, GPS satellite signals, coordinate system and map projection, Static, Kinematic and Differential GPS, GPS Applications</p>	15

Text Books:

- L. B. Campbell “Introduction to remote sensing” New Delhi: Taylor Publications; 2002.
- S. A. Drury “Image Interpretation in Geology” Australia: Allen and Unwin; 1987.
- R.P Gupta: “Remote Sensing Geology” New Delhi: Springer Verlag; 1990

Reference Books:

- M. Anji Reddy “Textbook of Remote Sensing and Geographical Information system” Hyderabad BS: Publications; 2011.
- M. Lillesand Thomas, W. Kiefer Ralph, and W. Chipman Jonathan “Remote sensing and image interpretation” New Delhi: John Wiley & Sons; 2008.
- Kang tsung Chang “Introduction to Geographical Information System” 7th ed. New Delhi: Tata McGraw Hill; 2010.
- A.M. Chandra and S.K. Ghosh. “Remote Sensing and Geographical Information system” New Delhi: Narosa Publishing House; 2006.

Focus: This course focuses on employability aligned with CO1 and CO2

Outcome: After completion of course, the student will be able to:

- CO1: Understand the representation Earth’s surface characteristics
- CO2: Comprehend the effect local Attraction and practical errors
- CO3: Develop basic knowledge of GIS
- CO4: Understand fundamental aspects of Photogrammetry
- CO5: "Recognize and understand fundamental principles of remote sensing, including the electromagnetic spectrum."

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01,P02 /PS01
C02	P01,P02 /PS01
C03	P01,P02 /PS01
C04	P01,P02 /PS01
C05	P01,P02 /PS01

BCEE 0209: APPLIED HYDROLOGY

Objective: To build on the student's background in hydrology and hydraulics and understanding of water resources systems and to develop the skills in hydrological modeling and also to develop skills in the ground water flow, type of aquifer and yield from the well.

Credits: 03

L-T-P-J: 2-1-0-0

Module No.	Content	Teaching Hours
I	Introduction: Applications of various Remote Sensing techniques in Hydrology. Introduction of Various Software's used in Hydrology. Precipitation: Depth-Area-Duration Relationship, Intensity-Duration-Frequency Relationship, Probable Maximum Precipitation (PMP).	15
II	Hydrological Abstractions: Basic concepts and approaches, Measurement and estimation of evapotranspiration, Introduction of various software's for Hydrological Modelling Hydrograph Analysis: Preparation of unit hydrograph, Synthetic hydrograph, Instantaneous unit hydrograph. Flood Modeling: Design Flood & it's estimation, Reservoir flood routing; Hydrologic flood routing.	15

Text Books:

- P. S. Eagleson, " *Dynamic hydrology* "New York: McGraw Hill Book Co;1970
- L. J. Battan, " *Fundamentals of meteorology*" New Jersey: Prentice Hall Inc. Englewood Cliffs,;1984
- G. W Kite, " *Frequency and risk analysis in hydrology*" Colorado: Water resources publication, Fort Collins,;1977
- A. Lattermann, " *System-Theoretical modeling in surface water hydrology* " Verlag: Springer;1991

Reference Books:

- V.P. Singh, " *Elementary Hydrology* ", New Delhi: Prentice-Hall;1992
- K Subramanya, " *Engineering Hydrology* ", New Delhi: Tata McGraw-Hill Publishing Company Limited;1994
- D.K. Todd, and L.W. Mays, " *Groundwater Hydrology, 3rd Edition* ", U.S.A: John Wiley & Sons, Inc;2004

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Analyze hydro-meteorological data
- CO2: Estimate abstractions from precipitation
- CO3: Compute yield from surface and subsurface basin
- CO4: Analyze Hydrological Modeling Software's

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01,P02 /PS01
C02	P01,P02 /PS01
C03	P01,P02 /PS01
C04	P01,P02 /PS01

BCEE 0210: ADVANCED CLIMATE CHANGE AND MODELING

Objective: To understand the process of Climate change and Modelling

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	Causes of climate change Global warming and climate change, Observed climate change and international responses, Effects of climate change -Policy and legislation, Greenhouse Gases. The global carbon cycle – biogeochemistry, Lapse Rate. Energy balance models: Energy balance models and glacial cycles, box models, general circulation modeling of the atmosphere. Global atmospheric circulation. Impacts of climate change on Freshwater Resources, Terrestrial and Inland Water Systems (Ecosystems), Ocean Systems, Human Health.	15
II	Modeling of atmospheric chemistry , working with climate models, climate model evaluation, climate model predictions and policy, volcanic eruptions; detection and attribution of anthropogenic forcing. International Agreements: the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Paris Agreement.	15

Text Books:

- JD Neelin. Climate Change and Climate Modeling New Delhi: Cambridge University Press; 2010.
- JP Peixoto and AH Oort Physics of Climate NY: American Institute of Physics; 1992.

Reference Books:

- DL Hartmann *Global Physical Climatology* San Diego: Academic Press; 1994.
- WM Washington and CL Parkinson *An Introduction to Three-Dimensional Climate Modeling* 2nd ed.UK: Univ. Science Books; 1998.

Focus: This course focuses on employability aligned with CO1 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: learn the basics of Climate change and its effect
- CO2: Understand the process of Modeling of Climate change
- CO3: Demonstrate a solid understanding of the climate system
- CO4: Evaluate the various factors that shape climate
- CO5: Understand the basic of Energy balance modeling

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1
CO5	PO1,PO2 /PSO1

BCEE 0212: ADVANCED WATER TREATMENT TECHNOLOGIES

Objective: To Learn Advanced water and water treatment technologies

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	<p>Overview of Advanced Waste Water Treatment: Nutrient Removal – Nitrogen & Phosphorus Nitrogen Removal: Nitrification, Denitrification. Phosphorus Removal: Introduction, Phosphorus removal by Chemical Precipitation: Principles of process, Chemicals applied, Chemistry of phosphorus precipitation, Process configuration, Phosphorus removal by Biological Precipitation: Principles of the process, Microorganisms involved in the process, Process configurations.</p> <p>Adsorption: Introduction, Fundamentals of adsorption, Type of adsorbents Development of adsorption, Activated carbon adsorption, Granular carbon adsorption. Membrane Filtration, Membrane Process Terminology Membrane Process Classification and operation: Microfiltration, Ultra filtration, Nano filtration, Reverse Osmosis, Electro dialysis Membrane Configurations: Microfiltration, Ultra filtration.</p>	15
II	<p>Ion Exchange: Fundamentals of Ion Exchange Types of Ion Exchange Resins Theory of Ion Exchange Applications: Removal and recovery of heavy metals, Removal of nitrogen, Removal of phosphorus, Organic chemical removal</p> <p>Electrochemical: Introduction Electro-coagulation: Factors affecting Electro coagulation, Electrode materials, Electro-floatation: Factors affecting electro floatation Comparison with other technology.</p> <p>Electro-oxidation: Electro oxidation process, Reactor configurations, Advanced Oxidation Processes, Theory of advanced oxidation, Types of oxidizing agents, ozone based and non-ozone based processes, Fenton and Photo-Fenton Oxidation, Solar Photo Catalytic Treatment Systems.</p>	15

Text Books:

- S.K. Garg Water Supply Engineering (Environmental Engineering Vol.-I) New Delhi: Khanna Publishers; 2008.
- S.K. Garg Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol.-II) New Delhi: Khanna Publishers; 2008.

Reference Books:

- H.T. Mann and D. Williamson Water Treatment and Sanitation – Simple Method for Rural Area London, UK Intermediate Technology Publications; 1982.
- B.C. Punmia Water Supply and Wastewater Engineering Vol. I and II New Delhi: Laxmi Publications; 2010.
- D. Srinivasan Environmental Engineering New Delhi: PHI Learning Pvt. Ltd; 2009.
- E.W. Steel and T.J. McGhee Water Supply and Sewerage New York USA: McGraw-Hill; 1991.
- E.G. Wanger and J.N. Lanoix Water Supply for Rural Areas and Small Communities Geneva: WHO; 1991.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand basic features of Advanced water treatment technologies.
- CO2: Analyze Different Techniques available for water and waste water treatment
- CO3: Evaluate physicochemical methods of water treatment
- CO4: Learn about the different advanced technologies available water management
- CO5: Understand different mechanism of water pollution control

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01,P02 /PS01
C02	P01,P02 /PS01
C03	P01,P02 /PS01
C04	P01,P02 /PS01
C05	P01,P02 /PS01

BCEE 0805: APPLIED HYDROLOGY LABORATORY

Objective: To strengthen the existing monitoring systems for water availability, monitoring of water use and would put much emphasis on IWRM and real-time monitoring and flow forecasting.

Credits: 01

L-T-P: 0-0-2

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> • Measurement of Coordinates using GPS receiver • Various Open Data Sourcing • Geo-referencing of Satellite Image using GIS software • Shape file creation and Attribute table data entry using GIS software. • Digitization of physical features on a map/image using GIS software. • Preparation of Base Maps • Testing of Water Samples through field water testing kit • Stream Network Delineation using GIS Software • Watershed Delineation using GIS Software • Hydrological Modeling. • Flood Analysis • Precipitation Data Analysis 	20

Text Books:

- M. Anji Reddy, *Textbook of Remote Sensing and Geographical Information systems*. Hyderabad: BS Publications; 2011
- M. Lillesand Thomas, W. Kiefer Ralph, W. Chipman Jonathan *remote sensing and image interpretation*. John Wiley & Sons; 2008

Reference Books:

- Kang tsung Chang. *Introduction to Geographical Information System*. U.S.A: Tata McGraw Hill, 7th edition; 2010
- A.M. Chandra and S.K. Ghosh. *Remote Sensing and Geographical Information system*. New Delhi: Narosa Publishing House; 2006

Focus: This course focuses on Skill development aligned with CO3 and CO1

Outcome: After completion of course, the student will be able to:

- *Understand the Practical Use of GPS Receiver*
- *Learn to Digitization, Geo-referencing, and image classification*
- *Relate Rainfall-Runoff Data*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1

BCEE 0806: EXPERIMENTAL ANALYSIS OF CLIMATE

Objective: To learn different measurement analysis of Climate

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> • Measurement of earth coordinates using GPS receiver. • Study of Various Open Data Source GIS for Climate change analysis • Geo-referencing of Satellite Image using GIS software. • Different Shape file creation and Attribute table data entry using GIS software. • Study of different features of earth surface in remote sensing Imagery using Remote sensing Software. • Digitization of physical features on a map/image using GIS software for Environmental & Climate analysis • Study of atmospheric parameters and prepare a plan to measure these parameters. • Study of atmospheric processes and their short term and long term affect • Study and explain how climate has changed naturally in the past and how it is now changing because of human influences • Describe and explain ozone depletion in the atmosphere. • Apply the concept of feedback mechanisms to specific examples of climate change • Study of the factors influencing the temperature and precipitation patterns on Earth • Collection, analysis and interpretation of atmospheric and meteorological data responsible for Climate change. 	20

Text Books:

- M. Anji Reddy *Textbook of Remote Sensing and Geographical Information systems* Hyderabad: BS Publications; 2011.
- A.M. Chandra and S.K. Ghosh *Remote Sensing and Geographical Information system* New Delhi: Narosa Publishing House; 2006

Reference Books:

- M. Lilles Thomas and W. Kiefer Ralph W. Chipman Jonathan *Remote sensing and image interpretation* New Delhi: John Wiley & Sons; 2008.
- Kang tsung Chang *Introduction to Geographical Information System* New Delhi: Tata McGraw Hill; 2010.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the Practical Use of GPS Receiver
- CO2: Learn to Digitization, Geo-referencing, and image classification
- CO3: Learn to collect atmospheric and meteorological data
- CO4: Understand process of formulation of climate models
- CO5: Understand different climate change parameters

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1,PO2 /PS01
C02	PO1,PO2 /PS01
C03	PO1,PO2 /PS01
C04	PO1,PO2 /PS01
C05	PO1,PO2 /PS01

BCEE 0807: ADVANCED WATER TREATMENT TECHNOLOGIES LABORATORY

Objective: To learn different advanced water and waste water analysis laboratory experiment

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> • Determination of Phosphate • Determination of copper. • Determination of Residual Chlorine • Determination of Most Probable Number of Coli forms • Measurement of Air Pollutants with respirable dust sampler • Determination of Total Suspended and Dissolved Solids • Determination of BOD • Determination of COD using Spectrophotometer • Determination of Kjeldahl Nitrogen • Determination of Fluoride • Determination of Nickel • Determination of Chlorides • Determination of ozone • Determination of Dissolved Oxygen 	20

Text Book:

- S. K. Garg "Water Supply Engineering" [Vol. I & II] NewDelhi: Khanna Publishers; 2008.

Reference Books:

- M. L. Davis and D. A. Cornwell "Introduction to Environmental Engineering" 4th Ed. Boston: McGraw-Hill; 2008.
- S. K. Garg "Water Supply Engineering" [Vol. I & II] NewDelhi: Khanna Publishers; 2008.

Focus: This course focuses on Skill development aligned with CO3 and CO2

Outcome: After completion of course, the student will be able to:

- CO1: Understand the methods of analysis of water
- CO2: Fundamentals of physical, chemical and biological water quality parameters.
- CO3: Develop basic know about the instruments used for water analysis.
- CO4: Understand the Different aspects of advanced Waste water analysis

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO1
CO2	PO1,PO2 /PSO1
CO3	PO1,PO2 /PSO1
CO4	PO1,PO2 /PSO1

BCEE 0401: RAILWAY ENGINEERING

Objective: The aim of the course is to impart the knowledge of planning, design, construction, and maintenance of railway tracks.

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	<p>Railway Engineering: Role of railways in transportation system, railways and highways comparisons; Introduction to Indian railway, railway gauges, creep, coning of wheels</p> <p>Permanent ways: Rail & rail joints (welding of rails, LWR, SWR, CWR), failures in rails, Sleepers, Ballast, Formation and its drainage, track fitting and fastening.</p> <p>Geometric design of railway track: Alignment and grades, cross section and its elements (at filling & cutting), grade compensation, cant and cant deficiency, negative cant and widening of gauges on curves, curves used for railway track (horizontal and vertical curves).</p>	20
II	<p>Track and track stresses, Train resistances and hauling power of locomotives;</p> <p>Railway track components: Important features</p> <p>Points and Crossings: Elements of A Simple Turn-Out, Details of Switch, Details of Crossings, Number and Angle of Crossings, Geometric Design of Turn-Out.</p> <p>Stations and Yards: Site Selection for A Railway Station, Layout of Different Types of Stations, Classification of Stations, Types of Railway Yard,</p> <p>Signaling and Interlocking: Control of train movements; Signals and interlocking</p> <p>Modernization of railways and future trends; Track standards and track rehabilitation.</p>	20

Text Books:

- S.P. Arora, and S.C. Saxena, *Railway Engineering*, New Delhi, Dhanpat Rai Publications, (2006).
- S. Chandra, and M.M Agarwal *Railway Engineering*, New Delhi Oxford University Press, (2008).

Reference Book:

- S.K. Khanna, M.G. Arora, and S.S. Jain, “*Airport Planning and Design*” Roorkee Nem Chand and Bros, (1994).

Focus: This course focuses on employability aligned with CO3 and CO6

Outcome: After completion of course, the student will be able to:

- CO1: Understand the importance of railway network in India and its organizational structure.
- CO2: Learn about rail joints, failures in rails and structural components of railway tracks.
- CO3: Design the geometrical parameters of railway tracks.
- CO4: Design the points and crossings used by Indian Railways.
- CO5: Describe the classification of railway stations and yards and their layouts.
- CO6: Define type of Signal systems used by Indian railways.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO4
CO2	PO1,PO2 /PSO4

C03	PO1,PO2 /PS04
C04	PO1,PO2,PO3 /PS04
C05	PO1,PO2 /PS04
C06	PO1,PO2 /PS04

BCEE 0302: BASICS OF TRANSPORTATION SYSTEM AND PLANNING

Objective: To introduce with design steps of Transportation System and its planning, familiarize with the modern advances in Transportation system.

Credits: 3

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: Overview of Transportation System, Nature of Traffic Problems in Cities, Present Scenario of Road Transport. Role of Transportation: Social, Political, Environmental; Goals and Objectives of Transportation Planning.</p> <p>Type of Transportation System: Intermediate Public Transport (IPT), Public Transport, Rapid and Mass Transport System.</p> <p>Travel Demand: Introduction to Four Stage Models: Trip classification, Trip generation, Trip Distribution,</p>	15
II	<p>Travel Demand: Modal Split and Trip Assignment.</p> <p>Transportation Facilities: Pedestrian Facilities, Bicycle Facilities, Parking Facilities, Transport System Management, Long Term and Short Term Planning, Use of IT In Transportation (ITS).</p>	15

Text Book:

- L.R. Kadiyali *Traffic Engineering and Transport Planning* New Delhi: Khanna Publishers; 2008

Reference Books:

- Dickey J. W. *Metropolitan Transportation Planning* UK: Taylor & Francis; 1983.
- W. W Hay, *Introduction to Transportation Engineering* New York, USA: John Wiley and Sons; 2003.
- E. K Mortak *Introduction to Transportation Engineering and Planning* New York, USA: McGraw Hill Publication; 2001.

Focus: This course focuses on employability aligned with CO4 and CO1

Outcome: On successful completion of this course, the students shall be able to:

- CO1: State the traffic problems associated with cities and role of transportation system.
- CO2: Describe type of transportation systems and their properties.
- CO3: Learn Four stage modelling for travel demand.
- CO4: Explain the standards required for the construction of pedestrian, bicycle and parking facilities.
- CO5: Describe the importance of long term planning, short term planning and use of ITS in transportation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6, PO7, PO12 / PS04
CO2	PO1, PO2, PO12 / PS04
CO3	PO1, PO2, PO3, PO4, PO5, PO12 / PS04
CO4	PO1, PO2, PO3, PO4, PO6, PO12 / PS04
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12/ PS04

BCEE 0303: AIRPORT PLANNING AND DESIGN

Objective: This course also helps in the development of skills on airport planning and design with the prime focus on runway and taxiway geometrics.

Credits: 04

L-T-P-J: 3-1-0-0

Module No.	Content	Teaching Hours
I	Aircraft characteristics: Aircraft characteristics related to airport design; Airport configuration – Runway configurations, Relation of terminal area to runways, Runway orientation, Wind rose diagram. Geometric design of the airfield: ICAO and FAA design standards, Runways, Taxiways, Holding aprons and aprons	20
II	Planning and design of the terminal area: Apron-gate system, Size and number of gates, Aircraft parking configurations, Passenger terminal system. Design of Runway & Taxiways Airport lighting and marking Air traffic control: Airport planning and air travel demand forecasting	20

Text Books:

- G.V. Rao, *Airport Planning and Design* New Delhi: Tata McGraw Hill; 1992.
- S. C. Saxena *Airport Engineering: Planning and Design* New Delhi: CBS Publications & Distributors; 2015.

Reference Book:

- Khanna and Arora *Airport Planning and Design* New Delhi: Dhanpat Rai & Sons; 2015.

Focus: This course focuses on employability & Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Describe characteristics of aircraft affecting the design of airport.
- CO2: Design the orientation of the Runway and runway length.
- CO3: Explain the standards for the design of runway, taxiway and aprons.
- CO4: Sketch the aircraft parking configuration and terminal area.
- CO5: Explain all kind of runway lighting and markings.
- CO6: Assess the future air travel demand.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO4
CO2	PO1,PO2,PO3 /PSO4
CO3	PO1,PO2 /PSO4
CO4	PO1,PO2 /PSO4
CO5	PO1,PO2 /PSO4
CO6	PO1,PO2 /PSO4

BCEE 0304: BASICS OF TRAFFIC ENGINEERING

Objective: To introduce students with the basics of Traffic engineering, regulations and safety.

Credits:03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	Introduction: Traffic Survey: Speed, Vehicle Volume counts, O-D survey, Use of Photographic Technique in Traffic survey, Elements of Parking survey Analysis, Statistical Methods of Traffic Engineering. Fundamentals of traffic flow: Traffic flow elements, gap and gap acceptance, Introduction to highway capacity analysis.	15
II	Traffic operation and Controls: Traffic signs, Road marking, Traffic signals and its design. Traffic Regulations: Regulation of traffic, Traffic regulation at Controlled and uncontrolled intersections, at grade and grade separated intersections. Traffic Safety: Road accidents, Causes and Prevention, Street Lighting and Traffic management, Traffic calming techniques.	15

Text Book:

- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.

Reference Books:

- S. K. Khanna and C. E. G. Justo *Highway Engineering* Roorkee : Nemchand Bros.;2001.
- C. J Khisty & B. K. Lall *Transportation Engineering*, New Delhi: Prentice Hall of India; 2002.

Focus: This course focuses on employability aligned with CO3 and CO5

Outcome: On successful completion of this course, the students shall be able to:

- CO1: Mention speed survey, volume survey, O-D survey, Photographic traffic survey to collect the traffic data.
- CO2: Describe traffic flow elements from the traffic data.
- CO3: Summarize the need of the traffic signs, signals and road markings.
- CO4: Identify the components of controlled intersections, uncontrolled intersections, At grade intersections and grade separated intersections.
- CO5: Assess the road accidents and their causes, along with their prevention methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P06 / PS04
CO2	P01, P02, P05, P012 / PS04
CO3	P01,P06, P012 / PS04
CO4	P01, P06, P07 / PS04
CO5	P01, P02, P03, P04, P05, P06, P09, P010, P011, P012/ PS04

BCEE 0305: CONSTRUCTION TECHNOLOGY & MANAGEMENT

Objective: The objective of this course is to develop an understanding of the basics of project management, structure of project organization and various stakeholders involved in a project. This course also enables the learner to practice the various methods of construction planning, project scheduling and resource allocation along with a brief introduction about the contract estimation and construction management.

Credits: 03

L-T-P-J: 2-1-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: Phase of project, project management and its relevance, stakeholders of a project, structure of project organization, management levels, and traits of a project manager.</p> <p>Construction Planning: Introduction, activities involved types of project plan, work breakdown structure. Planning terminologies, Critical path method, forward and backward pass, PERT, Ladder network, Precedence network, Line of balance.</p> <p>Project scheduling and resource leveling: Introduction, Resource allocation and leveling for unlimited resources, Resource allocation for limited resources, Multi resource allocation, Optimal scheduling.</p>	15
II	<p>Contracts Estimation and Bidding Strategy: Introduction, Determination of bid price, Bidding models. Project Monitoring and Control: Introduction, Project updating, Cost control.</p> <p>Construction Management: Construction Equipment and Management, Construction Account Management, Construction Material management, Construction Quality Management, Construction Safety Management, Computer Application In Construction Management, Workforce Motivation And Human Factors In Construction Management, Plant Management, Project Communication.</p>	15

Text Books:

- P.S. Gahlot and B.M. Dhir "Construction Planning and Management" New Delhi: New Age International (P) Ltd. Publishers; 2007.
- S.P. Arora and S.P. Bindra "A Text Book of Building Construction including Engineering Materials" New Delhi: Dhanpat Rai Publications (P) Ltd.; 2005.

Reference Books:

- M. T. Callahan, D. G. Quackenbush and J. E. Rowings Construction Project Scheduling New York: McGraw-Hill; 1992.
- D. I. Cleland and L. R. Ireland Project Management: Strategic Design and Implementation 4th Edition New York: McGraw-Hill; 2002.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcomes: After completion of course, the student will be able to:

- CO1: Prepare work breakdown plan and estimate resources requirements.
- CO2: Solve problems of resource allocation and levelling using network diagrams.
- CO3: Plan and develop management solutions to construction projects.
- CO4: Understand the principles of project management, resource management and inventory.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO3
CO2	PO1,PO2,PO3/PSO3

C03	P01,P011/PS03
C04	P011/PS03

BCEE 0306: TRANSPORTATION SYSTEM AND PLANNING

Objective: To be able to design Transportation System based on travel demand and to familiarize with the modern advances in Transportation system.

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	<p>Introduction: Overview of Transportation System, Nature of Traffic Problems in Cities, Present Scenario of Road Transport. Role of Transportation: Social, Political, Environmental; Goals and Objectives of Transportation Planning.</p> <p>Type of Transportation System: Intermediate Public Transport (IPT), Public Transport, Rapid and Mass Transport System.</p> <p>Travel Demand: Design of transportation system using Four Stage Models: Trip classification, Trip generation, Trip Distribution,</p>	15
II	<p>Travel Demand: Modal Split and Trip Assignment.</p> <p>Evaluation of Transport Planning Proposals: Economic Evaluation Methods - Net Present Value Methods, Benefit Cost Method, Internal Rate of Return Method.</p> <p>Transportation Facilities: Pedestrian Facilities, Bicycle Facilities, Parking Facilities, Transport System Management, Long Term and Short Term Planning, Use of IT In Transportation (ITS).</p>	15

Text Book:

- L. R. Kadiyali Traffic Engineering and Transport Planning New Delhi: Khanna Publishers; 2008.

Reference Books:

- Dickey, J. W. *Metropolitan Transportation Planning* UK Taylor & Francis; 1983.
- W. W. Hay, *Introduction to Transportation Engineering* New York: USA John Wiley and Sons; 2003.
- E. K. Mortak *Introduction to Transportation Engineering and Planning* New York USA: McGraw Hill Publications; 2001.

Focus: This course focuses on employability aligned with CO5 and CO4

Outcome:

On successful completion of this course, the students shall be able to:

- CO1: Understand the traffic problems associated with cities and role of transportation system.
- CO2: Describe type of transportation systems and their properties.
- CO3: Learn and Compute four stage modelling for travel demand.
- CO4: Evaluate transportation planning projects on the basis of economics.
- CO5: Describe the importance of long term planning, short term planning and use of ITS in transportation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6, PO7, PO12 / PS04
CO2	PO1, PO2, PO12 / PS04
CO3	PO1, PO2, PO3, PO4, PO5, PO12 / PS04
CO4	PO1, PO2, PO3, PO4, PO5, PO6, PO10, PO11, PO12 / PS04
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO12/ PS04

BCEE 0307: ADVANCE TRAFFIC ENGINEERING

Objective: To introduce students with the basics of Traffic engineering, regulations and safety and to perform traffic study.

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	Introduction: Traffic Survey: speed, Journey and Delay Surveys, Vehicle Volume counts, O-D survey, Use of Photographic Technique in Traffic survey, Elements of Parking survey Analysis, Statistical Methods of Traffic Engineering. Fundamentals of traffic flow: Traffic flow elements, gap and gap acceptance, highway capacity analysis.	15
II	Traffic operation and Controls: Traffic signs, Road marking, Traffic signals and its design. Traffic Regulations: Regulation of traffic, Design of Controlled and uncontrolled intersections, at grade and grade separated intersections. Traffic Safety: Road accidents, Causes and Prevention, Road safety audit Street Lighting and Traffic management, Traffic calming techniques, Detection of crash	15

Text Book:

- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.

Reference Books:

- S. K. Khanna and C. E. G. Justo *Highway Engineering* Roorkee: Nemchand Bros.; 2001.
- C. J Khisty & B. K. Lall *Transportation Engineering* New Delhi: Prentice Hall of India; 2002.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: On successful completion of this course, the students shall be able to:

- CO1: Conduct the speed survey, volume survey, journey and delay survey, O-D survey, Photographic traffic survey to collect the traffic data.
- CO2: Compute traffic flow elements from the traffic data.
- CO3: Judge the need of the traffic signs, signals and road markings.
- CO4: Design the components of controlled intersections, uncontrolled intersections, At grade intersections and grade separated intersections.
- CO5: Assess the road accidents and their causes, along with their prevention methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO4, PO5, PO6, PO9, PO12 / PS04
CO2	PO1, PO2, PO3, PO5, PO12 / PS04
CO3	PO1, PO2, PO3, PO4, PO5, PO6, PO12 / PS04
CO4	PO1, PO2, PO3, PO6, PO7 / PS04
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO11, PO12 / PS04

BCEE 0314: TRAFFIC ENGINEERING

Objective: To introduce students with the basics of Traffic engineering, regulations and safety.

Credits:03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	Introduction: Traffic Survey: Speed, Vehicle Volume counts, O-D survey, Use of Photographic Technique in Traffic survey, Elements of Parking survey Analysis, Statistical Methods of Traffic Engineering. Fundamentals of traffic flow: Traffic flow elements, gap and gap acceptance, Introduction to highway capacity analysis.	15
II	Traffic operation and Controls: Traffic signs, Road marking, Traffic signals and its design. Traffic Regulations: Regulation of traffic, Traffic regulation at Controlled and uncontrolled intersections, at grade and grade separated intersections. Traffic Safety: Road accidents, Causes and Prevention, Street Lighting and Traffic management, Traffic calming techniques.	15

Text Book:

- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.

Reference Books:

- S. K. Khanna and C. E. G Justo. *Highway Engineering* Roorkee: Nemchand Bros.; 2001.
- C. J Khisty & B. K. Lall *Transportation Engineering*, New Delhi: Prentice Hall of India; 2002.

Focus: This course focuses on employability aligned with CO3 and CO4

Outcome: On successful completion of this course, the students shall be able to:

- CO1: Mention speed survey, volume survey, O-D survey, Photographic traffic survey to collect the traffic data.
- CO2: Describe traffic flow elements from the traffic data.
- CO3: Summarize the need of the traffic signs, signals and road markings.
- CO4: Identify the components of controlled intersections, uncontrolled intersections, At grade intersections and grade separated intersections.
- CO5: Assess the road accidents and their causes, along with their prevention methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO6 / PS04
CO2	PO1, PO2, PO5, PO12 / PS04
CO3	PO1,PO6, PO12 / PS04
CO4	PO1, PO6, PO7 / PS04
CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO11, PO12/ PS04

BCEE 0800: COMPUTER AIDED ESTIMATION AND PLANNING LABORATORY

Objective: This course gives an exposure to students in utilizing the sophisticated spread sheets programs, estimation software and other package programs.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Contents	Teaching Hours
I/II	<ul style="list-style-type: none"> • Quantity takeoff, Preparation and delivery of the bid or proposal of an engineering construction project. • Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking. • Scheduling of a small construction project using Primavera scheduling systems including reports and tracking. • Simulation models for project risk analysis 	20

Reference Books

- Paulson. B.R., Computer Applications in Construction, McGraw Hill, 2005.
- Krishnamoorthy .C.S and Rajeev .S, Computer Aided Design, Narosa publishing house, New Delhi, 2001.
- Feigenbaum .L, Construction Scheduling with Primavera Project Planner, Prentice Hall Inc., 2009.

Focus: This course focuses on Skill development aligned with CO1 and CO2

Course Outcomes:

- Prepare delivery of Bid or proposal of engineering project
- Perform scheduling of constructions projects using tools primavera and MS projects.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO7/PSO4
CO2	PO7/PSO4

BCEE 0808: TRAFFIC SIMULATION AND ANALYSIS LABORATORY

Objective: To impart knowledge of traffic simulation and evaluate the results. Also to create cross section design of highways.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Teaching Hours
I/II	VISSIM <ul style="list-style-type: none"> • Introduction to the Traffic Simulation • Introduction of VISSIM Software • Basic commands of VISSIM • Modelling of road sections • Modelling of Unsignalised Intersection • Modelling of Signalised Intersection • Modelling of Rotary Intersection • Modelling of Grade Separated Intersection • Introduction to basic commands of Open Roads • Drafting the components of Road 	20

Text Books:

- VISSIM 5.30-05 User Manual
- <https://communities.bentley.com/products/road.../video-replace-reference>

Reference Books:

- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.
- S. K. Khanna and C. E. G Justo. *Highway Engineering* Roorkee: Nemchand Bros.; 2001.
- C. J Khisty & B. K. Lall *Transportation Engineering* New Delhi: Prentice Hall of India; 2002.

Focus: This course focuses on Skill development aligned with CO3 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Understand the Traffic simulation and drawings of road
- CO2: Perform the Traffic simulation analysis
- CO3: Evaluate the simulation results
- CO4: Create drawing for highway cross sections

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01, P06, P09, P012 /PS04
C02	P01, P02, P06, P09, P012 /PS04
C03	P01, P02, P03, P06, P09, P012 /PS04
C04	P01, P06, P09, P012 /PS04

BCEE 0809: TRAFFIC ENGINEERING LABORATORY

Objective: To impart knowledge of traffic studies and interpretation of the results.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Teaching Hours
I/II/III	<ul style="list-style-type: none"> • Traffic Volume Study • Spot speed study • Photographic survey to collect traffic data • Analysis and modeling of urban signalized networks • Analysis and estimation of signalization, delays, queuing • Traffic capacity and level of service estimation in highways • Analysis of pedestrian traffic • Traffic safety analysis • Investigation of hazardous locations • Design and operation of parking systems 	20

Text Book:

- IRC:SP: 19-2001, *Manual for Survey, Investigation and Preparation of Road Projects*, IRC Code (2001)

Reference Books:

- L. R. Kadiyali *Traffic engineering and transport planning* 6th Ed. New Delhi: Khanna publishers; 2011.
- S. K. Khanna and C. E. G. Justo *Highway Engineering* Roorkee: Nemchand Bros.; 2001.

Focus: This course focuses on Skill development aligned with CO2 and CO4

Outcome: After completion of course, the student will be able to:

- CO1: Define traffic collection methods
- CO2: Conduct the speed survey, volume survey, journey and delay survey, O-D survey, Photographic traffic survey to collect the traffic data.
- CO3: Analyse the Signalised intersection, LOS, Pedestrian traffic
- CO4: Identify hazardous locations for traffic

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1 /PSO4
CO2	PO1, PO2, PO6, PO12 /PSO4
CO3	PO1, PO2, PO3, PO6, PO9, PO12 /PSO4
CO4	PO1, PO2, PO3, PO6, PO9, PO12 /PSO4