VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF CIVIL ENGINEERING

B. Tech. Civil Engineering

(B. Tech. BCL)

CBCS Curriculum

(*2021-2022*)

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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.
Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.
Impactful People: Happy, accountable, caring and effective workforce and students.
Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.
Service to Society: Service to the region and world through knowledge and compassion

VISION STATEMENT OF THE SCHOOL OF CIVIL ENGINEERING

To excel in Civil Engineering education and research with a global perspective and commitment to sustainability.

MISSION STATEMENT OF THE SCHOOL OF CIVIL ENGINEERING

M1. Academic Excellence: Impart high-quality Civil Engineering education through innovative teaching methodologies and modern laboratory facilities.

M2. Research: Promote research, consultancy, and innovation addressing real-world Civil Engineering challenges with emphasis on sustainable infrastructure and societal needs.

M3. Global Perspective & Industry Engagement: Prepare globally competent Civil Engineers through industry interaction and collaboration with national and international institutions.

M4. Ethics, Sustainability & Lifelong Learning: Produce socially responsible Civil Engineers with strong ethical values and leadership skills, dedicated to sustainable development and lifelong learning.

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B. Tech. Civil Engineering

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates will be successful civil engineering professionals / entrepreneurs.

PEO2: Graduates will pursue higher studies and research for professional development.

PEO3: Graduates will demonstrate civic responsibility in addressing societal and environmental challenges.

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B. Tech. Civil Engineering

PROGRAMME OUTCOMES (POs)

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

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B. Tech. Civil Engineering

PROGRAMME SPECIFIC OUTCOMES (PSOs)

After successful completion of the program, students will be able to

PSO 1: Apply core civil engineering principles in structural, geotechnical, transportation, environmental, and water resources engineering to create resilient infrastructure.

PSO 2: Apply emerging technologies to plan, model, design and manage civil engineering projects to meet global infrastructure needs.

PSO 3: Analyse societal challenges and develop innovative solutions for the sustainable built environment.

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B. Tech. Civil Engineering

Curriculum

S. No	Description	Credits
1	FC - Foundation Core	
	Basic Sciences	26
	Basic Engineering	22
	Humanities and Social Sciences	19
2	Program Core	
	DLES - Discipline-linked Engineering Sciences	10
	DC - Discipline Core	50
3	Program Electives	
	DE - Discipline Elective	15
4	PI - Projects and Internship	9
5	OE - Open Elective	12
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Foundation Core

S. No	Course Code	Course Title	Course Type	L	T	P	J	Credits
1	BCHY101L	Engineering Chemistry	Theory Only	3	0	0	0	3.0
2	BCHY101P	Engineering Chemistry Lab	Lab Only	0	0	2	0	1.0
3	BCSE101E	Computer Programming: Python	Embedded Theory and Lab	1	0	4	0	3.0
4	BCSE103E	Computer Programming: Java	Embedded Theory and Lab	1	0	4	0	3.0
5	BECE101L	Basic Electronics	Theory Only	2	0	0	0	2.0
6	BECE101P	Basic Electronics Lab	Lab Only	0	0	2	0	1.0
7	BEEE101L	Basic Electrical Engineering	Theory Only	2	0	0	0	2.0
8	BEEE101P	Basic Electrical Engineering Lab	Lab Only	0	0	2	0	1.0

9	BENG101L	Technical English Communication	Theory Only	2	0	0	0	2.0
10	BENG101P	Technical English Communication Lab	Lab Only	0	0	2	0	1.0
11	BENG102P	Technical Report Writing	Lab Only	0	0	2	0	1.0
12	BFLE200L	B.Tech. Foreign Language - 2021onwards	Basket	0	0	0	0	2.0
13	BHSM300L	B.Tech. CLE- HSM Elective - 2021 onwards	Basket	0	0	0	0	3.0
14	BMAT101L	Calculus	Theory Only	3	0	0	0	3.0
15	BMAT101P	Calculus Lab	Lab Only	0	0	2	0	1.0
16	BMAT102L	Differential Equations and Transforms	Theory Only	3	1	0	0	4.0
17	BMAT201L	Complex Variables and Linear Algebra	Theory Only	3	1	0	0	4.0
18	BMAT202L	Probability and Statistics	Theory Only	3	0	0	0	3.0
19	BMAT202P	Probability and Statistics Lab	Lab Only	0	0	2	0	1.0
20	BMEE102P	Engineering Design Visualization Lab	Lab Only	0	0	4	0	2.0
21	BMEE201L	Engineering Mechanics	Theory Only	2	1	0	0	3.0
22	BPHY101L	Engineering Physics	Theory Only	3	0	0	0	3.0
23	BPHY101P	Engineering Physics Lab	Lab Only	0	0	2	0	1.0
24	BSTS101P	Quantitative Skills Practice I	Soft Skill	0	0	3	0	1.5
25	BSTS102P	Quantitative Skills Practice II	Soft Skill	0	0	3	0	1.5
26	BSTS201P	Qualitative Skills Practice I	Soft Skill	0	0	3	0	1.5
27	BSTS202P	Qualitative Skills Practice II	Soft Skill	0	0	3	0	1.5
28	BCHY102N	Environmental Sciences	Online Course	0	0	0	0	2.0
29	BCLE101N	Introduction to Engineering	Project	0	0	0	0	1.0
30	BEXC100N	Extracurricular Activities / Co-Curricular Activities - B.Tech. Programmes	Basket	0	0	0	0	2.0
31	BHUM101N	Ethics and Values	Online Course	0	0	0	0	2.0

32	BSSC101N	Essence of Traditional Knowledge	Online Course	0	0	0	0	2.0
33	BSSC102N	Indian Constitution	Online Course	0	0	0	0	2.0

Discipline-linked Engineering Sciences

S. No	Course Code	Course Title	Course Type	L	T	P	J	Credits
1	BCLE201L	Construction Materials	Theory Only	2	0	0	0	2.0
2	BCLE202L	Fluid Mechanics	Theory Only	3	0	0	0	3.0
3	BCLE202P	Fluid Mechanics Lab	Lab Only	0	0	2	0	1.0
4	BCLE203L	Mechanics of Solids	Theory Only	3	0	0	0	3.0
5	BCLE203P	Mechanics of Solids Lab	Lab Only	0	0	2	0	1.0

Discipline Core

S. No	Course Code	Course Title	Course Type	L	T	P	J	Credits
1	BCLE204L	Surveying	Theory Only	3	0	0	0	3.0
2	BCLE204P	Surveying Lab	Lab Only	0	0	2	0	1.0
3	BCLE205L	Environmental Engineering	Theory Only	3	0	0	0	3.0
4	BCLE205P	Environmental Engineering Lab	Lab Only	0	0	2	0	1.0
5	BCLE206E	Building Planning and Drawing	Embedded Theory and Lab	1	0	2	0	2.0
6	BCLE207L	Soil Mechanics	Theory Only	3	0	0	0	3.0
7	BCLE207P	Soil Mechanics Lab	Lab Only	0	0	2	0	1.0
8	BCLE208L	Structural Analysis	Theory Only	2	1	0	0	3.0
9	BCLE209L	Engineering Geology	Theory Only	2	0	0	0	2.0
10	BCLE301L	Concrete Technology	Theory Only	3	0	0	0	3.0
11	BCLE301P	Concrete Technology Lab	Lab Only	0	0	2	0	1.0

12	BCLE302L	Hydraulics and Hydraulic Machines	Theory Only	3	0	0	0	3.0
13	BCLE302P	Hydraulics and Hydraulic Machines Lab	Lab Only	0	0	2	0	1.0
14	BCLE303L	Foundation Engineering	Theory Only	2	1	0	0	3.0
15	BCLE304L	Design of Reinforced Concrete Structures	Theory Only	3	0	0	0	3.0
16	BCLE304P	Reinforced Concrete Structures Lab	Lab Only	0	0	2	0	1.0
17	BCLE305L	Transportation Engineering	Theory Only	2	1	0	0	3.0
18	BCLE306L	Water Resources Engineering	Theory Only	3	0	0	0	3.0
19	BCLE306P	Water Resources Engineering Lab	Lab Only	0	0	2	0	1.0
20	BCLE307L	Construction Practices and Management	Theory Only	3	0	0	0	3.0
21	BCLE308L	Design of Steel Structures	Theory Only	3	0	0	0	3.0
22	BCLE308P	Steel Structures Lab	Lab Only	0	0	2	0	1.0
23	BCLE309L	Estimating and Costing	Theory Only	2	0	0	0	2.0

Discipline Elective

S. No	Course Code	Course Title	Course Type	L	T	P	J	Credits
1	BCLE210L	AI in Civil Engineering	Theory Only	3	0	0	0	3.0
2	BCLE211L	Urban Planning and Development	Theory Only	3	0	0	0	3.0
3	BCLE212L	Natural Disaster Mitigation and Management	Theory Only	3	0	0	0	3.0
4	BCLE213E	Remote Sensing and GIS	Embedded Theory and Lab	2	0	2	0	3.0
5	BCLE310L	Environmental Impact Assessment	Theory Only	3	0	0	0	3.0
6	BCLE311L	Industrial Waste Management	Theory Only	3	0	0	0	3.0
7	BCLE312L	Air and Noise Pollution Control	Theory Only	3	0	0	0	3.0

8	BCLE313L	Solid Waste Management	Theory Only	3	0	0	0	3.0
9	BCLE314L	Geotechnical Earthquake Engineering	Theory Only	3	0	0	0	3.0
10	BCLE315L	Groundwater Engineering	Theory Only	3	0	0	0	3.0
11	BCLE316L	Rock Engineering	Theory Only	3	0	0	0	3.0
12	BCLE391J	Technical Answers to Real Problems Project	Project	0	0	0	0	3.0
13	BCLE392J	Design Project	Project	0	0	0	0	3.0
14	BCLE393J	Laboratory Project	Project	0	0	0	0	3.0
15	BCLE394J	Product Development Project	Project	0	0	0	0	3.0
16	BCLE396J	Reading Course	Project	0	0	0	0	3.0
17	BCLE397J	Special Project	Project	0	0	0	0	3.0
18	BCLE398J	Simulation Project	Project	0	0	0	0	3.0
19	BCLE401L	Traffic Engineering	Theory Only	3	0	0	0	3.0
20	BCLE402L	Pre-stressed Concrete and Industrial Structures	Theory Only	3	0	0	0	3.0
21	BCLE403L	Open Channel Hydraulics	Theory Only	3	0	0	0	3.0

Projects and Internship

S. No	Course Code	Course Title	Course Type	L	T	P	J	Credits
1	BCLE399J	Summer Industrial Internship	Project	0	0	0	0	1.0
2	BCLE497J	Project - I	Project	0	0	0	0	3.0
3	BCLE498J	Project - II / Internship	Project	0	0	0	0	5.0
4	BCLE499J	One Semester Internship	Project	0	0	0	0	14.0

Open Elective

S. No	Course Code	Course Title	Course Type	L	T	P	J	Credits
1	BHUM201L	Mass Communication	Theory Only	3	0	0	0	3.0
2	BHUM202L	Rural Development	Theory Only	3	0	0	0	3.0
3	BHUM203L	Introduction to Psychology	Theory Only	3	0	0	0	3.0
4	BHUM204L	Industrial Psychology	Theory Only	3	0	0	0	3.0
5	BHUM205L	Development Economics	Theory Only	3	0	0	0	3.0
6	BHUM206L	International Economics	Theory Only	3	0	0	0	3.0
7	BHUM207L	Engineering Economics	Theory Only	3	0	0	0	3.0
8	BHUM208L	Economics of Strategy	Theory Only	3	0	0	0	3.0
9	BHUM209L	Game Theory	Theory Only	3	0	0	0	3.0
10	BHUM210E	Econometrics	Embedded Theory and Lab	2	0	2	0	3.0
11	BHUM211L	Behavioral Economics	Theory Only	3	0	0	0	3.0
12	BHUM212L	Mathematics for Economic Analysis	Theory Only	3	0	0	0	3.0
13	BHUM213L	Corporate Social Responsibility	Theory Only	3	0	0	0	3.0
14	BHUM214L	Political Science	Theory Only	3	0	0	0	3.0
15	BHUM215L	International Relations	Theory Only	3	0	0	0	3.0
16	BHUM216L	Indian Culture and Heritage	Theory Only	3	0	0	0	3.0
17	BHUM217L	Contemporary India	Theory Only	3	0	0	0	3.0
18	BHUM218L	Financial Management	Theory Only	3	0	0	0	3.0
19	BHUM219L	Principles of Accounting	Theory Only	3	0	0	0	3.0

20	BHUM220L	Financial Markets and Institutions	Theory Only	3	0	0	0	3.0
21	BHUM221L	Economics of Money, Banking and Financial Markets	Theory Only	3	0	0	0	3.0
22	BHUM222L	Security Analysis and Portfolio Management	Theory Only	3	0	0	0	3.0
23	BHUM223L	Options, Futures and other Derivatives	Theory Only	3	0	0	0	3.0
24	BHUM224L	Fixed Income Securities	Theory Only	3	0	0	0	3.0
25	BHUM225L	Personal Finance	Theory Only	3	0	0	0	3.0
26	BHUM226L	Corporate Finance	Theory Only	3	0	0	0	3.0
27	BHUM227L	Financial Statement Analysis	Theory Only	3	0	0	0	3.0
28	BHUM228L	Cost and Management Accounting	Theory Only	3	0	0	0	3.0
29	BHUM229L	Mind, Embodiment and Technology	Theory Only	3	0	0	0	3.0
30	BHUM230L	Health Humanities in Biotechnological Era	Theory Only	3	0	0	0	3.0
31	BHUM231L	Reproductive Choices for a Sustainable Society	Theory Only	3	0	0	0	3.0
32	BHUM232L	Introduction to Sustainable Aging	Theory Only	3	0	0	0	3.0
33	BHUM233L	Environmental Psychology	Theory Only	3	0	0	0	3.0
34	BHUM234L	Indian Psychology	Theory Only	3	0	0	0	3.0
35	BHUM235E	Psychology of Wellness	Embedded Theory and Lab	2	0	2	0	3.0
36	BHUM236L	Taxation	Theory Only	3	0	0	0	3.0
37	BMGT108L	Entrepreneurship	Theory Only	3	0	0	0	3.0
38	BPHY201L	Optics	Theory Only	3	0	0	0	3.0
39	BPHY202L	Classical Mechanics	Theory Only	3	0	0	0	3.0
40	BPHY203L	Quantum Mechanics	Theory Only	3	0	0	0	3.0

41	BPHY301E	Computational Physics	Embedded Theory and Lab	2	0	2	0	3.0
42	BPHY302P	Physics Lab	Lab Only	0	0	2	0	1.0
43	BPHY401L	Solid State Physics	Theory Only	3	0	0	0	3.0
44	BPHY402L	Electromagnetic Theory	Theory Only	3	0	0	0	3.0
45	BPHY403L	Atomic and Nuclear Physics	Theory Only	3	0	0	0	3.0
46	BPHY404L	Statistical Mechanics	Theory Only	3	0	0	0	3.0
47	BSTS301P	Advanced Competitive Coding - I	Soft Skill	0	0	3	0	1.5
48	BSTS302P	Advanced Competitive Coding - II	Soft Skill	0	0	3	0	1.5
49	CFOC101M	Advanced Green Manufacturing Systems	Online Course	0	0	0	0	3.0
50	CFOC102M	Introduction to Cognitive Psychology	Online Course	0	0	0	0	3.0
51	CFOC103M	Introduction to Political Theory	Online Course	0	0	0	0	3.0
52	CFOC104M	Six Sigma	Online Course	0	0	0	0	3.0
53	CFOC105M	Emotional Intelligence	Online Course	0	0	0	0	2.0
54	CFOC106M	Manufacturing Strategy	Online Course	0	0	0	0	2.0
55	CFOC107M	Supply Chain Analytics	Online Course	0	0	0	0	2.0
56	CFOC108M	Systems Engineering: Theory and Practice	Online Course	0	0	0	0	2.0
57	CFOC109M	Design Thinking - A Primer	Online Course	0	0	0	0	1.0
58	CFOC110M	MCDM Techniques Using R and MATLAB	Online Course	0	0	0	0	1.0
59	CFOC111M	Perspectives on Neurolinguistic	Online Course	0	0	0	0	1.0
60	CFOC112M	Sociology of Science	Online Course	0	0	0	0	1.0

61	CFOC113M	Contemporary Themes in India's Economic Development and Economic Survey	Online Course	0	0	0	0	3.0
62	CFOC119M	Training of Trainers	Online Course	0	0	0	0	3.0
63	CFOC120M	Knowledge Management	Online Course	0	0	0	0	2.0
64	CFOC121M	Leadership	Online Course	0	0	0	0	1.0
65	CFOC122M	Educational Leadership	Online Course	0	0	0	0	2.0
66	CFOC123M	Cost Accounting	Online Course	0	0	0	0	1.0
67	CFOC124M	Practitioners Course In Descriptive, Predictive and Prescriptive Analytics	Online Course	0	0	0	0	2.0
68	CFOC125M	Decision-Making Under Uncertainty	Online Course	0	0	0	0	1.0
69	CFOC126M	Data Analysis and Decision Making - III	Online Course	0	0	0	0	3.0
70	CFOC127M	Business Analytics and Data Mining Modeling Using R Part II	Online Course	0	0	0	0	1.0
71	CFOC128M	Business Analytics and Text Mining Modeling Using Python	Online Course	0	0	0	0	2.0
72	CFOC129M	Economics of Health and Health Care	Online Course	0	0	0	0	2.0
73	CFOC130M	Human Resource Development	Online Course	0	0	0	0	3.0
74	CFOC131M	Performance and Reward Management	Online Course	0	0	0	0	3.0
75	CFOC132M	Corporate Social Responsibility	Online Course	0	0	0	0	2.0
76	CFOC133M	E-Business	Online Course	0	0	0	0	3.0
77	CFOC134M	Innovation, Business Models and Entrepreneurship	Online Course	0	0	0	0	2.0
78	CFOC135M	The Ethical Corporation	Online Course	0	0	0	0	2.0

79	CFOC136M	Toyota Production System	Online Course	0	0	0	0	2.0
80	CFOC137M	Intellectual Property Rights and Competition Law	Online Course	0	0	0	0	2.0
81	CFOC138M	Patent Search for Engineers and Lawyers	Online Course	0	0	0	0	2.0
82	CFOC161M	Data Science for Engineers	Online Course	0	0	0	0	2.0
83	CFOC181M	WildLife Conservation	Online Course	0	0	0	0	2.0
84	CFOC188M	Ethical Hacking	Online Course	0	0	0	0	3.0
85	CFOC190M	Positive Psychology	Online Course	0	0	0	0	2.0
86	CFOC191M	Forests and their Management	Online Course	0	0	0	0	3.0
87	CFOC205M	Energy Efficiency, Acoustics and Daylighting in Building	Online Course	0	0	0	0	3.0
88	CFOC206M	Fire Protection, Services and Maintenance Management of Building	Online Course	0	0	0	0	3.0
89	CFOC207M	Electronic Waste Management - Issues And Challenges	Online Course	0	0	0	0	1.0
90	CFOC208M	Higher Surveying	Online Course	0	0	0	0	3.0
91	CFOC209M	Environmental Remediation of Contaminated Sites	Online Course	0	0	0	0	3.0
92	CFOC210M	Soil Structure Interaction	Online Course	0	0	0	0	3.0
93	CFOC211M	Introduction to Accounting and Finance for Civil Engineers	Online Course	0	0	0	0	2.0
94	CFOC212M	Scheduling Techniques in Projects	Online Course	0	0	0	0	1.0
95	CFOC213M	GPS Surveying	Online Course	0	0	0	0	1.0
96	CFOC214M	Sustainable Materials and Green Buildings	Online Course	0	0	0	0	3.0

97	CFOC215M	Geomorphic Processes: Landforms and Landscapes	Online Course	0	0	0	0	2.0
98	CFOC223M	Privacy and Security in Online Social Media	Online Course	0	0	0	0	2.0
99	CFOC232M	Consumer Behaviour	Online Course	0	0	0	0	2.0
100	CFOC233M	Enhancing Soft Skills and Personality	Online Course	0	0	0	0	2.0
101	CFOC246M	Characterization of Construction Materials	Online Course	0	0	0	0	3.0
102	CFOC248M	Environmental Geomechanics	Online Course	0	0	0	0	3.0
103	CFOC249M	Mechanical Characterization of Bituminous Materials	Online Course	0	0	0	0	3.0
104	CFOC250M	Geosynthetics and Reinforced Soil Structures	Online Course	0	0	0	0	3.0
105	CFOC251M	Geotechnical Engineering II Foundation Engineering	Online Course	0	0	0	0	3.0
106	CFOC252M	Landscape Architecture and Site Planning - Basic Fundamentals	Online Course	0	0	0	0	2.0
107	CFOC253M	Plastic Waste Management	Online Course	0	0	0	0	2.0
108	CFOC254M	Advanced Topics in the Science and Technology of Concrete	Online Course	0	0	0	0	1.0
109	CFOC255M	Applied Environmental Microbiology	Online Course	0	0	0	0	3.0
110	CFOC256M	Digital Land Surveying And Mapping (DLS&M)	Online Course	0	0	0	0	2.0
111	CFOC257M	Earthquake Geology: A tool for Seismic Hazard Assessment	Online Course	0	0	0	0	3.0
112	CFOC258M	Introduction to Geographic Information Systems	Online Course	0	0	0	0	1.0
113	CFOC259M	Structural Dynamics	Online Course	0	0	0	0	3.0
114	CFOC261M	Geo Spatial Analysis in Urban Planning	Online Course	0	0	0	0	1.0
115	CFOC262M	Geotechnical Engineering - 1	Online Course	0	0	0	0	3.0
116	CFOC263M	Maintenance and Repair of Concrete Structures	Online Course	0	0	0	0	3.0

117	CFOC265M	Geomorphology	Online Course	0	0	0	0	3.0
118	CFOC266M	Remote Sensing Essentials	Online Course	0	0	0	0	3.0
119	CFOC267M	Hydraulic Engineering	Online Course	0	0	0	0	3.0
120	CFOC268M	Environmental Quality Monitoring and Analysis	Online Course	0	0	0	0	3.0
121	CFOC282M	Waste to Energy Conversion	Online Course	0	0	0	0	2.0
122	CFOC381M	Introduction to Research	Online Course	0	0	0	0	2.0
123	CFOC384M	Entrepreneurship Essentials	Online Course	0	0	0	0	3.0
124	CFOC385M	Fuzzy Logic and Neural Networks	Online Course	0	0	0	0	2.0
125	CFOC386M	Microeconomics : Theory & Applications	Online Course	0	0	0	0	3.0
126	CFOC387M	Introduction to Environmental Economics	Online Course	0	0	0	0	3.0
127	CFOC388M	Energy Resources, Economics and Environment	Online Course	0	0	0	0	3.0
128	CFOC389M	Literary Criticism (From Plato to Leavis)	Online Course	0	0	0	0	3.0
129	CFOC390M	Twentieth Century Fiction	Online Course	0	0	0	0	3.0
130	CFOC392M	Strategic Trade and Protectionism - Theories and Empirics	Online Course	0	0	0	0	2.0
131	CFOC393M	Introduction to Cultural Studies	Online Course	0	0	0	0	3.0
132	CFOC394M	Introduction to Basic Spoken Sanskrit	Online Course	0	0	0	0	1.0
133	CFOC401M	The Nineteenth - Century English Novel	Online Course	0	0	0	0	3.0
134	CFOC402M	Introduction to World Literature	Online Course	0	0	0	0	3.0
135	CFOC403M	Patent Drafting for Beginners	Online Course	0	0	0	0	1.0

136	CFOC404M	Patent Law for Engineers and Scientists	Online Course	0	0	0	0	3.0
137	CFOC405M	Economic Growth & Development	Online Course	0	0	0	0	2.0
138	CFOC406M	Human Behaviour	Online Course	0	0	0	0	2.0
139	CFOC407M	Introduction to Modern Indian Political Thought	Online Course	0	0	0	0	3.0
140	CFOC408M	English Literature of the Romantic Period, 1798 - 1832	Online Course	0	0	0	0	2.0
141	CFOC409M	Literature, Culture and Media	Online Course	0	0	0	0	3.0
142	CFOC410M	Introduction to Brain & Behaviour	Online Course	0	0	0	0	2.0
143	CFOC411M	Modern Indian Writing in Translation	Online Course	0	0	0	0	3.0
144	CFOC412M	Introduction to Political Ideologies : Contexts, Ideas and Practices	Online Course	0	0	0	0	3.0
145	CFOC413M	Indian Business History	Online Course	0	0	0	0	2.0
146	CFOC416M	Feminism : Concepts and Theories	Online Course	0	0	0	0	3.0
147	CFOC472M	Industrial Automation And Control	Online Course	0	0	0	0	3.0
148	CFOC476M	Principles of Industrial Engineering	Online Course	0	0	0	0	3.0
149	CFOC479M	Introduction to Stochastic Processes	Online Course	0	0	0	0	3.0
150	CFOC480M	Introduction to System Dynamics Modeling	Online Course	0	0	0	0	2.0
151	CFOC481M	Management of New Products and Services	Online Course	0	0	0	0	1.0
152	CFOC482M	Integrated Marketing Management	Online Course	0	0	0	0	2.0
153	CFOC483M	Simulation of Business Systems: An Applied Approach	Online Course	0	0	0	0	2.0
154	CFOC484M	Production and Operation Management	Online Course	0	0	0	0	3.0

155	CFOC486M	Managerial Skills for Interpersonal Dynamics	Online Course	0	0	0	0	3.0
156	CFOC487M	Financial Institutions and Markets	Online Course	0	0	0	0	3.0
157	CFOC488M	Business Analytics For Management Decision	Online Course	0	0	0	0	3.0
158	CFOC489M	Services Marketing : A Practical Approach	Online Course	0	0	0	0	1.0
159	CFOC490M	Sales and Distribution Management	Online Course	0	0	0	0	2.0
160	CFOC491M	Principles of Human Resource Management	Online Course	0	0	0	0	2.0
161	CFOC492M	Managing change in organizations	Online Course	0	0	0	0	2.0
162	CFOC493M	Management of Inventory Systems	Online Course	0	0	0	0	3.0
163	CFOC494M	Quality Design And Control	Online Course	0	0	0	0	3.0
164	CFOC495M	Foundation Course in Managerial Economics	Online Course	0	0	0	0	2.0
165	CFOC496M	Engineering Econometrics	Online Course	0	0	0	0	3.0
166	CFOC497M	Financial Statement Analysis and Reporting	Online Course	0	0	0	0	3.0
167	CFOC498M	Business Statistics	Online Course	0	0	0	0	3.0
168	CFOC499M	Global Marketing Management	Online Course	0	0	0	0	2.0
169	CFOC500M	Marketing Research and Analysis - II	Online Course	0	0	0	0	3.0
170	CFOC501M	Infrastructure Planning and Managements	Online Course	0	0	0	0	3.0
171	CFOC502M	Modelling and Analytics for Supply Chain Management	Online Course	0	0	0	0	3.0
172	CFOC503M	Marketing Analytics	Online Course	0	0	0	0	3.0
173	CFOC504M	Financial Management For Managers	Online Course	0	0	0	0	3.0
174	CFOC505M	Management of Commercial Banking	Online Course	0	0	0	0	3.0

175	CFOC506M	Behavioral and Personal Finance	Online Course	0	0	0	0	2.0
176	CFOC507M	Total Quality Management - 1	Online Course	0	0	0	0	2.0
177	CFOC508M	Entrepreneurship	Online Course	0	0	0	0	3.0
178	CFOC509M	Modeling of Tundish Steelmaking Process in Continuous Casting	Online Course	0	0	0	0	2.0
179	CFOC510M	Fundamentals of Electronic Materials and Devices	Online Course	0	0	0	0	2.0
180	CFOC511M	Introduction to Materials Science and Engineering	Online Course	0	0	0	0	3.0
181	CFOC512M	Corrosion - Part I	Online Course	0	0	0	0	2.0
182	CFOC575M	Wildlife Ecology	Online Course	0	0	0	0	3.0
183	CFOC617M	Gender and Literature	Online Course	0	0	0	0	2.0
184	CFOC631M	Conservation Geography	Online Course	0	0	0	0	3.0
185	CFOC642M	Conservation Economics	Online Course	0	0	0	0	3.0
186	CFOC692M	Education for Sustainable Development	Online Course	0	0	0	0	3.0
187	CFOC853M	Smart Cities	Online Course	0	0	0	0	3.0

Foundation Core

BCHY101L	Engineering Chemistry	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To enable students to have fundamental understanding of the basic concepts of different disciplines of chemistry.
2. To provide avenues for learning advanced concepts from school to university.
3. To empower students with emerging concepts in applied chemistry to be useful in addressing societal needs.
4. To integrate analytical and computational ability with experimental skills to create individuals competent in basic science and its by-product of its application.
5. To offer opportunities to create pathways for self-reliant in terms of knowledge and higher learning.

Course Outcomes

At the end of the course the student will be able to

1. Apply the concepts of thermodynamics, chemical kinetics, coordination chemistry, organic reactions and intermediates.
2. Describe the working principles of energy storage devices.
3. Interpret the preparation methods of functional materials.
4. Apply spectroscopic, diffraction and microscopic techniques.
5. Illustrate the applications of water treatment, fuel combustion and corrosion protection methods.

Module: 1	Chemical thermodynamics and kinetics	6 hours

Laws of thermodynamics – entropy change (selected processes) – spontaneity of a chemical reaction and Gibbs free energy – heat transfer; Kinetics – Concept of activation energy and energy barrier – Arrhenius equation – effect of catalysts (homo and heterogeneous) – Enzyme catalysis (Michaelis – Menten Mechanism).

Module: 2	Metal Complexes and organometallics	6 hours

Inorganic complexes – structure, bonding and application; Organometallics – introduction, stability, structure and applications of metal carbonyis, ferrocene and Grignard reagent; Metals in biology (haemoglobin, chlorophyll-structure and property).

Module: 3	Organic intermediates and reaction transformations	6 hours

Organic intermediates – stability and structure of carbocations, carbanions and radicals; Aromatics (aromaticity) and heterocycles (3, 4, 5,6 membered and fused systems); Organic transformations for making useful drugs for specific disease targets (two examples) and dyes (addition, elimination, substitution and cross coupling reactions).

Module: 4	Energy devices	6 hours

Electrochemical and electrolytic cells – electrode materials with examples (semi-conductors), electrode-electrolyte interface-chemistry of Li ion secondary batteries, supercapacitors; Fuel cells: H2-O2 and solid oxide fuel cell (SOFC); Solar cells – photovoltaic cell (silicon based), photoelectrochemical cells and dye-sensitized cells.

Module: 5	Functional materials	7 hours

Oxides of AB, AB_2, ABO_3 type (specific examples); Composites – types and properties; Polymers – thermosetting and thermoplastic polymers – synthesis and application (TEFLON, BAKELITE); Conducting polymers – polyacetylene and effect of doping – chemistry of display devices specific to OLEDs; Nano materials – introduction, bulk vs nano (quantum dots), top-down and bottom-up approaches for synthesis and properties of nano Au.

Module: 6	Spectroscopic, diffraction and microscopic techniques	5 hours

Fundamental concepts in spectroscopic and instrumental techniques; Principle and applications of UV-Visible and XRD techniques (numericals); Overview of various techniques such as AAS, IR, NMR, SEM and TEM.

Module: 7	Industrial Applications	7 hours

Water purification methods – zeolites, ion-exchange resins and reverse osmosis; Fuels and combustion – LCV, HCV, Bomb Calorimeter (numericals), anti-knocking agents); Protective coatings for corrosion control; cathodic and anodic protection – PVD technique; Chemical sensors for environmental monitoring – gas sensors; Overview of computational methodologies: energy minimization and conformational analysis.

Module: 8	Contemporary Issues	2 hours
Guest lectures from Industry and Research and Development Organizations		
Total Lecture Hours		**45 hours**
Text Book(s)		
1.	Theodore E. Brown, H Eugene, LeMay Bruce E. Bursten, Catherine Murphy, Patrick Woodward, Matthew E. Stoltzfus, Chemistry: The Central Science, 2017, 14th Edition Pearson Publishers, 2017. UK.	
Reference Books		
1. Peter Vollhardt, Neil Schore, Organic Chemistry: Structure and Function, 2018, 8th Ed. WH Freeman, London 2. Atkins' Physical Chemistry: International, 2018, Eleventh edition, Oxford University Press; UK. 3. Colin Banwell, Elaine McCash, Fundamentals for Molecular Spectroscopy, 4th Edition, McGraw Hill, US 4. Solid State Chemistry and its Applications, Anthony R. West. 2014, 2nd Edition, Wiley, UK. 5. Angale Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Photovoltaic Solar energy: From fundamentals to Applications, 2017, Wiley Publishers, UK. 6. Lawrence S. Brown and Thomas Holme, Chemistry for engineering Students, 2018, 4th edition – Open access version.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		
Recommended by Board of Studies	28.06.2021	
Approved by Academic Council	No. 63	**Date** 23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BCHY101P	Engineering Chemistry Lab	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

To apply theoretical knowledge gained in the theory course and get hands-on experience of the topics.

Course Outcomes

At the end of the course the student will be able to

1. Determine the concentration of various analytes using volumetric and instrumental methods.
2. Employ methods for the synthesis of organic compounds and nanomaterials
3. Apply thermodynamic functions, chemical kinetic principles and molecular geometries through experiments.

Indicative Experiments	
1.	Thermodynamics functions from EMF measurements : Zinc – Copper system.
2.	Determination of reaction rate, order and molecularity of ethylacetate hydrolysis.
3.	Colorimetric estimation of Ni^{2+} using conventional and smart phone digital-imaging methods.
4.	Laboratory scale preparation of important drug intermediate – para aminophenol for the synthesis for acetaminophen.
5.	Magnesium-sea water activated cell – Effect of salt concentration on voltage generation.
6.	Analysis of iron in an alloy sample by potentiometry.
7.	Preparation of tin oxide by sol-gel method and its characterization.
8.	Size dependent colour variation of Cu_2O nanoparticles by spectrophotometer.
9.	Determination of hardness of water sample by complexometric titration before and after ion-exchange process.
10.	Computational Optmimization of molecular geometry using Avogadro software.
Total Laboratory Hours	**30 hours**

Mode of Evaluation: Mode of assessment: Continuous assessment / FAT / Oral examination and others.

Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-

BCSE101E	Computer Programming: Python	L	T	P	C
		1	0	4	3
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. To provide exposure to basic problem-solving techniques using computers.
2. To inculcate the art of logical thinking abilities and propose novel solutions for real world problems through programming language constructs.

Course Outcome

1. Apply algorithmic thinking to solve real-world problems using Python
2. Solve mathematical calculation using basic python statements.

Module:1	**Introduction to Problem Solving**	**1 hour**

Problem Solving: Definition and Steps, Problem Analysis Chart, Developing an Algorithm, Flowchart and Pseudocode.

Module:2	**Python Programming Fundamentals**	**2 hours**

Introduction to python - Interactive and Script Mode - Indentation - Comments - Variables Reserved Words - Data Types - Operators and their precedence - Expressions - Built-in Functions - Importing from Packages.

Module:3	**Control Structures**	**2 hours**

Decision Making and Branching: if, if-else, nested if, multi-way if-elif statements - Looping: else clauses in loops, nested loops break, continue and pass while loop, for loop statements.

Module:4	**Collections**	**3 hours**

Lists: Create, Access, Slicing, Negative indices, List methods, List comprehensions -Tuples: Create, Indexing and slicing, Operations on tuples - Dictionary: Create, add, and replace values, Operations on dictionaries - Sets: Creation and operations.

Module:5	**Strings and Regular Expressions**	**2 hours**

Strings: Comparison, Formatting, Slicing, Splitting, Stripping -Regular Expressions: Matching, Search and replace, Patterns.

Module:6	**Functions and Files**	**3 hours**

Functions Parameters Parameters and Arguments: Positional arguments, Keyword arguments, with default values Local and Global scope of variables Functions with Arbitrary Lambda Function. Files: Create, Open, Read, Write, -arguments - Recursive Functions Append and Close - tell and seek methods.

Module:7	**Modules and Packages**	**2 hours**

Built-in modules - User-Defined modules - Overview of Numpy and Pandas packages.

	Total Lecture Hours:	**15 Hours**

Text Book(s)

1. Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming, 2nd Edition, No starch Press, 2019

References

1. Martic C Brown, Python: The Complete Reference, 4th Edition, McGraw Hill Publishers, 2018.
2. John V. Guttag, Introduction to computation and programming using python: with applications to understanding data. 2nd Edition, MIT Press, 2016.

Mode of Evaluation: No separate evaluation for theory component.

Indicative Experiments	
1.	Problem Analysis Chart, Flowchart and Pseudocode Practices.
2.	Sequential Constructs using Python Operators, Expressions.
3.	Branching (if, if-else, nested if, multi-way if-elif statements) and Looping (for, while, nested looping, break, continue, else in loops).
4.	List, Tuples, Dictionaries & Sets.
5.	Strings, Regular Expressions.
6.	Functions, Lambda, Recursive Functions and Files.
7.	Modules and Packages (NumPy and Pandas)
	Total Laboratory Hours **60 hours**

Text Book(s)	
1.	Mariano Anaya, Clean Code in Python: Develop maintainable and efficient code, 2nd Edition, Packt Publishing Limited, 2021.
Reference Books	
1.	Harsh Bhasin, Python for beginners, 1st Edition, New Age International (P) Ltd., 2019,

Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BCSE103E	Computer Programming: Java	L	T	P	C
		1	0	4	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To introduce the core language features of Java and understand the fundamentals of Object-Oriented programming in Java.
2. To develop the ability of using Java to solve real world problems.

Course Outcome

At the end of the course the student will be able to

1. Apply the basics of programming constructs to solve real world problems
2. Develop java classes with object and references using constructors and destructors.

Module:1	Java Basics	2 hour

OOP Paradigm Features of Java Language JVM - Bytecode Java program structure Basic programming constructs operators. -Java naming conventions --variables data types

Module:2	Looping Constructs and Arrays	2 hours

Control and looping constructs - Arrays - one dimensional and multi-dimensional enhanced for loop - Strings - Wrapper classes. -

Module:3	Classes and Objects	2 hours

Class Fundamentals - Access and non-access specifiers - Declaring objects and assigning object reference variables - array of objects - constructors and destructors - usage of "this" and "static" keywords.

Module:4	Inheritance and Polymorphism	3 hours

Inheritance types use of "super" final keyword Polymorphism Overloading and Overriding - abstract class - Interfaces.

Module:5	Packages and Exception Handling	2 hours

Packages: Creating and Accessing - Sub packages.
Exception Handling - Types of Exception - Control Flow in Exceptions - Use of try, catch, finally, throw, throws in Exception Handling - User defined exceptions.

Module:6	IO Streams and Files	3 hours

Java I/O streams FileInputStream & FileOutputStream FileReader & FileWriter-DataInputStream & DataOutputStream BufferedInputStream & BufferedOutputStream PrintOutputStream - Serialization and Deserialization.

Module:7	Collection Framework	2 hours

Generic classes and methods - Collection framework: List and Map.

	Total Lecture Hours:	15 Hours

Text Book(s)

1. Y. Daniel Liang, "Introduction to Java programming" comprehensive version-11th Edition, Pearson publisher, 2017.

References

1. Herbert Schildt, The Complete Reference -Java, Tata McGraw-Hill publisher, 10th Edition, 2017.
2. Cay Horstmann, "Big Java", 4th edition, John Wiley & Sons publisher, 5th edition, 2015
3. E.Balagurusamy, "Programming with Java", Tata McGraw-Hill publishers, 6th edition, 2019

Mode of Evaluation: No separate evaluation for theory component.			
Indicative Experiments			
1.	Programs using sequential and branching structures.		
2.	Experiment the use of looping, arrays and strings.		
3.	Demonstrate basic Object-Oriented programming elements.		
4.	Experiment the use of inheritance, polymorphism and abstract classes.		
5.	Designing packages and demonstrate exception handling.		
6.	Demonstrate the use of IO streams, file handling and serialization.		
7.	Program to discover application of collections.		
	Total Laboratory Hours		**60 hours**
Text Book(s)			
1.	Marc Loy, Patrick Niemeyer and Daniel Leuck, Learning Java, O'Reilly Media, Inc., 5th Edition, 2020.		
Reference Books			
1.	Dhruti Shah, 100+ Solutions in Java: A Hands-On Introduction to Programming in Java, BPB Publications, 1st Edition, 2020.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BCSE101L	Basic Electronics	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To introduce the students to the basic concepts of electronic components, sources, measurements. and instrumentation.
2. To apply the inculcated knowledge for developing simple circuits using various electronic components and devices
3. To familiarize the students with the basic concepts of number systems and digital logic.
4. To analyse the concepts associated with multiple sensors and their sensing mechanisms.

Course Outcome

At the end of the course the student will be able to

1. Apply the working principles of electronic components, sources, and measuring equipment used in electronic systems.
2. Illustrate the characteristics and practical applications of diodes and transistors.
3. Illustrate the characteristics and operation of amplifier and oscillator circuits.
4. Construct digital circuits using logic gates to realize Boolean functions
5. Interpret the operation and characteristics of measurement systems and devices.
6. Apply the principles of sensor mechanisms in measurement systems.

Module:1	Electronic Components, Sources, and Measuring Equipment	3 hours

Evolution of Electronics - Impact of Electronics in Industry and Society - Familiarization of Resistors, Capacitors, Inductors Colour Coding - types and specifications, Electro-mechanical components - Relay and Contactors Regulated Power supply, Function Generator - Multimeter - CRO

Module:2	Junction Diodes	4 hours

Intrinsic and extrinsic semiconductors - doping PN Junctions, Formation of Junction, Physical operation of diode, Barrier Potential, I - V Characteristics, Rectifiers, Zener diode I-V Characteristics, Zener diode as Voltage regulator.

Module:3	Transistors	5 hours

Bipolar Junction Transistor (BJT) - Device structure and physical operation, Concept of CB, CE and CC Configuration, Transistor as a Switch, Metal-Oxide Field Effect Transistor (MOSFET) Device Structure, mode of operation and Characteristics, MOSFET configurations (CS, CD, CG).

Module:4	Amplifiers and Oscillators	4 hours

BJT as an amplifier (CE configuration), MOSFET as an amplifier (CS configuration), Feedback concept, Oscillators - Barkhaunsen's criteria for sustained oscillation, RC Phase Shift Oscillator, LC Oscillator.

Module:5	Digital Logics	4 hours

Number systems, conversion of bases, Boolean algebra, Logic Gates, Concept of universal gate, Simplification and implementation of Boolean functions.

Module:6	Principles of Measurement and Analysis	3 hours

Units and standards, Errors, Functional Elements of a Measurement System and Instruments, Applications and Classification of Instruments, Types of measured Quantities, Measures of Dispersion, Sample deviation and sample mean, Calibration and standard.

Module:7	Sensors and Transducers	5 hours

Sensor fundamentals and characteristics General concepts and terminology of measurement systems, Sensors and transducers Classification of sensors, Static and dynamic characteristics. Principle of Resistive Sensors, Capacitive Sensors, Inductive Sensors, Magnetic sensors, Optical sensor, Self-generating Sensors

Module:8	Contemporary issues	2 hours

Guest lectures from Industry and, Research and Development Organisations

	Total Lecture Hours:	30 Hours

Text Book(s)

1. A, P. Malvino, D, J, Bates, Electronic Principles, 2017, 7/e, Tata McGraw-Hill.

2.	Albert D. Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 2016, First Edition, Pearson Education, Noida, India.
References	
1.	David A Bell, Electronic Devices and Circuits, Oxford Press, 5th Edition, 2008
2.	Robert L. Bolysted and Louis Nashelsky, Electronic Devices and Circuit Theory, Prentice Hall of India, 11th Edition, 2017
3.	D. Patranabis - Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003
4.	A.K. Sawhney, Puneet Sawhney, A Course In Electrical and Electronic Measurements, and Instrumentation, Dhanpat Rai & Co., 2015

Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT			
Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BECE101P	Basic Electronics Lab	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To learn the various characteristics of diodes and transistors
2. To understand the concept of digital logic functions and verify the truth tables
3. To learn the performance metrics of measurement systems and characteristics of various sensors

Course Outcomes

At the end of the course the student will be able to

1. Determine the VI characteristics of diodes and transistors
2. Simulate combinational circuits using logic gates in Multisim.
3. Measure the physical parameters using different transducers.

Indicative Experiments

1.	Identify, mark the terminal and find the value of a particular component from the given group of electronic components, Study of electronic measurement devices (Multimeter, DSO, function generator)
2.	V-I Characteristics of PN Junction diodes and Zener diodes
3.	Half Wave and Full Wave Rectifier circuits
4.	Zener Diode as a voltage regulator
5.	Characteristics of BJT in Common Emitter Configuration
6.	Characteristics of MOSFET in Common Source Configuration
7.	Frequency response of BJT single stage amplifier
8.	Study of the signal generation using RC Phase Shift Oscillator
9.	Study of logic gates and implementation of Boolean Functions
10.	Strain gauge sensors for measurement of normal strain.
11.	Displacement measurement using LVDT and LDR.
12.	Temperature measurement using RTD, Thermistor and Thermocouple.
	Total Laboratory Hours **30 hours**

Text Book(s)

1.	A. P. Malvino, D. J. Bates, Electronic Principles, 2017, 7/e, Tata McGraw-Hill.
2.	Albert D. Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 2016, First Edition, Pearson Education, Noida, India.

Reference Books

1.	Robert L. Bolysted and Louis Nashelsky, Electronic Devices and Circuit Theory, Prentice Hall of India, 11th Edition, 2017
2.	D. Patranabis - Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003

Mode of Evaluation: Continuous assessment / FAT / Oral examination and others

Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BEEE101L	Basic Electrical Engineering	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Provide insights into relevant concepts and principles in electrical engineering
2. Facilitate understand and comprehend laws, rules and theorems to compute parameters of electric circuits
3. Enable comprehend and analyze the concepts of electrical machines and measuring instruments

Course Outcome

At the end of the course the student will be able to

1. Evaluate DC and AC circuit parameters using various laws and theorems
2. Analyze the parameters of magnetically coupled circuits and compare various types of electrical machines
3. Comprehend the measurement techniques of electrical parameters
4. Understand the concept of electric supply system and comprehend essential electrical safety requirements

Module:1	DC Circuits	6 hours
Basic circuit elements and sources; Ohms law, Kirchhoff's laws; Series and parallel connection of circuit elements; Source transformation; Node voltage analysis; Mesh current analysis; Maximum power transfer theorem		
Module:2	**AC Circuits**	**6 hours**
Alternating voltages and currents, RMS, average, form factor, peak factor; Single phase RL, RC, RLC series and parallel circuits; Power and power factor; Balanced three phase systems		
Module:3	**Magnetic Circuits**	**4 hours**
Electromagnetic Induction: Self and mutual; Magnetically coupled circuits; Series and parallel magnetic circuits; Dot convention		
Module:4	**Electrical Machines**	**5 hours**
Principle of operation, construction and applications of DC machines, transformers, induction motors, synchronous generators, stepper motor, Brushless DC (BLDC) motor		
Module:5	**Electrical Measurements**	**4 hours**
Principle, Construction and operation of moving coil and moving iron instruments; Power and energy measurement in single phase and three phase systems		
Module:6	**Electrical Supply Systems & Safety**	**3 hours**
Concepts of electrical power generation, transmission and distribution systems; Wiring; Electrical safety; Earthing; Protective devices		
Module:7	**Contemporary Issues**	**2 hours**
Guest lectures from Industry and, Research and Development Organizations		
	Total Lecture Hours:	**30 Hours**

Text Book(s)

1. Allan R. Hambley, Electrical Engineering: Principles & Applications, 2019, 7th edition, Pearson Education

References

1. DP Kothari & I J Nagrath, Basic Electric Engineering, 2019, 4th edition, McGraw Hill Education
2. John Bird, Electrical Circuit Theory and Technology, 2013, 5th edition, Routledge Publications
3. S. Salivahnan, R Rengaraj, G R Venkatakrishnan, Basic Electrical, Electronics and Measurement Engineering, 2018, McGraw Hill Education
4. E.W Golding, F.C Widdis, Electrical Measurements and Measuring Instruments, 2011, Reem Publications
5. VK Mehta and Rohit Mehta, Principles of Power System, 2005, S. Chand

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT			
Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BEEE101P	Basic Electrical Engineering Lab	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Understanding the concepts of electrical engineering for development and implementation of electrical systems
2. Impart knowledge and skill in wiring and its standards
3. Facilitate comprehend and identify appropriate measuring devices for an electric circuit

Course Outcomes

At the end of the course the student will be able to

1. Understand, analyze and validate the electric circuit parameters
2. Design and develop electrical systems for domestic and commercial applications
3. Acquire skills for interpretation of measurement during experimentation
4. Attain skills to use modern engineering tools for electrical system layout planning

Indicative Experiments	
1.	Verification of Kirchhoff's voltage law
2.	Verification of Kirchhoff's current law
3.	Verification of maximum power transfer theorem
4.	Sinusoidal steady state response of RLC circuits
5.	Wiring circuit for a single lamp and a fan with regulator
6.	Wiring circuit for Godown with two-way switch
7.	Load test on single phase transformer/DC motor
8.	Measurement of power in a single phase AC Load
9.	Measurement of power and energy consumed by a given three phase AC load
10.	Study of earthing and measurement of earth pit resistance
11.	Cost estimation of residential electrical wiring
12.	Electrical layout for a residential/commercial/industrial application using CAD software
Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Allan R. Hambley, Electrical Engineering: Principles & Applications, 2019, 7th edition, Pearson Education

Mode of Evaluation: Continuous Assessment / FAT / Oral Examination

Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BENG101L	**Technical English Communication**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. To develop LSRW skills for effective communication in professional situations
2. To enhance knowledge of grammar and vocabulary for meaningful communication
3. To understand information from diverse texts for effective technical communication

Course Outcomes

At the end of the course the student will be able to

1. Utilize proper grammar and terminology while writing and speaking
2. Apply the principles of effective communication in both official and casual situations.
3. Demonstrate effective reading and listening skills to synthesize and draw intelligent inferences
4. Prepare with clarity and significance in both academic and informal context.

Module: 1	**Introduction to Communication**	**4 hours**

Nature and Process - Types of communication: Intra-personal, Interpersonal, Group-verbal and non-verbal communication / Cross-cultural Communication - Communication Barriers and Essentials of good communication - Principles of Effective Communications

Module: 2	**Grammatical Aspects**	**4 hours**

Sentence Pattern - Modal Verbs - Concord (SVA) - Conditionals - Error detection

Module: 3	**Elements of quantum mechanics**	**4 hours**

Job Application Letters - Resume Writing - Statement of Purpose

Module: 4	**Business Correspondence**	**4 hours**

Business Letters: Calling for Quotation, Complaint & Sales Letter - Memo - Minutes of Meeting - Describing products and processes

Module: 5	**Professional Writing**	**4 hours**

Paraphrasing & Summarizing - Executive Summary - Structure and Types of Proposal -Recommendations

Module: 6	**Team Building & Leadership Skills**	**4 hours**

Principles of Leadership - Team Leadership Model - Negotiation Skills - Conflict Management

Module: 7	**Research Writing**	**4 hours**

Interpreting and Analysing a research article - Approaches to Review Paper Writing -
Structure of a research article - Referencing

Module: 8	**Guest Lecture from Industry and R&D organizations**	**2 hours**

Contemporary Issues

Total Lecture Hours	**30 hours**

Text Book(s)

1.	Raman, Meenakshi & Sangeeta Sharma. (2015). Technical Communication: Principles and Practice, (3rd Edition). India: Oxford University Press.

Reference Books

1.	Taylor, Shirley & Chandra.V. (2010). Communication for Business A Practical Approach 4th Edition. India: Pearson Longman.
2.	Kumar, Sanjay & Pushpalatha. (2018). English Language and Communication Skills for Engineers. India: Oxford University Press.
3.	Koneru Aruna. (2020). English Language Skills for Engineers. India: McGraw Hill Education.

4.	Rizvi, M. Ashraf. (2018). Effective Technical Communication 2nd Edition. Chennai: McGraw Hill Education.
5.	Mishra, Sunitha & Muralikrishna, C. (2014). Communication Skills for Engineers. India: Pearson Education.
6.	Watkins, P. (2018). Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers. India: Cambridge University Press.

Mode of Evaluation: CAT/Assignment / Quiz / FAT / Group Discussion			
Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

BENG101P	Technical English Communication Lab	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. To use appropriate grammatical structures in professional communication
2. To improve English communication skills for better employability
3. To enhance meaningful communication skills in writing and public speaking

Course Outcomes

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

1. Demonstrate professional rhetoric to articulate ideas and concepts effectively.
2. Elucidate the assigned readings and deliver eloquent presentations.
3. Apply receptive skills to improve communication at work and in everyday circumstances.

Indicative Experiments

1.	Grammar & Vocabulary Error Detection Activity: -Worksheets
2.	Listening to Narratives Interviews of eminent personalities & Ted Talks Activity: Listening Comprehension / Summarising
3.	Video Resume SWOT Analysis & digital resume techniques Activity: Preparing a digital résumé for mock interview
4.	Listening to Narrative Product & Process Description Describing and Sequencing Activity: Demonstration of product and processs
5.	Mock Meetings Types of meetings and meeting etiquette Activity: Conduct of meetings and drafting minutes of the meeting
6.	Reading research article Scientific and Technical articles Activity: Writing Literature review
7.	Analytical Reading Case Studies on Communication, Team Building and Leadership Activity: Group Discussion
8.	Presentations Preparing Conference/Seminar paper Activity: Individual/ Group presentations
9.	Intensive Listening Scientific documentaries Activity: Note taking and Summarising
10.	Interview Skills Interview questions and techniques Activity: Mock Interviews

Total Laboratory Hours	**30 Hours**

Mode of Assessment: Continuous Assessment/FAT/Written Assignments / Quiz/ Oral Presentation and Group Activity.

Recommended by Board of Studies	28.06.2021

Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	-	-	-

BENG102P	Technical Report Writing	L	T	P	C
		0	0	2	1
Pre-requisite	Technical English Communication	**Syllabus version**			
		1.0			

Course Objectives

1. To augment specific writing skills for preparing technical reports
2. To think critically, evaluate, analyse general and complex technical information
3. To acquire proficiency in writing and presenting reports

Course Outcomes

At the end of the course the student will be able to

1. Write error free sentences using appropriate grammar, vocabulary and style
2. Synthesize information and concepts in preparing reports
3. Demonstrate the ability to write and present reports on diverse topics

Indicative Experiments

1.	Advanced Grammar, Vocabulary and Editing Usage of Tenses Adjectives and Adverbs Jargon vs Technical Vocabulary Abbreviations - Mechanics of Editing: Punctuation and Proof Reading Activity: Worksheets
2.	Research and Analyses Synchronise Technical Details from Newspapers - Magazines - Articles and e-content Activity: Writing introduction and literature review
3.	Systematisation of Information Techniques to Converge Objective-Oriented data in Diverse Technical Reports Activity: Preparing Questionnaire
4.	Data Visualisation Interpreting Data Graphs Tables Charts Imagery Infographics Activity: Transcoding
5.	Introduction to Reports Meaning - Definition Purpose - Characteristics and Types of Reports Activity: Worksheets on Types of reports
6.	Structure of Reports Title - Preface - Acknowledgement - Abstract/Summary - Introduction - Materials and Methods - Results - Discussion Conclusion - Suggestions/Recommendations Activity: Identifying the structure of report
7.	Report Writing Data Collection - Draft an Outline and Organize Information Activity: Drafting reports
8.	Supplementary Texts Appendix - Index - Glossary - References - Bibliography - Notes Activity: Organizing supplementary texts
9.	Review of Final Reports Structure - Content - Style - Layout and Referencing Activity: Examining clarity and coherence in final reports
10.	Presentation Presenting Technical Reports Activity: Planning, creating and digital presentation of reports

		Total Laboratory Hours	**30 Hours**
Mode of Assessment: Continuous Assessment/FAT/Written Assignments / Quiz/ Oral Presentation and Group Activity.			
Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	-	-	-

BMAT101L	Calculus	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. Enhance to use technology to model the physical situations into mathematical problems, experiment, interpret results, and verify conclusions.

Course Outcomes

At the end of the course the student will be able to

1. Solve problems involving single-variable differentiation and integration.
2. Determine extrema of multivariable functions using partial derivatives and constrained optimization techniques.
3. Calculate the areas and volumes using double and triple integrals in appropriate coordinate systems.
4. Apply special functions to evaluate integrals occurring in mathematical and engineering applications.
5. Solve problems involving scalar and vector fields using vector calculus concepts and integral theorems.

Module: 1	Single Variable Calculus	8 hours

Differentiation- Extrema on an Interval Rolle's Theorem and the Mean value theorem-Increasing and decreasing functions.-First derivative test-Second derivative test-Maxima and Minima-Concavity. Integration-Average function value - Area between curves - Volumes of solids of revolution.

Module: 2	Multivariable Calculus	5 hours

Functions of two variables-limits and continuity-partial derivatives -total differential-Jacobian and its properties.

Module: 3	Application of Multivariable Calculus	5 hours

Taylor's expansion for two variables-maxima and minima-constrained maxima and minima-Lagrange's multiplier method.

Module: 4	Multiple integrals	8 hours

Evaluation of double integrals-change of order of integration-change of variables between Cartesian and polar co-ordinates - evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates.

Module: 5	Special Functions	6 hours

Beta and Gamma functions-interrelation between beta and gamma functions-evaluation of multiple integrals using gamma and beta functions. Dirichlet's integral -Error functions complementary error functions.

Module: 6	Vector Differentiation	5 hours

Scalar and vector valued functions gradient, tangent plane-directional derivative-divergence and curl-scalar and vector potentials. Statement of vector identities-simple problems.			
Module: 7	**Vector Integration**		**6 hours**
Line, surface and volume integrals - Statement of Green's, Stoke's and Gauss divergence theorems -verification and evaluation of vector integrals using them.			
Module: 8	**Contemporary Issues**		**2 hours**
Guest lectures from Industry and, Research and Development Organizations			
Total Lecture Hours			**45 hours**
Text Book(s)			
1.	George B.Thomas, D.Weir and J. Hass, Thomas Calculus, 2014, 13th edition, Pearson		
Reference Books			
1.	Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, Wiley India		
2.	B.S. Grewal, Higher Engineering Mathematics, 2020, 44th Edition, Khanna Publishers		
3.	John Bird, Higher Engineering Mathematics, 2017, 6th Edition, Elsevier Limited.		
4.	James Stewart, Calculus: Early Transcendental, 2017, 8th edition, Cengage Learning.		
5.	K.A.Stroud and Dexter J. Booth, Engineering Mathematics, 2013, 7th Edition, Palgrave Macmillan.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BMAT101P	Calculus Lab	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To familiarize with the basic syntax, semantics and library functions of MATLAB which serves as a tool not only in calculus but also many courses in engineering and sciences
2. To visualize mathematical functions and its related properties.
3. To evaluate single and multiple integrals and understand it graphically.

Course Outcomes

1. Solve calculus-based mathematical problems using MATLAB and represent the solutions graphically.
2. Interpret graphical and numerical solutions of single-variable and multivariable calculus problems using MATLAB.

Indicative Experiments	
1.	Introduction to MATLAB through matrices and general Syntax
2.	Plotting and visualizing curves and surfaces in MATLAB - Symbolic computations using MATLAB
3.	Evaluating Extremum of a single variable function
4.	Understanding integration as Area under the curve
5.	Evaluation of Volume by Integrals (Solids of Revolution)
6.	Evaluating maxima and minima of functions of two variables
7.	Applying Lagrange multiplier optimization method
8.	Evaluating Volume under surfaces
9.	Evaluating triple integrals
10.	Evaluating gradient, curl and divergence
11.	Evaluating line integrals in vectors
12.	Applying Green's theorem to real world problems
Total Laboratory Hours	**30 hours**

Text Book

1.	Brian H. Hahn, Daniel T. Valentine, Essential MATLAB for Engineers and Scientists, Academic Press, 7th edition, 2019.

Reference Books

1.	Amos Gilat, MATLAB: An Introduction with Applications, Wiley, 6/e, 2016.
2.	Maritn Brokate, Pammy Manchanda, Abul Hasan Siddiqi, Calculus for Scientists and Engineers, Springer, 2019

Mode of Evaluation: DA and FAT

Recommended by Board of Studies	24.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-

BMAT102L	Differential Equations and Transforms	L	T	P	C
		3	1	0	4
Pre-requisite	BMAT101L, BMAT101P	Syllabus version			
		1			

Course Objectives

1. To impart the knowledge of Laplace transform, an important transform techniques for
2. Engineers which requires knowledge of integration.
3. Presenting the elementary notions of Fourier series, this is vital in practical harmonic analysis.
4. Enriching the skills in solving initial and boundary value problems.
5. Impart the knowledge and application of difference equations and the Z-transform in discrete systems that are inherent in natural and physical processes.

Course Outcomes

At the end of the course the student will be able to

1. Apply standard methods to solve second-order linear ordinary differential equations.
2. Employ appropriate analytical techniques to formulate and solve linear first- and second-order partial differential equations.
3. Apply Laplace transform techniques to solve differential equations involving unit step and impulse functions.
4. Compute the Fourier series and Fourier transforms of periodic and aperiodic functions.
5. Apply Z-transform techniques to solve first- and second-order difference equations.

Module: 1	Ordinary Differential Equations (ODE)	6 hours

Second order non- homogenous differential equations with constant coefficients- Differential equations with variable coefficients- method of undetermined coefficients-method of Variation of parameters-Solving Damped forced oscillations and LCR circuit theory problems.

Module: 2	Partial Differential Equations (PDE)	5 hours

Formation of partial differential equations - Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation-Method of separation of variables Formation of partial differential equations - Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation-Method of separation of variables

Module: 3	Laplace Transform	7 hours

Definition- Properties of Laplace transform-Laplace transform of standard functions - Laplace transform of periodic functions-Unit step function-Impulse function. Inverse Laplace transform-Partial fractions method and by Convolution theorem.

Module: 4	Solution to ODE and PDE by Laplace transform	7 hours

Evaluation of double integrals-change of order of integration-change of variables between Cartesian and polar co-ordinates - evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates.

Module: 5	Fourier Series	6 hours

Fourier series Euler's formulae- Dirichlet's conditions Change of interval Half range series - RMS value - Parseval's identity.

Module: 6	Fourier Transform	6 hours
Complex Fourier transform - properties - Relation between Fourier and Laplace Transforms-Fourier sine and cosine transforms - Parseval's identity- Convolution Theorem and simple applications to solve PDE.Fourier series Euler's formulae- Dirichlet's conditions Change of interval Half range series - RMS value - Parseval's identity		
Module: 7	**Z-Transform**	**6 hours**
Definition of Z-transform and Inverse Z-transform - Standard functions - Partial fractions and convolution method. Difference equation - first and second order difference equations with constant coefficients - solution of simple difference equations using Z-transform.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lectures from Industry and, Research and Development Organizations		
	Total Lecture Hours	**45 hours**
	Total Tutorial Hours	**15 hours**

Text Book(s)	
1	Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, John Wiley India.
2	B.S. Grewal, Higher Engineering Mathematics, 2020, 44th Edition, Khanna Publishers.
Reference Books	
1	Michael D. Greenberg, Advanced Engineering Mathematics, 2006, 2nd Edition, Pearson Education, Indian edition.
2	A First Course in Differential Equations with Modelling Applications, Dennis Zill, 2018, 11th Edition, Cengage Publishers.
Mode of Evaluation: CAT, written assignment, Quiz, FAT	

Recommended by Board of Studies	24.06.2021		
Approved by Academic Council	No.64	**Date**	16-12-2021

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BMAT201L	Complex Variables and Linear Algebra	L	T	P	C
		3	1	0	4
Pre-requisite	BMAT102L	Syllabus version			
		1.0			

Course Objectives

1. To present comprehensive, compact, and integrated treatment of one of the most important branches of applied mathematics namely Complex variables to the engineers and the scientists.
2. To present comprehensive, compact, and integrated treatment of another most important branches of applied mathematics namely Linear Algebra to the engineers
3. and the scientists.
4. To provide students with a framework of the concepts that will help them to analyse deeply about many complex problems.

Course Outcomes

At the end of the course the student will be able to

1. Construct analytic functions to determine complex potentials associated with fluid flow and electric field problems.
2. Apply elementary conformal and bilinear transformations to map regions in the complex plane.
3. Evaluate real integrals using contour integration.
4. Determine bases, dimensions, and orthogonality in vector and inner product spaces using linear algebraic methods.
5. Solve problems involving matrices, linear transformations, eigenvalues, eigenvectors, and systems of linear equations.

Module: 1	Analytic Functions	7 hours

Complex variable - Analytic functions and Cauchy - Riemann equations; Laplace equation and Harmonic functions; Construction of Harmonic conjugate and analytic functions; Applications of analytic functions to fluid-flow and electric field problems.

Module: 2	Conformal and Bilinear transformations	7 hours

Conformal mapping Elementary transformations; Translation, Magnification, Rotation, Inversion; Exponential and Square transformations ($w = e^z$, z^2); Bilinear transformation; Cross-ratio-Images of the regions bounded by straight lines under the above transformations:

Module: 3	Complex Integration	7 hours

Functions given by Power Series - Taylor and Laurent series-Singularities - Poles Residues; Integration of a complex function along a contour; Statements of Cauchy-Goursat theorem- Cauchy's integral formula-Cauchy's residue theorem-Evaluation of real integrals-Indented contour integral.

Module: 4	Vector Spaces	6 hours

Vector space - subspace; linear combination span linearly dependent - Independent -bases; Dimensions; Finite dimensional vector space. Row and column spaces; Rank and nullity.

Module: 5	Linear Transformations	6 hours

Linear transformations - Basic properties; Invertible linear transformation; Matrices of linear transformations; Vector space of linear transformations; Change of bases; Similarity.

Module: 6	Inner Product Spaces	5 hours

Dot products and inner products; Lengths and angles of vectors; Matrix representations of inner products; Gram - Schmidt - Orthogonalization.

Module: 7	Matrices and System of Equations	5 hours

Eigenvalues and Eigen vectors; Properties of Eigenvalues and Eigen vectors; Cayley-Hamilton theorem; System of linear equations; Gaussian elimination and Gauss Jordan methods.

Module: 8	**Contemporary Issues**	**2 hours**
	Total Lecture Hours **Total Tutorial Hours**	**45 hours** **15 hours**

Text Book(s)	
1.	G. Dennis Zill, Patrick D. Shanahan, A first course in complex analysis with applications, 2013, 3rd Edition, Jones and Bartlett Publishers Series in Mathematics.
2.	Jin Ho Kwak, Sungpyo Hong, Linear Algebra, 2004, Second edition, Springer.
Reference Books	
1.	Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, John Wiley & Sons (Wiley student Edition).
2.	Michael, D. Greenberg, Advanced Engineering Mathematics, 2006, 2nd Edition, Pearson Education.
3.	Bernard Kolman, David, R. Hill, Introductory Linear Algebra - An applied first course, 2011, 9th Edition Pearson Education.
4.	Gilbert Strang, Introduction to Linear Algebra, 2015, 5th Edition, Cengage Learning
5.	B.S. Grewal, Higher Engineering Mathematics, 2020, 44th Edition, Khanna Publishers.

Mode of Evaluation: Digital Assignments (Solutions by using soft skill), Quiz, Continuous Assessments, Final Assessment Test.

Recommended by Board of Studies	24.06.2021		
Approved by Academic Council	No. 64	**Date**	16-12-2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BMAT202L	Probability and Statistics	L	T	P	C
		3	0	0	3
Pre-requisite	BMAT101L, BMAT101P	Syllabus version			
		1.0			

Course Objectives

1. To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations.
2. To analyze distributions and relationship of real-time data.
3. To apply estimation and testing methods to make inference and modelling techniques for decision making.

Course Outcomes

At the end of the course the student will be able to

1. Compute descriptive measures of statistical data.
2. Apply suitable probability distributions to model random variables.
3. Determine relationships among variables using correlation and regression techniques.
4. Perform statistical estimation and hypothesis-testing procedures to draw inferences about population characteristics.
5. Employ statistical methods to solve reliability and maintainability problems in engineering systems.

Module: 1	Introduction to Statistics	6 hours

Statistics and data analysis; Measures of central tendency; Measure of Dispersion, Moments-Skewness-Kurtosis (Concepts only).

Module: 2	Random variables	8 hours

Random variables- Probability mass function, distribution and density functions-Joint probability distribution and Joint density functions; Marginal, Conditional distribution and Density functions-Mathematical expectation and its properties- Covariance, Moment generating function.

Module: 3	Correlation and Regression	4 hours

Correlation and Regression Rank Correlation; Partial and Multiple correlation; Multiple regression.

Module: 4	Probability Distributions	7 hours

Binomial distribution; Poisson distributions; Normal distribution; Gamma distribution; Exponential distribution; Weibull distribution.

Module: 5	Hypothesis Testing-l	4 hours

Testing of hypothesis -Types of errors - Critical region, Procedure for testing of hypothesis-Large sample tests- Z test for Single Proportion- Difference of Proportion- Mean and difference of means.

Module: 6	Hypothesis Testing-II	9 hours

Small sample tests- Student's t-test, F-test- chi-square test- goodness of fit - independence of attributes- Design of Experiments - Analysis of variance - One way-Two way-Three way classifications - CRD-RBD-LSD.

Module: 7	Reliability	5 hours

Basic concepts- Hazard function-Reliabilities of series and parallel systems- System Reliability - Maintainability-Preventive and repair maintenance- Availability.

Module: 8	Contemporary Issues	2 hours
	Total Lecture Hours	**45 hours**

Text Book(s)

1.	R. E. Walpole, R. H. Myers, S. L. Mayers, K. Ye, Probability and Statistics for engineers and scientists 2012 9th Edition Pearson Education		
Reference Books			
1.	Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, 2016, 6th Edition, John Wiley & Sons.		
2.	E. Balagurusamy, Reliability Engineering, 2017, Tata McGraw Hill, Tenth reprint.		
3.	J. L. Devore, Probability and Statistics, 2012, 8th Edition, Brooks/Cole, Cengage Learning.		
4.	R. A. Johnson, Miller Freund's, Probability and Statistics for Engineers, 2011, 8th edition, Prentice Hall India.		
5.	Bilal M. Ayyub, Richard H. McCuen, Probability, Statistics and Reliability for Engineers and Scientists, 2011, 3rd edition, CRC press.		
Mode of Evaluation: Digital Assignments, Continuous Assessment Tests, Quiz, Final Assessment Test.			
Recommended by Board of Studies	24.06.2021		
Approved by Academic Council	No. 64	**Date**	16-12-2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BMAT202P	Probability and Statistics Lab	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. To enable the students for having experimental knowledge of basic concepts of statistics using R programming.
2. To study the relationship of real-time data and decision making through testing methods using R.
3. To make students capable to do experimental research using statistics in various engineering problems.

Course Outcomes

At the end of the course the student will be able to

1. Interpret the graphical and statistical output of R programs to draw conclusions from experimental data.
2. Implement statistical computations — including descriptive statistics, probability distributions, correlation, regression, and hypothesis testing — using R programming.

Indicative Experiments	
1.	Introduction: Understanding Data types; importing/exporting data
2.	Computing Summary Statistics /plotting and visualizing data using Tabulation and Graphical Representations
3.	Applying correlation and simple linear regression model to real dataset; computing and interpreting the coefficient of determination
4.	Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficients of determination
5.	Fitting the probability distributions: Binomial distribution
6.	Normal distribution, Poisson distribution
7.	Testing of hypothesis for one sample mean and proportion from real time problems
8.	Testing of hypothesis for two sample means and proportion from real time problems
9.	Applying the t-test for independent and dependent samples
10.	Applying Chi-square test for goodness of fit test and Contingency test to real dataset
11.	Performing ANOVA for real dataset for Completely randomized design, Randomized Block design, Latin square Design
	Total Laboratory Hours **30 hours**

Text Book

1.	Statistical analysis with R by Joseph Schmuller, John wiley and sons Inc., New Jersey 2017.

Reference Books:

1.	The Book of R: A First course in Programming and Statistics, by Tilman M Davies, William Pollock, 2016.
2.	R for Data Science, by Hadley Wickham and Garrett Grolemund, O' Reilly Media Inc., 2017.

Mode of Evaluation: Continuous assessment, FAT / Oral examination and others

Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 64	**Date**	16-12-2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-

CO2	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-

BMEE102P	**Engineering Design Visualization Lab**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. Understand the importance of basic concepts and principles of engineering drawing for representing engineering components, sections, views by graphical representation using CAD.
2. Enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
3. Develop the ability to communicate with others through the language of technical drawing and sketching.
4. Apply the standards for the use of international and traditional units for technical drawing.

Course Outcome

Upon completion of this subject, the student will be able to
1. Prepare sheet layouts and construct dimensional elements for engineering drawings as per standards.
2. Construct two-dimensional graphical drawings for engineering applications.
3. Draw projections of point, lines solids, sections of solids for regular polyhedrons and solids of revolutions using computer aided drawing.
4. Construct and visualize geometrical solids in 3D space through orthographic and isometric projections.

Module:1	**Introduction to Engineering Drawing**	**8 hours**

Introduction to Engineering Drawing, drawing instruments, Drawing standards (BIS), Lettering in engineering, Sheet layout, elements of dimensioning - systems of dimensioning.

Module:2	**Free Hand Sketching**	**8 hours**

Free hand sketching- Pictorial representation of engineering objects – representation of three-dimensional objects in two-dimensional media – need for multiple views – developing visualization skills through free hand sketching of three-dimensional objects.

Module:3	**Orthographic Projection**	**8 hours**

Introduction to projections: General principles of orthographic projection – first angle projection – layout of views - Projection of Points, Projection of lines. 2D drawing using CAD.

Module:4	**3D modelling and Projections**	**12 hours**

Projection of Solids: Classification of solids, Projection of solids in simple position-Solid Modelling.
Sections of Solids: Right regular solids and auxiliary views for the true shape of the sections.
Development of Surfaces, Intersection of Solids: Intersection of two solids.

Module:5	**Isometric Projection and Perspective Projection**	**8 hours**

Isometric View/Projection: Isometric scales, Isometric projections of simple and combination of solids. Conversion of pictorial view into orthographic Projection- 2D drawing from 3D drawing – Missing views.
Perspective Projection: Orthographic representation of a perspective view.

Module:6	**Orthographic Projection into Isometric view**	**8 hours**

Conversion of Orthographic projection into isometric view- 3D modelling from 2D drawing.

Module:7	**Project on Product Development**	**8 hours**

Project on a product development related to any engineering application.

	Total Lecture Hours:	**60 Hours**

Text Book(s)

1	Venugopal K and Prabhu Raja V, Engineering Graphics, New AGE International Publishers, 2018.

Reference Books

1	Bhatt N. D., Engineering Drawing, Charotar Publishing House Pvt. Ltd, 2019.
2	Randy H. Shih, SOLIDWORKS 2021 and Engineering Graphics - An Integrated Approach, SDC Publications, 2021.
3	Dennis K. Lieu, Sheryl A. Sorby, Visualization, Modeling, and Graphics for Engineering Design, Delmar,

	Cengage Learning, 2009.
4	Natarajan.K.V,A Textbook of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2015.
Indicative Experiments	
1	Free Hand Sketching
2	2D drafting using CAD software
3	Dimensioning of 2D figures
4	Projection of points and lines -2D drafting
5	Projection of solids in simple position- 3D modelling
6	Section of solids- 3D modelling
7	Conversion of pictorial drawing into orthographic projection-CAD
8	Conversion of orthographic projection into isometric view-CAD
9	Engineering design and visualization of an engineering product -I
10	Engineering design and visualization of an engineering product -II
Mode of Evaluation: Examination and evaluation is done for CAD exercises. Continuous assessments in terms of CAD exercises, models / products designed and created; FAT & Oral examination	

Recommended by Board of Studies	02.07.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	2	-	-	-	-	-

BMEE201L	Engineering Mechanics	L	T	P	C
		2	1	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To enable students to apply fundamental laws and basic concepts of rigid body mechanics to solve problems of bodies under rest or in motion.
2. To enable the students to apply conditions of static equilibrium to analyse physical systems.
3. To compute the properties of areas and bodies.

Course Outcome:

Upon successful completion of the course the students will be able to

1. Compute the resultant and analyse equilibrium (without and with friction) of systems of forces acting on particles and rigid bodies in plane and space.
2. Calculate the support reactions and the internal forces of the members of trusses and frames.
3. Apply transfer theorems to determine the properties of various sections.
4. Calculate motion parameters of particles and rigid bodies.

Module:1	Statics of Particles	5 hours

Fundamental concepts and principles - Resolution of a force -Resultant of forces in a plane- Equilibrium of a particle in a plane; Addition of concurrent forces in space- Equilibrium of a particle in space.

Module:2	Statics of Rigid Bodies	7 hours

Equivalent systems of forces- Principle of Transmissibility - Moment of a force about a point and an axis- Couples and force-couple systems- Equilibrium of rigid bodies in two and three dimensions- Types of beams, supports and reactions; Principle of virtual work – System of connected rigid bodies.

Module:3	Analysis of Structures	5 hours

Analysis of plane trusses - Method of joints and method of sections- Frames

Module:4	Friction	5 hours

The laws of dry friction – Coefficients of Friction- Angles of Friction- Types of Friction Problems - Wedges and Ladder friction- Belt friction.

Module:5	Properties of Surfaces and Solids	7 hours

First moments of areas and lines- Centroids of composite areas and lines- - Theorems of Pappus-Guldinus- Second moment of area- Parallel axis theorem- Rectangular and Polar Moments of inertia of composite areas- Radius of Gyration- Product of Inertia- Principal Axes and Principal Moments of Inertia- Mass moments of inertia of thin plates.

Module:6	Dynamics of Particles	8 hours

Kinematics of Particles: Displacement, Velocity and Acceleration – Rectilinear motion – Curvilinear motion – Tangential and Normal components – Radial and Transverse components.
Kinetics of Particles: Newton's Second Law- Energy and Momentum Methods-Principle of Work and Energy-Principle of Impulse and Momentum- Direct Central Impact

Module:7	Dynamics of Rigid Bodies	8 hours

Kinematics of rigid bodies: Translation and fixed-axis rotation- General plane motion: velocity- Instantaneous centre of rotation- General plane motion: acceleration.
Kinetics of rigid bodies:Equations of motion -Angular momentum- Plane motion of a rigid body- Principle of work and energy for rigid bodies- Principle of impulse and momentum for rigid bodies.

	Total Lecture Hours:	45 Hours

Text Book(s)

1. Beer, Johnston, Cornwell, David Mazurek, and Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, 12th Edition, McGraw-Companies, Inc., New York, 2019.

Reference Books

1. Russell C Hibbeler, Engineering Mechanics: Statics and Dynamics (14th Edition), Pearson Education Inc., Prentice Hall, 2016.
2. Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - Statics, Volume II - Dynamics, 9th Edition, John Wiley & Sons, New York, 2018.

Mode of Evaluation: Examination and evaluation is done for CAD exercises. Continuous assessments in terms of CAD

exercises, models / products designed and created; FAT & Oral examination			
Recommended by Board of Studies	02.07.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BPHY101L	Engineering Physics	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. To explain the dual nature of radiation and matter.
2. To apply Schrödinger's equation to solve finite and infinite potential problems and apply quantum ideas at the nanoscale.
3. To understand the Maxwell's equations for electromagnetic waves and apply the concepts to semiconductors for engineering applications.

Course Outcomes

At the end of the course the student will be able to

1. Apply Newtonian mechanics to model the waves in an elastic medium.
2. Interpret the properties of electromagnetic waves using the Maxwell's equations.
3. Apply quantum mechanical ideas to microscopic systems.
4. Employ Einstein's theory of stimulated emission to examine the characteristics and working of lasers.
5. Articulate the primary components of a typical optical fiber communications system and their working principles.

Module: 1	Introduction to waves	7 hours

Waves on a string - Wave equation on a string (derivation) - Harmonic waves- reflection and transmission of waves at a boundary (Qualitative) - Standing waves and their eigen frequencies.

Module: 2	Electromagnetic waves	7 hours

Physics of divergence - gradient and curl - Qualitative understanding of surface and volume integral - Maxwell Equations (Qualitative) - Displacement current - Electromagnetic wave equation in free space - Plane electromagnetic waves in free space - Hertz's experiment.

Module: 3	Elements of quantum mechanics	6 hours

Need for Quantum Mechanics: Idea of Quantization (Planck and Einstein) - Compton effect (Qualitative) – de Broglie hypothesis - - Davisson-Germer experiment - Wave function and probability interpretation - Heisenberg uncertainty principle - Schrödinger wave equation (time dependent and time independent).

Module: 4	Applications of quantum mechanics	5 hours

Eigenvalues and eigenfunction of particle confined in one dimensional box - Basics of nanophysics - Quantum confinement and nanostructures - Tunnel effect (qualitative) and scanning tunneling microscope.

Module: 5	Lasers	6 hours

Laser characteristics - spatial and temporal coherence - Einstein coefficients and their significance - Population inversion - two, three and four level systems - Pumping schemes - threshold gain coefficient - Components of a laser - He-Ne, Nd:YAG and CO_2 lasers and their engineering applications.

Module: 6	Propagation of EM waves in optical fibers	6 hours

Introduction to optical fiber communication system - light propagation through fibers - Acceptance angle - Numerical aperture - V-parameter - Types of fibers – Attenuation - Dispersion-intermodal and intramodal. Application of fiber in medicine - Endoscopy.

Module: 7	Optoelectronic devices	6 hours

Introduction to semiconductors - direct and indirect bandgap – Sources: LED and laser diode, Photodetectors: PN and PIN.		
Module: 8	**Contemporary Issues**	**2 hours**
Total Lecture Hours		**45 hours**

Text Book(s)

1. H. D. Young and R. A. Freedman, University Physics with Modern Physics, 2020, 15th Edition, Pearson, USA.
2. D. K. Mynbaev and Lowell L. Scheiner, Fiber Optic Communication Technology, 2011, 1st Edition, Pearson, USA

Reference Books

1. H. J. Pain, The Physics of vibrations and waves, 2013, 6th Edition, Wiley Publications, India.
2. R. A. Serway, J. W. Jewett, Jr, Physics for Scientists and Engineers with Modern Physics, 2019, 10th Edition, Cengage Learning, USA.
3. K. Krane, Modern Physics, 2020, 4th Edition, Wiley Edition, India.
4. M.N.O. Sadiku, Principles of Electromagnetics, 2015, 6th Edition, Oxford University Press, India.
5. W. Silfvast, Laser Fundamentals, 2012, 2nd Edition, Cambridge University Press, India.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BPHY101P	Engineering Physics Lab	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

To apply theoretical knowledge gained in the theory course and get hands-on experience of the topics.

Course Outcomes

At the end of the course the student will be able to

1. Analyse the idea of quantization through quantum mechanical experiments
2. Demonstrate the quantum mechanical ideas in microscopic domain.
3. Demonstrate the applications of optoelectronic devices in optical fibre communication.

Indicative Experiments	
1.	To determine the dependence of fundamental frequency with the length and tension of a stretched string using sonometer.
2.	To determine the characteristics of EM waves using Hertz experiment.
3.	To determine the wavelength of laser source (He-Ne laser and diode lasers of different wave lengths) using diffraction grating.
4.	To demonstrate the wave nature of electron by diffraction through graphite sheet.
5.	To determine the Planck's constant using electroluminescence process.
6.	To determine demonstrate the discrete energy levels and the wave functions using schrodinger equation (e.g., particle in a box problem can be given as an assignment)
7.	To determine the refractive index of a prism using spectrometer (angle of prism will be given.
8.	To determine the efficiency of a solar cell
9.	To determine the acceptance angle and numerical aperture of an optical fiber.
10.	To demonstrate the phase velocity and group velocity (simulation).
Total Laboratory Hours	**30 hours**

Mode of Evaluation: Continuous Assessment / FAT / Oral Examination

Recommended by Board of Studies	26.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

BSTS101P	**Quantitative Skills Practice I**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. To enhance the logical reasoning skills of the students and help them improve problem-solving abilities
2. To acquire skills required to solve quantitative aptitude problems
3. To boost the verbal ability of the students for academic and professional purposes

Course Outcome

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

1. Apply quantitative aptitude concepts and methods to solve problems in academic and placement assessments.
2. Analyse logical reasoning problems to identify relationships and determine appropriate solutions.
3. Apply verbal ability strategies to interpret and solve questions in academic and placement contexts.

Module:1	**Logical Reasoning**	**5 hours**

Word group categorization questions Puzzle type class involving students grouping words into right group orders of logical sense Cryptarithmetic

Module:2	**Data arrangements and Blood relations**	**6 hours**

Linear Arrangement - Circular Arrangement - Multi-dimensional Arrangement - Blood Relations

Module:3	**Ratio and Proportion**	**6 hours**

Ratio - Proportion - Variation - Simple equations - Problems on Ages - Mixtures and alligations

Module:4	**Percentages, Simple and Compound Interest**	**6 hours**

Percentages as Fractions and Decimals - Percentage Increase / Decrease - Simple Interest
- Compound Interest - Relation Between Simple and Compound Interest

Module:5	**Number System**	**6 hours**

Number system- Power cycle - Remainder cycle - Factors, Multiples - HCF and LCM

Module:6	**Essential grammar for Placement**	**7 hours**

- Prepositions
- Adjectives and Adverbs
- Tense
- Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerunds and Infinitives
- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Module:7	**Reading Comprehension for Placement**	**3 hours**

Types of questions - Comprehension strategies - Practice exercises

Module:8	**Vocabulary for Placement**	**6 hours**

Exposure to questions related to Synonyms — Antonyms — Analogy - Confusing words - Spelling correctness

	Total Lecture Hours:	**45 Hours**
Text Book(s)		
1.	SMART. (2018). Place Mentor 1st (Ed.). Chennai: Oxford University Press.	
2.	Aggarwal R.S. (2017). Quantitative Aptitude for Competitive Examinations 3rd (Ed.). New Delhi: S. Chand Publishing.	
3.	FACE. (2016). Aptipedia Aptitude Encyclopedia 1st (Ed.). New Delhi: Wiley Publications.	
4.	ETHNUS. (2016). Aptimithra,1st (Ed.) Bangalore: McGraw-Hill Education Pvt. Ltd.	
References		
1.	Sharma Arun. (2016). Quantitative Aptitude, 7th(Ed.). Noida: McGraw Hill Education Pvt. Ltd.	

Mode of Evaluation: CAT, Assessments and FAT (Computer Based Test)			
Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

BSTS102P	Quantitative Skills Practice II	L	T	P	C
		0	0	3	1.5
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. To enhance the logical reasoning skills of the students and help them improve problem-solving abilities
2. To acquire skills required to solve quantitative aptitude problems
3. To boost the verbal ability of the students for academic and professional purposes

Course Outcome

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

1. Apply logical reasoning and data interpretation to solve advanced problems.
2. Solve advanced quantitative aptitude problems using systematic methods.
3. Demonstrate written and oral communication proficiency in competitive assessments

Module:1	**Logical Reasoning Puzzles - Advanced**	**2 hours**

Advanced puzzles:

- Sudoku
- Mind-bender style word statement puzzles
- Anagrams
- Rebus puzzles

Module:2	**Logical connectives, Syllogism and Venn diagrams**	**2 hours**

Logical Connectives- Advanced Syllogisms - 4, 5, 6 and other multiple statement problems - Challenging Venn diagram questions: Set theory

Module:3	**Permutation, Combination and Probability - Advanced**	**4 hours**

Fundamental Counting Principle- Permutation and Combination- Computation of Permutation - Advanced problems - Circular Permutations - Computation of Combination Advanced problems -Advanced probability

Module:4	**Quantitative aptitude**	**6 hours**

Logarithms, Progressions, Geometry and Quadratic equations – Advanced

- Logarithm
- Arithmetic progression
- Geometric Progression
- Geometry
- Mensuration
- Coded inequalities
- Quadratic Equations

Concepts followed by advanced questions of CAT level

Module:5	**Image interpretation**	**2 hours**

Image interpretation: Methods- Exposure to image interpretation questions through brainstorming and practice

Module:6	**Critical Reasoning - Advanced**	**3 hours**

Concepts of Critical Reasoning - Exposure to advanced questions of GMAT level

Module:7	**Recruitment Essentials**	**8 hours**

Mock interviews: Cracking other kinds of interviews
Skype/ Telephonic interviews
Panel interviews
Stress interviews

Guesstimation 1. Best methods to approach Guesstimation questions 2. Practice with impromptu interview on Guesstimation questions **Case studies/ situational interview** 1. Scientific strategies to answer case study and situational interview questions 2. Best ways to present cases **3.** Practice on presenting cases and answering situational interviews asked in recruitment rounds		
Module:8	**Problem solving and algorithmic skills**	**18 hours**
Logical methods to solve problem statements in Programming - Basic algorithms introduced		
	Total Lecture Hours:	**45 Hours**
Text Book(s)		
1.	SMART. (2018). Place Mentor 1st (Ed.). Chennai: Oxford University Press.	
2.	Aggarwal, R.S. (2017). Quantitative Aptitude for Competitive Examinations 3rd (Ed.). New Delhi: S. Chand Publishing.	
3.	FACE. (2016). Aptipedia Aptitude Encyclopedia 1st (Ed.). New Delhi: Wiley Publications.	
4.	ETHNUS. (2016). Aptimithra,1st (Ed.) Bangalore: McGraw-Hill Education Pvt. Ltd.	
References		
1.	Sharma Arun. (2016). Quantitative Aptitude, 7th(Ed.). Noida: McGraw Hill Education Pvt. Ltd.	
Mode of Evaluation: CAT, Assessments and FAT (Computer Based Test)		

Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

BSTS201P	Qualitative Skills Practice I	L	T	P	C
		0	0	3	1.5
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. To enhance the logical reasoning skills of the students and help them improve problem-solving abilities
2. To acquire skills required to solve quantitative aptitude problems
3. To boost the verbal ability of the students for academic and professional purposes

Course Outcome

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

1. Apply quantitative aptitude methods to solve problems accurately and efficiently.
2. Analyse and evaluate logical reasoning concepts to assess alternative solutions and defend conclusions.
3. Demonstrate verbal ability skills effectively in academic and professional contexts.

Module:1	**Lessons on excellence**	**2 hours**

Skill introspection - Skill acquisition – consistent practice

Module:2	**Thinking Skill**	**6 hours**

- Problem Solving
- Critical Thinking
- Lateral Thinking

Rebus puzzles and word-link builder questions

Module:3	**Logical Reasoning**	**6 hours**

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Module:4	**Sudoku puzzles**	**3 hours**

Solving introductory to moderate-level Sudoku puzzles to boost logical thinking and comfort with numbers

Module:5	**Attention to detail**	**3 hours**

Picture and word-driven Qs to develop attention to detail as a skill

Module:6	**Quantitative Aptitude**	**14 hours**

Speed Maths

- Addition and Subtraction Of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication shortcuts
- Multiplication of 3 and higher-digit numbers
- Simplifications
- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility test shortcuts

Algebra and functions		
Module:7	**Verbal Ability**	**6 hours**
Grammar challenge A practice paper with sentence-based and passage-based questions on grammar discussed - Nouns and Pronouns, Verbs, Subject-Verb Agreement, Pronoun- Antecedent Agreement, Punctuations **Verbal reasoning**		
Module:8	**Recruitment essentials**	**5 hours**
Looking at an engineering career through the prism of an effective resume • Importance of a resume - the footprint of a person's career achievements • Designing an effective resume • An effective resume vs. a poor resume • Skills you must build starting today the requisite? • How does one build skills **Impression Management** Getting it right for the interview: • Grooming, dressing • Body Language and Other non-verbal signs • Displaying the right behaviour		
	Total Lecture Hours:	**45 Hours**
Text Book(s)		

1.	SMART. (2018). Place Mentor 1st (Ed.). Chennai: Oxford University Press.
2.	Aggarwal, R.S. (2017). Quantitative Aptitude for Competitive Examinations 3rd (Ed.). New Delhi: S. Chand Publishing.
3.	FACE. (2016). Aptipedia Aptitude Encyclopedia 1st (Ed.). New Delhi: Wiley Publications.
4.	ETHNUS. (2016). Aptimithra,1st (Ed.) Bangalore: McGraw-Hill Education Pvt. Ltd.

References

1.	Sharma Arun. (2016). Quantitative Aptitude, 7th(Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Mode of Evaluation: CAT, Assessments and FAT (Computer Based Test)			
Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 63	**Date**	23.09.2021

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

BSTS202P	Qualitative Skills Practice II	L	T	P	C
		0	0	3	1.5
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

1. To enhance the logical reasoning skills of the students and help them improve problem-solving abilities
2. To acquire skills required to solve quantitative aptitude problems
3. To boost the verbal ability of the students for academic and professional purposes

Course Outcome

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

1. Solve logical reasoning problems in aptitude assessments.
2. Apply advanced counting principles in quantitative and competitive assessments.
3. Use verbal ability and quantitative aptitude skills in placement assessments.

Module:1	**Logical Reasoning**	**5 hours**

- Clocks
- Calendars
- Direction Sense
- Cubes

Practice on advanced problems

Module:2	**Data interpretation and sufficiency-Advanced**	**5 hours**

- Advanced Data Interpretation and Data Sufficiency questions Of CAT level
- Multiple chart problems
- Caselet problems

Module:3	**Time and work - Advanced**	**5 hours**

- Work with different efficiencies
- Pipes and cisterns: Multiple pipe problems
- Work equivalence
- Division of wages
- Advanced application problems with complexity in calculating total work

Module:4	**Time S ed and Distance - Advanced**	**5 hours**

- Relative speed
- Advanced Problems based on trains
- Advanced Problems based on boats and streams
- Advanced Problems based on races

Module:5	**Profit and loss, Partnerships and averages - Advanced**	**5 hours**

- Partnership
- Averages
- Weighted average
- Advanced problems discussed

Module:6	**Number system - advanced**	**4 hours**

Advanced application problems on Numbers involving HCF, LCM, divisibility tests, remainder and power cycles.

Module:7	Verbal Ability	13 hours

Sentence Correction - Advanced 13hours •

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Quick introduction to 8 types Of errors followed by exposure to GMAT level questions

Sentence Completion and Para-jumbles - Advanced

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix/suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Practice on advanced GREI/GMAT level questions

Reading Comprehension - Advanced

Exposure to RCs of the level of GREI GMAT relating to a wide variety of subjects

Module:8	Writing skills for Placement	3 hours

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

	Total Lecture Hours:	**45 Hours**

Text Book(s)	
1.	SMART. (2018). Place Mentor 1st (Ed.). Chennai: Oxford University Press.
2.	Aggarwal, R.S. (2017). Quantitative Aptitude for Competitive Examinations 3rd (Ed.). New Delhi: S. Chand Publishing.
3.	FACE. (2016). Aptipedia Aptitude Encyclopedia 1st (Ed.). New Delhi: Wiley Publications.
4.	ETHNUS. (2016). Aptimithra,1st (Ed.) Bangalore: McGraw-Hill Education Pvt. Ltd.

References	
1.	Sharma Arun. (2016). Quantitative Aptitude, 7th(Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Mode of Evaluation: CAT, Assessments and FAT (Computer Based Test)			
Recommended by Board of Studies	28.06.2021		
Approved by Academic Council	No. 68	**Date**	19.12.2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

Discipline – linked Engineering Sciences

BCLE201L	CONSTRUCTION MATERIALS	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Learn the various properties of building materials.
2. Acquire the knowledge on application of various materials such as bricks, stones, timber.
3. Use the various materials such as cement, aggregates, mortars and miscellaneous materials for construction.

Course Outcomes

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

1. Identify suitable bricks and clay products based on their properties for construction applications.
2. Select appropriate types of stones and brick masonry for construction applications.
3. Choose suitable timber and timber products for structural and non-structural applications.
4. Classify the properties of cement, aggregates, and mortars for construction purpose.
5. Select suitable metallic and non-metallic construction materials for various engineering applications.

Module: 1	Properties of Building Materials	4 hours

Introduction-Physical and Mechanical properties of building materials-Bricks-Classification of bricks-Manufacturing process-Testing of bricks as per Indian Standards-Clay and its products.

Module: 2	Stone and Masonry Construction	4 hours

Classification of rocks-Characteristics of good building stones-Testing of stones-Artificial stones-Applications of stones-Stone Masonry-Brick Masonry.

Module: 3	Timber and Timber Products	4 hours

Classification of Trees-Structure of timber-Seasoning of timber-Defects in timber-Preservation-Process of timber-Testing of timbers as per Indian Standards-Various properties of timber-Timber products and its applications.

Module: 4	Cement and its properties	4 hours

Portland cement-Chemical composition of raw materials-Manufacturing process of cement-Hydration of cement-Classification of cement-Testing of cement and its properties.

Module: 5	Aggregates and aggregate properties	4 hours

Classification of aggregates-Characteristics of aggregates-Various properties of aggregates-Coarse aggregate-Testing of coarse aggregates as per Indian Standards-Fine aggregates-Testing of fine aggregates as per Indian Standards.

Module: 6	Mortars and its applications	4 hours

Introduction-Classification of Mortars-Properties-Lime mortar-Cement mortar-Selection of mortar-Testing of mortars-Applications.

Module: 7	Miscellaneous Materials	4 hours

Structures of ferrous metals-Classification of ferrous metals-Iron-Steel-Manufacturing process-Applications-Testing-various forms of steel sections-Aluminium-Uses-Properties-Copper-Uses-Properties-Ceramic materials-Classification of Ceramics-Manufacturing process of glass and its applications-Plastics and its applications-Rubber and its applications.

Module: 8	Contemporary Issues	2 hours

Guest lecture from industry and R & D organisations.

Total Lecture Hours	30 hours

Text Book(s)

1. Varghese, P. C., Building Materials, 2015, Second Edition, PHI Learning Pvt. Ltd., New Delhi.			
Reference Books			
1. Edward Allen, Joseph Iano, Fundamental Building Materials, 2014, Sixth Edition, John Wiley & Sons inc. 2. Rangwala, Building Construction, 2016, Charotar Publishers, India. 3. IS 2386-1:1963 (R2016), Indian Standard Methods of test for Aggregates for concrete.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3									1			3		
CO2	3									2			3		
CO3	3									1			3		
CO4	3									2			3		
CO5	3									2			3		

BCLE202L	FLUID MECHANICS	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Provide fundamental knowledge of fluid properties and apply the principle of mass and momentum in fluid flows.
2. Determine the losses in a flow system.
3. Acquire knowledge on open channel flow concepts and importance of dimensional analysis.

Course Outcomes

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

1. Apply the concepts of mechanics to determine fluid properties, hydrostatic pressure, and buoyancy forces.
2. Analyze head losses and discharge in pipe networks using energy equations.
3. Calculate specific energy, hydraulic jump characteristics, and discharge in open channel flows.
4. Determine prototype performance from model studies using the Buckingham Pi theorem
5. Compute the drag and lift forces over flat plates under laminar and turbulent boundary layer conditions

Module: 1	Introduction to Fluid Properties	
Scope of Fluid Mechanics-Control Volume, Dimensions and units-Fluid continuum-Fluid properties-Classification of fluids.		
Module: 2	**Fluid Statics and Buoyancy**	**6 hours**
Basic equation of fluid statics-Manometers-Hydrostatic forces on plane, vertical, inclined and curved submerged surfaces-Buoyancy and stability.		
Module: 3	**Fluid Dynamics**	**8 hours**
Types of flows, Reynold's Transport theorem-Continuity equation-Stream function and Velocity potential function-Laplace's equation-Euler's equation-Bernoulli's equation and its applications-Momentum equations-Application of momentum equation-Navier-Stokes Equation.		
Module: 4	**Flow through pipes**	**6 hours**
Major losses-Friction factor-Minor losses-Solution to pipe flow problems-single path and multi path systems-Fully developed Laminar flow in pipe-Laminar flow between parallel plates when both plates at rest-Laminar flow between parallel plates when upper plate moving with constant speed-Turbulent flow–shear stress distribution and velocity profiles.		
Module: 5	**Open channel flows**	**6 hours**
Types of open channel flows-Specific energy-Critical depth-Flow over bump-Hydraulic jump-Discharge measurement using weirs.		
Module: 6	**Dimensional analysis and similitude**	**6 hours**
Dimensional homogeneity-Buckingham Pi theorem-Dimensionless numbers-Flow similarity and model studies-Incomplete similarity studies.		
Module: 7	**Boundary layer flow**	**6 hours**
Boundary layer, Boundary layer thickness, Laminar flat plate boundary layer-Momentum integral equation-Laminar flow and turbulent flow-Drag-Lift-Streamlining of body shapes.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**

Text Book(s)			
1. Fox, R. W. McDonald, A.T., Mitchell, J.W., Introduction to Fluid Mechanics, 2020, Tenth Edition, John Wiley & Sons, USA.			
Reference Books			
1. Modi, P. N., Seth, S. M., Hydraulics and Fluid Mechanics including Hydraulic Machines, 2017, Twenty First Edition, Standard Book House, New Delhi. 2. Streeter. V., Wylie, B., Bedford, K.W., Fluid Mechanics, 2017, McGraw Hill, New Delhi. 3. Pani B. S., Fluid Mechanics : A Concise Introduction, 2016, PHI Learning Pvt. Ltd., India.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

BCLE202P	FLUID MECHANICS LAB	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Estimate the discharge in tanks and open channels.
2. Able to understand major loss and minor loss in pipe flow.
3. Classify the fluid motion and estimate the flow rate in pipes.

Course Outcomes

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

1. Calculate the coefficient of discharge for orifices, mouthpieces, and open channels
2. Determine the friction factor in pipe flow.
3. Analyze the discharge and head losses in pipe flow systems.

List of Experiments

1.	Assessment of discharge from a given tank using Orifice (Constant Head Method).
2.	Evaluation of discharge from a given tank using Mouth piece (Falling Head Method).
3.	Verification of conservation of energy principle for a given flow system using Bernoulli's Theorem.
4.	Determination of discharge in an open channel using Rectangular / Triangular Notch.
5.	Assessments of discharge of a given pipe flow using Venturi Meter.
6.	Evaluation of discharge of a given pipe flows using Orifice Meter.
7.	Determination of friction factor for a given flow system.
8.	Determination of minor losses for a given pipe.
9.	Determination of state of flow in a closed conduit using Reynold's experiment.
10.	(i) Determination of flow rate in a pipeline using Water Meter. (ii) Calibration of a Pitot-Static Tube.
Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	2	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	2	-	-	-	3	-	-

BCLE203L	MECHANICS OF SOLIDS	L	T	P	C
		3	0	0	3
Pre-requisite	Engineering Mechanics	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Provide the basic concepts and principles of deformable bodies.
2. Achieve an ability to calculate stresses and deformation of members under external loading.
3. Gain knowledge on application of solid mechanics on engineering applications and design problems.

Course Outcomes

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

1. Apply equilibrium principles to calculate stresses and deformations in bodies subjected to general loading conditions.
2. Draw shear force and bending moment diagrams in statically determinate beams for various loading and support conditions.
3. Determine the slope and deflection of statically determinate beams under various loading conditions.
4. Compute the torsional resistance of circular shafts, critical and failure load of columns.
5. Analyse the beams for unknown reactions and deformation using strain energy methods.

Module: 1	Concept of Stress and Strain	4 hours

Statically determinate structures-Stress and strain under general loading condition-Stress on Oblique Plane under axial loading-Principle of Superposition-Saint Venant's Principle.

Module: 2	Stresses and Strains on Deformable Bodies	8 hours

Hooke's Law-Stress under Tension, Compression and Shear-Relation between elastic constants-Poisson's Ratio-Bulk Modulus-Generalized Hooke's Law-Mohr's Circle-Principal stresses and strains-Stress tensor-Stresses in Thin-walled Pressure Vessels-Failure Theories.

Module: 3	Shear Force and Bending Moment- Simple Bending	8 hours

Bending of Beams-Types of loading and support conditions-Shear force and bending moment of Statically Determinate Beams-Simple bending theory- Bending stresses and shear stresses.

Module: 4	Deflection of Beams	8 hours

Slope and Deflection of Statically Determinate Beams-Macaulay's Method-Moment Area Method-Conjugate Beam Method.

Module: 5	Torsion of shaft	4 hours

Circular shaft in torsion-Torsional rigidity-Design of transmission shaft-Torsion of non-circular shaft.

Module: 6	Theory of Columns	5 hours

Long and short column-Stability of columns-Euler's formula-Rankine's formula-Secant formula.

Module: 7	Energy Methods	6 hours

Strain Energy-Strain Energy for general stress state-Castigliano's Theorems-Unit Load Method-Maxwell-Betti Theorem.

Module: 8	Contemporary Issues	2 hours

Guest lecture from industry and R & D organisations.			
		Total Lecture Hours	**45 hours**
Text Book(s)			
1. Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, David F. Mazurek, Mechanics of Materials, 2020, Eighth Edition, McGraw-Hill Education, India.			
Reference Books			
1. Bansal R. K, A textbook of Strength of Materials, 2018, Sixth Edition, Laxmi Publications, New Delhi India. 2. Gere J M and Goodno B J, Mechanics of Materials, 2019, Ninth Edition, Cengage Learning India Pvt. Ltd.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-

BCLE203P	MECHANICS OF SOLIDS LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Engineering Mechanics	Syllabus version			
		1			

Course Objectives

The objectives of this course is to :

1. Provide physical insight on deformation of bodies.
2. Study the stress and strains developed in bodies under the action of various loads.
3. Calculate the material properties of deformable bodies by means of various tests.

Course Outcomes

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

1. Calculate the mechanical properties of mild steel under tensile and shear loading.
2. Determine the elastic properties of steel and wooden beams under three-point loading.
3. Compare the load-carrying capacities of short and long columns.

List of Experiments

1	Tension test on mild steel bar.
2	Construction of Mohr's Circle graphically using principal stress values.
3	Double shear test.
4	Bending moment and shear force variation in beams subjected to three point loading.
5	Bending moment and shear force variation in beams subjected to four point loading
6	Calculation of bending stress of wooden beam.
7	Deflection of simply supported steel beam.
8	Deflection of Cantilever steel beam.
9	Determination of rigidity modulus of a steel bar.
10	Load carrying capacity of long and short columns.
Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	2	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	2	-	-	-	3	-	-

Discipline Core

BCLE204L	SURVEYING	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Provide basic knowledge on principles of surveying and its application for measuring distances, angles, elevations, coordinates and preparation of maps.
2. Familiarize students with various methods involved in surveying like tacheometry, curve setting, and profile levelling.
3. Nurture the students in use of various surveying instruments and introduce advanced surveying techniques such as Remote sensing, Photogrammetry, Total Station, DGPS and LIDAR.

Course Outcomes

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

1. Apply principles of linear and angular measurement in field surveying.
2. Determine bearings, angles, reduced levels, and coordinates using analytical methods.
3. Compute land areas and earthwork volumes using the field survey data
4. Prepare terrain maps and cross-sectional profiles for engineering applications.
5. Demonstrate the principles and methods of aerial surveying and remote sensing.

Module: 1	Measurements of Distances, Angles and Directions	7 hours

Importance of surveying-Classifications–Principles; Linear and angular measurement–Meridians, Azimuths and bearings–compass-Theodolites–adjustments–Horizontal and Vertical angle measurements-Plane table surveying.

Module: 2	Determination of Elevations	7 hours

Principles of levelling-Booking and reducing levels; Differential, profile levelling and cross sectioning, refraction & curvature correction, reciprocal levelling-Tacheometry–Stadia Tacheometry, tangential tacheometry and substance tacheometry-Contouring.

Module: 3	Modern Field Instruments	7 hours

Electronic Distance Measurement-Basic Principle–Classifications-Electro-optical system-computing distances–Electronic Total Station instruments–Types–Measurements with total station-Surveying with Differential Global Positioning Systems (GPS)-GPS measurements, errors and biases, Co-ordinate transformation, accuracy considerations. LIDAR.

Module: 4	Digital Photogrammetry and Remote Sensing	8 hours

Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping-mosaics. Drone technology–Unmanned Aerial Vehicles (UAVs)–Different types of application in Civil Engineering.

Electromagnetic Spectrum-interaction of electromagnetic radiation with the atmosphere and earth surface, platforms and sensors, remote sensing data acquisition, visual image interpretation; digital image processing, Study typical Google street map and Google Earth Map, Applications in Surveying.

Module: 5	Calculation of Area and Volume	5 hours

Area-Computation, measurements from cross section-Volume calculation from spot levels, earth work calculations, practical problems.

Module: 6	Curve Surveying	5 hours

Definitions-Designation of curve, elements of simple curve-Settings of simple circular curve-Compound and reverse curve-Transition curve–Introduction to vertical curve.

Module: 7	**Software Applications in Mapping**	**4 hours**
Preparation of Topographic Map-Contour Map-TIN model and Generation of 3D Surface-Preparation of Longitudinal & cross section of roads using Software–Introduction to GIS.		
Module: 8	**Contemporary issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**
Text Book(s)		
1. S. K. Duggal, Surveying Vol. I & II, 2013, Fourth Edition, Tata McGraw Hill, New Delhi.		
Reference Books		
1. Jerry Nathanson, Michael T. Lanzafama, Philip Kissam, Surveying Fundamentals and Practices, 2016, Seventh Edition, Pearson, UK. 2. Wolf. P. R., Ghilani C. G., Elementary Surveying: An Introduction to Geomatics, 2012, Pearson Prentice Hall, USA.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	2	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	2	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	2	-	-	3	-	-

BCLE204P	SURVEYING LAB	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Nurture students to learn various surveying instruments and its operation.
2. Enable students to learn preparation of maps through the collected survey data.

Course Outcomes

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

1. Analyze field observation data to determine distances, angles, bearings, and coordinates.
2. Develop topographic maps using geospatial tools.
3. Prepare vertical terrain profiles from levelling data using appropriate software tools.

List of Experiments

1.	Design of a parking facility.
2.	Preparation of a residential layout plan.
3.	Indirect way of calculating the distance between lamp posts.
4.	Find the height of the flagpole.
5.	Preparation of a map showing the boundary of a given area.
6.	Find the downward gradient of the underpass and evaluate the safety of the vehicles.
7.	To verify the camber percentage in a given road by performing longitudinal and cross section levelling.
8.	Setting out of a circular curve connecting two railway lines.
9.	Computation of straight-line distance between cell phone towers using GPS data.
10.	Finding the 3-D coordinates of survey points and plotting of contours.

Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	2	-	-	-	2	-	-	1	3	2	-
CO2	3	2	-	-	2	-	-	-	2	-	-	1	3	2	-
CO3	3	2	-	-	2	-	-	-	2	-	-	2	3	2	-

BCLE205L	ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Inculcate the basic principles and concepts to design and develop the unit operations and processes involved in water and wastewater treatment.
2. Develop the skills in evaluating the performance of water and wastewater treatment plants.
3. Provide knowledge on Air and Noise pollution and its effects.

Course Outcomes

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

1. Apply appropriate method to determine water demand and wastewater quantity.
2. Apply the principles of unit operations and processes in the water and wastewater treatment plants.
3. Analyse the sludge treatment and sewage disposal process for an effective wastewater management system.
4. Select suitable method to categorize, segregate, treat, and safe disposal of solid waste.
5. Examine the causes, impacts and control measures of air and noise pollution.

Module: 1	Water and Wastewater Quantity Estimation	5 hours

Available water resources–Water quality deterioration–Water demand for various purposes–Estimation of wastewater quantity–Objectives of water and wastewater treatment–Water quality Index–Environmental policy and legislation.

Module: 2	Water Supply and Sewerage Systems	6 hours

Typical layouts and water distribution–Network–Pipe network analysis–Hydraulics of flow in sanitary sewers–Sewer design–Storm drainage–Storm runoff estimation–Rain Watering.

Module: 3	Water Treatment	8 hours

Unit operations of processes–Sedimentation–Coagulation and flocculation–Filtration-Disinfection and its byproducts-Water Softening-Ion Exchange-Removal of iron and manganese-Fluoridation.

Module: 4	Primary Wastewater Treatment	6 hours

Characteristics of sewage–Quantity and flow variation–Process flow–Screens–Grit chambers–Oil & Grease removal–Primary sedimentation tanks-Operation and maintenance of treatment units.

Module: 5	Secondary Wastewater treatment	8 hours

Selection of Treatment Methods–Principles, Functions–Suspended growth system–Attached growth systems–Hybrid system–Advances in Sewage Treatment Disposal–Sludge Treatment Methods–Dilution–Self-purification of river–Oxygen sag curve–Streeter–Phelps model.

Module: 6	Solid Waste Management	5 hours

Source and types of solid waste-Rate of Generation-Sample Characterisation-Storage-Waste Segregation-Reduction-Reuse-Recycling-Public participation.

Module: 7	Air and Noise Pollution	5 hours

Air Pollution-Health effects-Dispersion-Stacks-Control systems-Concepts of Noise Pollution.

Module: 8	Contemporary Issue	2 hours

Guest lecture from industry and R & D organisations.

Total Lecture hours	45 hours

Text Book(s)

1. Howard Peavy, Donald Rowe, George Tchobanoglous, Environmental Engineering, 2017, First edition, McGraw Hill Education, USA.			
Reference Books			
1. Metcalf and Eddy, Wastewater Engineering, Treatment and reuse, 2017, Fourth edition, Tata McGraw-Hill Edition. 2. Sun Dar Lin, Water and Wastewater Calculations Manual, 2014, Third Edition, McGraw-Hill Education, USA.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	3	-	-	-	-	2	3	-	2
CO2	3	-	-	-	-	-		-	-	-	-	2	3	-	2
CO3	3	2	-	-	-	-	2	-	-	-	-	2	3	-	2
CO4	3	-	-	-	-	-		-	-	-	-	2	3	-	2
CO5	3	-	-	-	-	-	3	-	-	-	-	2	3	-	2

CLE205P	ENVIRONMENTAL ENGINEERING LAB	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. To understand the basic principles of environmental engineering and to introduce the fundamental concepts of environmental pollution and its sources especially to water and wastewater contamination.

Course Outcomes

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

1. Determine physicochemical parameters of water
2. Analyse BOD and COD characteristics of wastewater
3. Measure the level of environmental contamination in air and noise.

Indicative Experiments

1.	Determination of pH and hydrogen ion concentration in a given water sample
2.	Estimation of alkalinity and acidity in a given water sample
3.	Assessment of temporary and permanent hardness in a given water sample
4.	Find out the concentration of chloride and salinity in a given water sample
5.	Determination of turbidity and optimum dosages of various coagulants.
6.	Estimation of dissolved Oxygen and BOD
7.	Determination of solid concentration and correlating specific conductivity and establishing its relationship with TDS.
8.	Determination of COD from given sample
9.	Determination of indoor air and noise pollution measurements.
10.	Advanced instrumentation for water and wastewater analysis

Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	2	-	-	-	-	3	-	2	-	-	2	3	-	2
CO3	3	2	-	-	2	-	3	-	2	-	-	2	3	3	2

BCLE206E	BUILDING PLANNING AND DRAWING	L	T	P	C
		1	0	2	2
Pre-requisite	Engineering Design Visualization Laboratory	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Introduce building drawing using digital tools.
2. Plan and prepare detailed drawing of residential building and Industrial building as per NBC regulations.
3. Understand and create structural detailing drawing for various building components.

Course Outcomes

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

1. Use digital drafting tools for preparing a building drawing in accordance with Indian Standards
2. Apply the building bye-laws and land requirements for various types of buildings in accordance with the National Building Code.
3. Apply planning principles to prepare a plan, elevation and sectional drawing of residential buildings and elements
4. Prepare a plan and sectional drawings for structural components.
5. Draw plan, elevation, and sectional drawings of industrial buildings

Module: 1	**Introduction to Building Drawing**	**1 hour**

Indian Standards for Architectural and Building Drawings–Sizes, Layout and Reproduction of Drawings, Scales for Technical Drawings, Projections, Lettering and Dimensioning, Line types and Graphical Symbols.

Module: 2	**Introduction to Digital Tools**	**1 hour**

Various digital tools-Basic Commands, Drafting and Annotation–Sheets and Layouts–Blocks and customization.

Module: 3	**General Building Requirements & Development Control Rules**	**3 hours**

Various terminologies as per NBC-Classification of Buildings-Principles of planning-Building bye-laws-General building requirements-Requirements of parts of building-Land use classification-Building size limitations-Greenbelts and Landscaping.

Module: 4	**Building Elements**	**2 hours**

Foundations-Plinth beam-Column-Beam-Slab-Roofs-Lintel-Staircase-Doors and windows-Types-Specifications-Standard sizes-Notations.

Module: 5	**Planning and Drawing of Residential Building**	**2 hours**

Plan, Elevation and Sectional Drawings of Load Bearing Structure-Framed Structure-Multi-storey Buildings-Flat & pitched roof buildings.

Module: 6	**Reinforcement Detailing**	**2 hours**

Reinforcement detailing-Beams, slabs, staircase, Column and Foundations joints–Plan and sectional Drawings.

Module: 7	**Planning and Drawing of Industrial Shed**	**2 hours**

Plan, Elevation and Sectional Drawings of industrial shed with trusses.

Module: 8	Contemporary Issues	2 hours
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**15 hours**

Text Book(s)

1. Kumara Swamy N., Kameswara Rao A., Building Planning and Drawing, 2019, Ninth Edition, Charotar Publishing House Pvt. Ltd., Gujarat. .

Reference Books

1. Shah M. G., Kale C. M., Patki S. Y., Building drawing with an integrated approach to Built Environment, 2002, Fourth Edition, Tata McGraw Hill, New Delhi.
2. Gurcharan Singh, Civil Engineering Drawing, 2009, Standard Publishers, New Delhi.
3. BIS SP-7, National Building Code of India, 2016, Govt. of India, New Delhi.
4. IS 962:1989 (Reaffirmed: 2017)–Code of Practice for Architectural and Building Drawings.
5. IS 5525:1969 (Reaffirmed: 2018)–Recommendations for detailing of reinforcement in reinforced concrete works.

List of Experiments

1.	Planning and Preparation of Line Plan Drawing of a Residential Building.
2.	Detailed Plan of Load Bearing Structures.
3.	Detailed Plan of Framed Structures.
4.	Detailed Plan of Sloped Roof Structures.
5.	Detailed Plan of Lean-to-Roof Structures.
6.	Detailed Drawing of Doors and Windows.
7.	Detailed Drawing of Staircase.
8.	Reinforcement Detailing Drawings for Beams, Slabs, and Columns.
9.	Reinforcement Detailing Drawings for Staircase and Foundation.
10.	Planning and Detailed Drawing of Industrial Shed with Roof Truss.

Total Laboratory Hours	**30 Hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	2	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	2	-	-	3	-	-
CO5	3	-	-	-	-	-	-	-	-	2	-	-	3	-	-

BCLE207L	SOIL MECHANICS	L	T	P	C
		3	0	0	3
Pre-requisite	Engineering Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Assess the engineering properties of soils.
2. Understand the concept of compaction and consolidation of soils.
3. Evaluate the stress and strength behaviour of soils for engineering applications.

Course Outcomes

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

1. Identify the suitable index properties for classification of soils according to engineering standards.
2. Determine the compaction characteristics for geotechnical engineering applications.
3. Analyze the effects of soil permeability and stress distribution on effective stress and seepage behaviour.
4. Calculate the consolidation and shear strength parameters for field conditions.
5. Analyse stability of slopes using relevant theories.

Module: 1	**Introduction to Soil Mechanics**	**7 hours**

Introduction-Origin of soils-Basic Relationships-Properties of Soil Aggregate, Soil Structure-Soil Classification (USCS & BIS).

Module: 2	**Soil Compaction**	**4 hours**

Compaction, Laboratory compaction tests & Factors affecting compaction, Field compacting equipment, and compaction control.

Module: 3	**Soil Moisture Relationship**	**7 hours**

Soil-water statics-Capillary action, Concept of effective stress, Flow through soils-Quick sand condition-Permeability and methods for its determination-Flow nets and theirs applications for isotropic soils.

Module: 4	**Stress distribution**	**6 hours**

Boussinesq stress distribution theory, stress due to various types of load, Newmark's influence chart, Approximate methods.

Module: 5	**Compressibility and Consolidation**	**7 hours**

Normally consolidated and over-consolidated soil-Terzaghi's theory of one-dimensional consolidation-Time-rate of consolidation-Evaluation of compressibility and consolidation parameters.

Module: 6	**Shear strength of soil**	**7 hours**

Mohr's stress circle-Mohr-Coulomb failure criterion-Laboratory tests for shear strength determination-Effective and total stress, shear strength parameters-Shear strength characteristics of clays and sands, stress path.

Module: 7	**Stability of slopes**	**5 hours**

Types of slope failures, Finite and infinite slopes-Stability analysis of infinite slopes, Bishop's method Swedish circle method-Taylors stability chart Factor of safety-Mechanism of landslides and its remedial measures.

Module: 8	**Contemporary Issues**	**2 hours**

Guest lecture from industry and R & D organisations.

Total Lecture Hours	**45 hours**

Text Book(s)
1. Braja M. Das, Principles of Geotechnical Engineering, 2014, Eighth Edition, Cengage Learning Pvt. Ltd., New Delhi.
Reference Books
1. Holtz D., Kovacs, W. D., An Introduction to Geotechnical Engineering, 2011, Second Edition, Prentice Hall, USA. 2. Gopal Ranjan, A. S. R. Rao, Basic and Applied Soil Mechanics, 2005, New Age International Publishers, New Delhi.
Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	2	1	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	2	1	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	2	1	-	-	3	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-

BCLE207P	SOIL MECHANICS LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Engineering Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. To conduct laboratory tests on soil to determine various index and engineering properties of the soil.

Course Outcomes

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

1. Determine the various index properties for classification of soil based on Indian Standards
2. Conduct field density tests of soil based on various compaction criteria.
3. Determine the coefficient of permeability and shear strength parameters of soil using standard test methods.

List of Experiments

1.	Determination of Specific Gravity.
2.	Grain size Analysis – Mechanical Method.
3.	Consistency Limits - Liquid Limit, Plastic Limit, and Shrinkage Limit.
4.	Standard Proctor Compaction Test.
5.	Determination of Field Density - Core cutter method and Sand replacement method.
6.	Coefficient of Permeability – Constant head & Falling head method.
7.	Direct Shear Test.
8.	Unconfined Compression Test.
9.	Vane Shear Test.
10.	California Bearing Ratio Test.

Total Laboratory Hours	**30 hours**

Reference

1. Indian Standard (IS): 2720 (Part I) – (Reaffirmed 2006) Method of test for soils.

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	2	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	2	-	-	-	3	-	-

BCLE208L	**STRUCTURAL ANALYSIS**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Pre-requisite	Mechanics of Solids	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Compute the indeterminacies of structures.
2. Evaluate reaction components of structures using different methods and draw SFD, BMD and influence lines.
3. Apply software for indeterminate beams.

Course Outcomes

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

1. Compute the static and kinematic indeterminacies of various structures.
2. Draw SFD and BMD of indeterminate beams and frames using Clapeyron's three moment method
3. Determine deflections and reaction components of continuous beams and portal frames using the strain energy method.
4. Analyse continuous beams and portal frames by applying the slope deflection and moment distribution methods
5. Draw influence line diagrams for rolling loads on beams and determine forces in cables and arches.

Module: 1	**Introduction to Structural Analysis**	**3 hours**

Types of Structures and loads-Static Indeterminacy-Internal and External-Kinematic Indeterminacy-Beams–Determinate and Indeterminate beam-Pin Jointed and Rigid jointed frames.

Module: 2	**Clapeyron's Three Moment Equation Method**	**6 hours**

Analysis of Fixed beam-Propped Cantilever beam and Continuous beam- For different types of loading-Yielding of supports-Sketch Shear force diagram and Bending moment diagram for continuous beams and Rigid Jointed Frames.

Module: 3	**Strain Energy Method**	**8 hours**

Determination of deflection – Castigliano's I Theorem-continuous beams, pin jointed frames and rigid jointed frames-Castigliano's II Theorem to determine the reactions of continuous beams, pin jointed frames and rigid jointed frames.

Module: 4	**Displacement Method-Slope Deflection Method**	**7 hours**

Computation of slope and deflection-Analysis of Continuous beams and portal frames with and without sway-Sketch Shear force diagram and Bending moment diagram for continuous beams and portal frames.

Module: 5	**Displacement Method-Moment Distribution Method**	**7 hours**

Stiffness calculation-Distribution factors-Analysis of continuous beam, portal frames with and without sway- Sketch Shear force diagram and Bending moment diagram for continuous beams and portal frames.

Module: 6	**Rolling Loads and Influence Lines**	**6 hours**

Rolling Loads-Types- Influence line diagram for different loading conditions-Muller Breslau principle, Influence line diagram for Determinate and Indeterminate beams.

Module: 7	Simple Cables and Arches	6 hours
Tension in simple cables-Three hinged arches and two hinged arches–Determination of normal thrust, bending moment and shear force.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**

Text Book(s)

1. C. S. Reddy, Basic Structural Analysis, 2017, Third Edition, Tata Mcgraw Hill Education Private Ltd., New Delhi.

Reference Books

1. Devadas Menon, Structural Analysis, 2017, Second Edition, Alpha Science International Ltd.
2. R. C. Hibbeler, Structural Analysis, 2017, Ninth Edition, Pearson Education, UK.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	-	3	-	-	-	-	-	-	2	1	-	-	3	-	-
CO3	-	3	-	-	-	-	-	-	2	1	-	-	3	-	-
CO4	-	3	-	-	-	-	-	-	2	1	-	-	3	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-	3	-	-

BCLE209L	ENGINEERING GEOLOGY	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Demonstrate the importance of Geology in decision making of Civil Engineering structures and to solve geology related problems on earth.
2. Introduce the basics of engineering properties of earth materials for civil engineering construction.
3. Develop quantitative skills and a frame work for solving engineering geological problems.

Course Outcomes

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

1. Apply concepts of engineering geology, earth's internal structure, and plate tectonics in civil engineering practices
2. Classify rocks, minerals, and soils based on their engineering properties
3. Analyse the causes and impacts of geological hazards and propose suitable remedial measures
4. Illustrate the hydrological cycle, aquifers, and rainwater harvesting techniques for groundwater management.
5. Prepare site investigation reports for construction projects using geological observations and field data.

Module: 1	**Introduction**	**4 hours**

Branches of geology useful to civil engineering–Importance of Engineering Geology in Civil Engineering–Forum of Engineering Geologists and Civil Engineers–History and development of Engineering Geology in India-Earth's interior and propagation of seismic waves-Plate Tectonics

Module: 2	**Minerals and Rocks**	**4 hours**

Origin and characteristics of minerals–Classification of rock forming minerals–Physical properties of minerals–Major rock types and their origin–Classification and engineering usage of igneous, sedimentary and metamorphic rocks.

Module: 3	**Weathering and Soil Formation**	**4 hours**

Weathering of rocks–Types of weathering–Impact of weathering on engineering constructions–Soil origin and formation–Geological processes responsible for soil formation-Classification and its engineering importance–Clay minerals in soils and their engineering significance.

Module: 4	**Rock Structures**	**4 hours**

Strength behaviour of rocks-Stress and Strain in rocks-concept of rock deformation-Dip and Strike-Causes and mechanism of folds, fault and joints –Potential problems from rock structures in engineering constructions.

Module: 5	**Underground Water**	**4 hours**

Hydrological cycle–Source of underground water–Water table–Aquifers–Groundwater movement–Investigation–Geophysical exploration-Artificial recharge of groundwater–Rainwater harvesting.

Module: 6	**Geological Hazards**	**5 hours**
Causes and formation of flood, cyclone, landslides and earthquake–Remedial measures–Geological consideration for dam and reservoir site, tunnels and bridges.		
Module: 7	**Geology Report**	**3 hours**
Preparation of geological map–Contour map–Objective of report–Inputs–Site investigations report.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture hours		**30 hours**
Text Book(s)		
1. Subinoy Gangopadhyay, Engineering Geology, 2013, Oxford University Press, New Delhi.		
Reference Books		
1. Parbin Singh, Engineering & General Geology, 2013, Eighth Edition, S. K. Kataria and Sons, New Delhi. 2. Blyth F. G. H, A Geology for Engineers, 2009, Edward Arnold–London, Cambridge University Press, UK.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		
Recommended by Board of Studies	24.02.2022	
Approved by Academic Council	No. 65	Date 17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	2	-	-	-	2	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	2	-	-	-	2	-	-	3	-	-

BCLE301L	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Construction Materials	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Understand the classification of cement, aggregates, its manufacturing process and testing.
2. Know the various types of materials used to make concrete, their influence on strength and durability properties.
3. Study the proportioning of concrete mix for different grades of concrete and to know the various types of special concretes and their properties.

Course Outcomes

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

1. Classify the properties of cement, aggregates and water as per standards.
2. Demonstrate the fresh and hardened properties of concrete
3. Identify the different processes involved in mixing, handling, placing, compacting, and curing of concrete.
4. Illustrate the durability properties of concrete under various environmental conditions
5. Design concrete mixes as per Indian Standards and assess the significance of special concretes.

Module: 1	**Concrete Ingredients**	**6 hours**

Cement-Classification of cement-Testing of cement-Aggregates-Properties-Testing of aggregates as per Indian Standards-Quality of water.

Module: 2	**Fresh Concrete and Admixtures**	**6 hours**

Workability-Factors affecting workability-Various workability tests-Admixtures-Chemical admixtures-Mineral admixtures.

Module: 3	**Strength of Concrete**	**6 hours**

Mechanical properties of concrete-Compressive, Tensile, Flexural strength-Porosity-Gel/space ratio-Macro and Micro cracking-Aggregate-Cement ratio-Modulus of elasticity of concrete-Fatigue strength-Impact strength-Non-destructive testing methods.

Module: 4	**Various stages of Concrete**	**6 hours**

Mixers-Various types of concrete mixers-Handling-Pumpable concrete-Placing of concrete-Compaction-Curing-Under water concreting-Curing.

Module: 5	**Durability of Concrete**	**6 hours**

Permeability-Sulphate attack-Attack by sea water-Acid attack-Alkali-aggregate reaction-Freezing and thawing-Corrosion of reinforcement-Shrinkage-Plastic shrinkage-Drying shrinkage.

Module: 6	**Mix Design**	**6 hours**

Concrete mix design–Factors to be considered for mix design-Variables in proportioning-Different methods of mix design-Indian Standard Method IS 10262.			
Module: 7	**Special Concrete**		**7 hours**
Polymer concrete composites-Recycled aggregate concrete-Fibre-reinforced concrete-Ferro cement-High performance concrete-Self compacting concrete-Light weight concrete.			
Module: 8	**Contemporary Issues**		**2 hours**
Guest lecture from industry and R & D organisations.			
Total Lecture Hours			**45 hours**
Text Book(s)			
1. Neville A. M., Brooks, J. J., Concrete Technology, 2017, Second Edition, Pearson, London, UK.			
Reference Books			
1. Mehta P. K., Concrete: Microstructure, Properties and Materials, 2014, McGraw-Hill, New Delhi. 2. IS: 10262-2019, Concrete Mix Proportioning – Guidelines (Second Revision), Bureau of Indian Standards, New Delhi.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	2	-	2	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	2	-	2	3	-	-
CO5	3	-	2	-	-	-	-	-	-	2	-	2	3	-	-

BCLE301P	CONCRETE TECHNOLOGY LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Construction Materials	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Test on various properties of cement, fine aggregate and coarse aggregate.
2. Assess the workability of concrete.
3. Determine the various mechanical properties and Non-Destructive testing of concrete.

Course Outcomes

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

1. Determine the material properties of concrete ingredients as per relevant standards.
2. Design the concrete mix and demonstrate the fresh and hardened properties of concrete
3. Assess the quality and strength of concrete using NDT techniques.

List of Experiments

1.	Tests on various properties of Cement.
2.	Tests on various properties of Fine aggregate.
3.	Tests on various properties of Coarse aggregate.
4.	Workability test - Slump Cone test.
5.	Workability tests - Compaction factor test.
6.	Workability tests - Vee-Bee Consistometer.
7.	Compressive strength of concrete, Splitting tensile strength of concrete.
8.	Flexural strength of concrete.
9.	Modulus of elasticity of concrete.
10.	Non-destructive testing–Tests on existing Beam, Column & Slabs.
Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	-	3	-	-
CO2	3	-	2	-	-	-	-	-	2	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	2	-	-	2	3	-	2

BCLE302L	**HYDRAULICS AND HYDRAULIC MACHINES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Pre-requisite	Fluid Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Impart basic knowledge and to expose to basic working principles of hydraulic machineries and to design pumps and turbines
2. Acquire adequate knowledge about various types of forces acting on a dam.
3. Understand the different components of diversion headwork.

Course Outcome

Upon completion of the course students will be able to

1. Determine the performance characteristics of turbines and pumps under varying operating conditions and efficiency parameters.
2. Apply seepage theories and flow net concepts in evaluating failures of diversion headworks.
3. Select suitable hydraulic structures based on site conditions.
4. Apply reservoir storage concepts for site selection and reservoir planning.
5. Analyse forces, failure modes, and stability criteria to design dams and spillways

Module: 1	**Impact of Free Jet on vanes and Hydraulic turbines**	**4 hours**

Principles of Impingement of Jets-Velocity Triangles-Tangential Jet Impingement on a Moving Vane-Mechanisms of Transfer of Energy from Water to a Wheel-Basic Features of Hydraulic Turbines-Similarity Laws and Specific Speed of Turbines

Module: 2	**Reaction Turbines and Impulse Turbines**	**8 hours**

Working Proportions of a Francis Turbine-Cavitation-Draft Tube- Types-Characteristics of Francis Turbines-Governing of Turbines-Propeller Turbine-Kaplan Turbine-Working Proportions of a Kaplan Turbine-Governing of Kaplan Turbines-Performance Characteristics of Kaplan Turbines-Impulse turbine-Components of Pelton Turbine-Governing of Pelton Turbines-Cavitation and Erosion Problems-Selection of Turbine Type-Model Studies of Hydraulic Turbines.

Module: 3	**Characteristics of Pumps**	**8 hours**

Centrifugal Pump-Components-Working ratios of centrifugal pump-Similarity ratios for centrifugal pump-Mixed flow pump–Minimum speed to start the pump-Priming of the pump-Specific speed–Reciprocating pump-Work done-Negative slip-Effect of acceleration of piston on velocity and pressure in the suction and Delivery pipes-Indicator Diagram – Air vessel.		
Module: 4	**Diversion Head works and Theory of Seepage and Design of Weirs**	**6 hours**
Weir and Barrage-Gravity and Non Gravity weirs-Diversion head work components–failure of hydraulic structures–Bligh's creep theory–Lane's weighted creep theory–flow nets–Design of vertical drop weir.		
Module: 5	**Canal falls, Regulators, Modules and Cross Drainage Works**	**5 hours**
Canal Falls-Types of falls-Canal regulations–Canal escape-Types of canal escapes–Requirement of good module-Types of outlets-Non modular outlet-Flexible outlet-Rigid modules-Cross drainage works–Types-Selection of Suitable type of cross drainage work.		
Module: 6	**Types of Reservoir and its various Storage Zones**	**4 hours**
Types of Reservoir-Storage zones of reservoir–Catchment Yield and Reservoir Yield-Reservoir losses–Selection of a suitable reservoir-Economic height of Dam.		
Module: 7	**Dams and Components of Hydroelectric Scheme**	**8 hours**
Types of dams-Selection of the type of dam–Factors governing selection of dam-Construction of Modern Dams–Gravity dam–Forces acting on a gravity dam–Modes of failure and criteria for structural stability–Elementary profile of gravity dam-Design of gravity dam-Earthen dams and rock fill dams–Types-causes of failure-Spillway-Location of spillway-Types of Spillway-Classification of Hydel plants–Principal components of a hydroelectric scheme-Hydropower potentials of India.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture hours		**45 hours**

Text Book(s)

1. Subramanya K "Hydraulic Machinery" 2013, First Edition, Tata McGraw Hill, **New Delhi.**
2. Santosh Kumar Garg (2019), Irrigation Engineering and Hydraulic Structures, Vol. II, Thirty fifth Edition, Khanna Publisher, New Delhi.

Reference Books

1. P. Novak, A.I.B. Moffat and C. Nalluri and R. Narayanan " Hydraulic Structures", 2017, First Edition, Taylor, and Francis, UK.
2. Modi, P. N., and Seth, S. M., "Hydraulics and Fluid Mechanics including Hydraulic Machines", 2017, Twenty First Edition, Standard Book House, New Delhi.
3. Guidelines for Preparing Operation and Maintenance Manual for Dams, Central Water Commission Ministry of Water Resources, River Development & Ganga Rejuvenation Government of India, Dam Safety Rehabilitation Directorate, 2018, New Delhi.

Mode of Evaluation: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-

CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	3	2	-	-	-	-	-	-	-	-	-	3	-	-

BCLE302P	**HYDRAULICS AND HYDRAULIC MACHINES LAB**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite	Fluid Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Provide an exposure in the performance characteristics of different types of pumps
2. Acquire adequate knowledge about the working principle of different types of turbine.
3. Determine the force exerted by the Jet on vanes.

Course Outcome

Upon completion of the course students will be able to

1. Analyze the performance characteristics of different types of pumps
2. Analyze the performance characteristics of different turbines.
3. Determine the force exerted by a jet on vanes

List of Experiments	
1.	Performance characteristics of a Centrifugal pump (Rated Speed).
2.	Characteristics test of a self-priming pump.
3.	Determine the efficiency of a submersible pump.
4.	Characteristics test on gear pump.
5.	Characteristics test of a reciprocating pump.
6.	Load test on Pelton turbine.
7.	Characteristics test on Francis turbine.
8.	Load test on Kaplan turbine
9.	Impact of jet on curved vanes.
10.	Performance test on multistage pump (Parallel and Series connections)
Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	2	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	2	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	2	-	-	-	3	-	-

BCLE303L	**FOUNDATION ENGINEERING**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Pre-requisite	Soil Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Impart knowledge on site investigation and select suitable exploration technique.
2. Select suitable type of foundation and design shallow and deep foundations.
3. Understand earth pressure theories and evaluate lateral earth pressure.

Course Outcomes

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

1. Identify suitable soil exploration techniques and seismic characteristics for engineering applications.
2. Select suitable shallow foundations based on safe bearing capacity and settlement requirements.
3. Compute the load-carrying capacity of single piles and pile groups under given soil conditions.
4. Analyse the stability of well foundations using relevant theories.
5. Apply Rankine and Coulomb earth pressure theories to evaluate lateral earth pressures on retaining walls.

Module: 1	**Subsurface Investigations**	**5 hours**

Drilling of boreholes, sampling-Plate load test-Standard Penetration and Cone Penetration tests-Geophysical tests, Borelogs-Factors to be considered for selection of foundation.

Module: 2	**Seismic considerations for Foundations**	**5 hours**

Seismic site characterisation-Seismic hazards-Dynamic soil properties-Zones and zone factors-Liquefaction-Design seismic force.

Module: 3	**Bearing Capacity of Shallow Foundations**	**6 hours**

Types of foundations-Shallow foundations-Terzaghi and Meyerhoff bearing capacity theory-IS code method-Effect of water table-Isolated footing-Combined footing and Raft foundation.

Module: 4	**Settlement analysis of Shallow Foundations**	**6 hours**

Contact pressure-Settlement analysis in sands and clays-Differential settlement, permissible limits.		
Module: 5	**Pile Foundations**	**7 hours**
Deep foundations-Pile foundations-Dynamic and static formulae, axial load capacity of piles in sand and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction-Construction of pile foundations-Introduction to Piled raft foundation.		
Module: 6	**Well Foundations**	**7 hours**
Methods of construction-Tilt and shift-Remedial measures-Bearing capacity-Settlement and lateral stability of well foundation.		
Module: 7	**Earth Pressure Theories**	**7 hours**
Earth pressure at rest, active and passive earth pressure-Rankine and Coulomb earth pressure theories-Earth pressure due to surcharge-Retaining walls.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**
Text Book(s)		
1. Braja M Das, Principles of Geotechnical Engineering, 2015, Eighth Edition, Cengage Learning India Pvt. Ltd., USA.		
Reference Books		
1. Joseph E Bowls, Foundation Analysis & Design, 2017, Fifth Edition, McGraw Hill Education, New Delhi. 2. Gopal Ranjan, A. S. R. Rao, Basic and Applied Soil Mechanics, 2005, New Age International Publishers, New Delhi.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		
Recommended by Board of Studies	24.02.2022	
Approved by Academic Council	No. 65	Date 17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	2	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	2	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	2	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	2	-	-	-	-	3	-	-
CO5	3	2	-	-	-	-	-	2	-	-	-	-	3	-	-

BCLE304L	DESIGN OF REINFORCED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3
Pre-requisite	Structural Analysis	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Understand the basic concepts of limit state design.
2. Design methodologies by limit state design for the beams, slabs, column, and footings.
3. Design water tank and retaining walls.

Course Outcomes

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

1. Select the suitable methods for the design of reinforced concrete structures.
2. Design RC structural members for flexure, shear and axial loads and illustrate reinforcement details
3. Design the footing and draw the reinforcement details
4. Analyze the stability and stress distribution of walls to design the water tank and retaining wall.
5. Calculate the crack width and deflection of RC members based on serviceability requirements

Module: 1	**Introduction**	**4 hours**

Basic design concept of working stress method-Ultimate load design and limit state design methods for Reinforced Concrete (RC)-Properties of concrete and reinforcing steel-Type of loads on structures and load combinations.

Module: 2	**Limit State Design for Flexure**	**6 hours**

Analysis and design of singly and doubly reinforced rectangular and flanged sections–Behaviour of RC members in shear, bond and anchorage-Behaviour of rectangular RC beams in shear and torsion-Design of RC members for combined bending-Shear and torsion.

Module: 3	**Design of Slabs and Staircase**	**6 hours**

Types of slab-Analysis and design of cantilever slab-Analysis and design of one way simply supported and continuous slabs-Analysis and design of two way simply supported and continuous slabs-Types of staircase-Design of dog-legged staircase.

Module: 4	**Design of RC Columns**	**6 hours**

Classification of columns-Unsupported and effective length of column-Design of short columns under axial compression-Design of pedestals-Design of columns with axial load, uniaxial bending and biaxial bending-Introduction to slender columns.		
Module: 5	**Design of Footings**	**7 hours**
Types of footings-Design of wall footing–Design of axially and eccentrically loaded square, rectangular and sloped footings-Design of combined rectangular footing for two columns.		
Module: 6	**Design of Water Tank and Retaining Wall**	**7 hours**
Classification of water tanks and method of analysis-Permissible stresses, codal provisions-Design of circular and rectangular water tank resting on ground using IS code method-Design of circular and rectangular underground water tank using IS code method. Types of retaining wall-Design of cantilever and counterfort retaining wall.		
Module: 7	**Serviceability Limit States: Deflection and Cracking**	**7 hours**
Serviceability limit states deflection-Deflection limits–Short term deflections-Deflections by elastic theory-Effective flexural rigidity-Long term deflection-Deflection due to differential shrinkage-Deflection due to creep, deflection due to temperature effects, checks on total deflection-Serviceability limit state: Cracking-Cracking in reinforced concrete members, Limits on cracking, factors influencing crack widths-Estimation of flexural crack width, Estimation of crack width under direct and eccentric tension, thermal and shrinkage cracking.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**

Text Book(s)

1. Unnikrishna Pillai S., Devados Menon, Reinforced Concrete Design, 2017, Third Edition, Tata McGraw – Hill, New Delhi.

Reference Books

1. Subramanian N., Design of Reinforced Concrete Structures, 2014, First Edition, Oxford University Press, USA.
2. Varghese P. C., Advanced Reinforced Concrete Design, 2005, Second Edition, Prentice Hall India Learning Private Ltd., New Delhi.
3. IS 456:2000, Indian Standard Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	2	2	1	-	-	3	-	-
CO2	-	-	3	-	-	-	-	2	2	1	-	-	3	-	-
CO3	-	-	3	-	-	-	-	2	2	1	-	-	3	-	-
CO4	-	3	3	-	-	-	-	2	-	-	-	-	3	-	-
CO5	-	3	-	-	-	-	-	2	2	1	-	-	3	-	-

BCLE304P	REINFORCED CONCRETE STRUCTURES LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Structural Analysis	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Investigate the behaviour of reinforced concrete beams and columns.
2. Design of reinforced concrete beams and columns using software.

Course Outcomes

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

1. Design the singly and doubly reinforced concrete beams for various support conditions.
2. Analysis the column behaviour under axial and bending loads using simulation software and standard design procedure.

List of Experiments

1.	Determine the flexural behaviour of singly reinforced beam.
2.	Determine the flexural behaviour of doubly reinforced beam.
3.	Determine the load carrying capacity of reinforced concrete short column under axial loading.
4.	Design the simply supported R.C.C beam using software and validate (i.e. singly reinforced concrete beam) using design sheet.
5.	Design the Fixed RC beam using software and validate (i.e. singly reinforced concrete beam) using design sheet.
6.	Design the simply supported RC beam using software and validate (i.e. doubly reinforced concrete beam) using design sheet.

7.	Design the Fixed R.C.C beam using software and validate (i.e. doubly reinforced concrete beam) using design sheet
8.	Design of axially loaded RC short column using software and validate using design sheet.
9.	Design of axially loaded RC slender column using software and validate using design sheet.
10.	Design of eccentrically loaded RC short column using software and validate using design sheet.

Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	3	-	3	-	-	2	-	2	-	-	-	3	-
CO2	-	3	3	-	3	-	-	2	-	2	-	-	-	3	-

BCLE305L	**TRANSPORTATION ENGINEERING**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**
Pre-requisite	Surveying	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Describe the transportation system.
2. Design the highway geometry and various traffic facilities.
3. Assess the highway pavement materials and design highway pavements.

Course Outcomes

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

1. Apply the knowledge of transportation system elements and perform basic highway project planning.
2. Design highway geometric elements to prepare layouts for traffic facilities.
3. Analyse traffic conditions using collected traffic data to improve traffic facilities.
4. Identify the suitable materials for highway pavement construction.
5. Design highway pavements using standard procedures

Module: 1	**Overview of Transportation System**	**4 hours**

Different modes of transport-Roadway system and classification; public, private, intermediate public transportation, bicycle and pedestrian transport-Urban and inter-urban transportation.

Module: 2	**Transportation System Planning and Highway Development**	**6 hours**

Transport planning process-Evaluation of highway projects-Identifying most suitable highway alignment-Engineering surveys and project preparation. Practice: highway alignment.

Module: 3	**Geometric Design of Highways**	**8 hours**

Need for a good design-Highway cross section elements-Sight distance, design of horizontal alignment-Design of vertical alignment-Practice: Geometric design.		
Module: 4	**Traffic Engineering and Control**	**6 hours**
Traffic Characteristics-Traffic Engineering studies-Traffic flow and capacity-Traffic regulation and control. Practice: fundamental traffic parameters.		
Module: 5	**Design of Traffic Facilities**	**6 hours**
Design of intersections-Design of interchanges-Design of parking facilities-Design of bicycle and pedestrian facilities-Highway lighting-Practice: Design problems.		
Module: 6	**Pavement Materials**	**5 hours**
Materials used in Highway Construction-Soils, aggregates, bituminous material, bituminous paving mixes, Portland cement and cement concrete-Desirable properties, tests, requirements for different types of pavements. Practice: Evaluation of material properties.		
Module: 7	**Pavement Design**	**8 hours**
Introduction-Flexible and rigid pavements-Pavement components and their functions-Parameters for pavement analysis-Analysis of pavement structures-Design of flexible pavements as per IRC-Design of concrete pavements as per IRC-Practice: Design of pavements.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**

Text Book(s)

1. Chakraborty, P, Das, A., Principles of Transportation Engineering, 2017, Second Edition, Prentice Hall India Learning, Pvt. Ltd., New Delhi.

Reference Books

1. Kuhn B. K., Transportation Engineering: A Practical Approach to Highway Design, Traffic Analysis, and Systems Operation, 2019, First Edition, McGraw-Hill Education, USA.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	-	-	-	-	-	3	-	2
CO2	-	3	2	-	-	2	-	2	2	1	-	-	3	-	2
CO3	-	3	-	-	-	2	-	-	2	1	-	-	2	-	3
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	-	2	-	-	3	-	2	2	1	-	-	2	-	3

BCLE306L	WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Fluid Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Acquire the basic knowledge on rainfall analysis, stream flow analysis and flood forecasting techniques.
2. Familiarise the ground water flow characteristics and irrigation practices in India.
3. Attain the knowledge on irrigation canal design and sedimentation process of reservoir.

Course Outcomes

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

1. Apply the concepts of hydrologic cycles and models to estimate the precipitation and water budget.
2. Compute the aquifer parameters for different hydro-geological boundary conditions.
3. Determine the optimum method of irrigation for efficient use of water resources.
4. Design irrigation systems and structures based on soil characteristics and crop water requirements.
5. Analyze reservoir sedimentation and implement appropriate mitigation measures.

Module: 1	Rainfall and Hydrologic Abstractions Measurement	5 hours

Hydrologic cycle and budget-Precipitation variability, rainfall and snow measurement techniques-Design of precipitation gauging network-Hydrologic Abstractions-Infiltration-Evaporation-Evapotranspiration interception and depression storage-Rain harvesting-Design procedure.

Module: 2	Stream Flow and Runoff Analysis	6 hours

Measurement of stream flow-Factors affecting stream flow-Hydrograph analysis, base flow separation, unit hydrograph and curve number methods of stream flow determination, synthetic unit hydrograph-Hydrological modelling for stream flow estimation-Methods for peak discharge estimation.		
Module: 3	**Estimation of Floods and Droughts**	**7 hours**
Design flood estimation-Frequency analysis, design storm, risk, reliability safety factors-Flood routing-Flood migration-Flood damage analysis-Droughts-Definition and Classification-Drought management.		
Module: 4	**Groundwater Hydrology**	**6 hours**
Vertical distribution of groundwater-Aquifer properties-Equation of motion for groundwater flow-Well hydraulics, Open wells-Sea-Water intrusion, Water-quality model analysis.		
Module: 5	**Irrigation Practices**	**6 hours**
Need for Irrigation in India, Scope, National Water Policy, Physical properties of soil that influence soil moisture characteristics–Concept of soil water potential and its components, Crop water requirements-Irrigation Scheduling-Irrigation efficiencies–Duty-Delta-base period-Surface and subsurface methods of Irrigation-Standards for irrigation water quality, water logging and consequences–Salinity and alkalinity Reclamation.		
Module: 6	**Canal Irrigation & Minor Irrigation Structures**	**8 hours**
Classification of canals-Alignment of canals-Design of rigid boundary canals-Lacey's and Tractive force concepts in canal design-Lining of canals-Sediment transport in canals, River training, Lining and maintenance of canals– Surplus weir, Canal Regulator, Tank sluice with tower head and Canal drop.		
Module: 7	**Erosion and Reservoir Sedimentation**	**5 hours**
Erosion process-Estimation of sheet erosion-Channel erosion-Sediment yield from watersheds-Trap efficiency-Distribution of sediment deposits-Reservoir sedimentation control-Erosion and reservoir sedimentation problems in India.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**

Text Books

1. Subramanya. K., Engineering Hydrology, 2020, Fifth Edition, McGraw Hill Education Pvt. Ltd., New Delhi.
2. Santosh Kumar Garg (2019), Irrigation Engineering and Hydraulic Structures, Vol. II, Thirty fifth Edition, Khanna Publisher, New Delhi.

Reference Books

1. Chin, D. A., Water Resources Engineering, 2020, Fourth Edition, Pearson, USA.
2. Mays, L. W. Water Resources Engineering, 2019, Third Edition, John Wiley and Sons, USA.
3. Handbook on Irrigation System Operation Practices, Central Water Commission, 1990.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	2	-	-	-	-	-	3	-	2
CO2	3	2	-	-	-	-	2	-	-	-	-	-	3	-	2

CO3	3	-	-	-	-	-	3	-	-	-	-	-	3	-	2
CO4	3	-	2	-	-	-	2	-	-	-	-	-	3	-	2
CO5	3	2	-	-	-	-	3	-	-	-	-	-	3	-	2

BCLE306P	**WATER RESOURCES ENGINEERING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite	Fluid Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Analyse the reservoir operation losses and rainfall- runoff trends.
2. Analyse the water-quality model.
3. Design Minor irrigation structures.

Course Outcomes

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

1. Determine reservoir losses, runoff characteristics, and flood behaviour using hydrological principles.
2. Compute the Water Quality Index using statistical approach.
3. Design minor irrigation structures based on hydrological conditions

List of Experiments

1.	Reservoir operation losses.
2.	Rainfall runoff modelling.
3.	Flood frequency analysis.
4.	Flood routing model analysis.

5.	Water-quality model analysis.
6.	Design of Surplus weir.
7.	Design of Canal regulator.
8.	Design of Tank sluice with tower head.
9.	Design of Canal Drop.
10.	Design of Culvert.

Total Laboratory Hours	**30 hours**
Mode of Assessment: Continuous Assessment, FAT, Oral Examination.	

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	3	-	-	2	-	-	3	-	2
CO2	3	2	-	-	-	-	3	-	-	2	-	-	3	-	2
CO3	3	2	2	-	-	-	2	-	-	2	-	-	3	-	2

BCLE307L	**CONSTRUCTION PRACTICES AND MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Understand the basic principles and properties of building systems.
2. Familiarize with the general and special construction techniques of structures.
3. Plan and schedule different types of construction projects.

Course Outcomes

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

1. Identify suitable construction practices for various construction activities.
2. Choose appropriate methods and equipment for plain and reinforced cement concrete construction.
3. Apply suitable construction techniques for special construction projects.
4. Develop a Work Breakdown Structure (WBS) for construction project planning by considering management functions and tendering procedures.
5. Prepare construction project schedules by applying network analysis techniques.

Module: 1	**General Construction Practices**	**6 hours**

Site Preparation and Setting Out of works–Earthwork Operation Basics–Earthwork Equipment–Construction of Shallow and Deep Foundations–Masonry–Types & Construction–Flooring–DPC and Waterproofing Techniques.

Module: 2	Concrete Construction	6 hours
Construction Joints–Concrete Temporary works–Formwork and Scaffolding–Type –Special Formwork-Formwork removal–Bending and placing of reinforcement in RCC works–Bar bending schedules–Concreting equipment–In-situ Concreting Process–Plastering and Pointing.		
Module: 3	**Special Construction**	**6 hours**
Diaphragm Wall Construction–Tunnelling–Wood Light-Frame Construction–Structural Steel Construction–Precast Concrete Systems–Modular Construction–Rapid Wall Building Systems.		
Module: 4	**Construction Management Fundamentals**	**6 hours**
Management Functions–Organizational structure–General Tendering & Contracting procedure–Construction Legislation–Arbitration–Workmen Compensation and Minimum Wages Acts–OSHAS Regulations.		
Module: 5	**Construction Planning**	**6 hours**
Time Management Overview–Work Breakdown Structure–Bar Charts–Using Bar Charts for progress Monitoring & Resource usage–Activity duration estimation–Basic Networks: Activity on Arrow (AoA) and Activity on Node (AoN) diagrams.		
Module: 6	**Network Analysis**	**6 hours**
Critical Path Method (CPM)–Floats–Types and Applications–Resource Scheduling using software–Time-Cost Trade-off.		
Module: 7	**Other Scheduling Methods**	**7 hours**
Precedence Diagramming Method (PDM)–Programme Evaluation and Review Technique (PERT)–Linear Scheduling Method (LSM)-International Case Studies of Construction Mega Projects.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**

Text Book(s)

1. Mehta, M. L., Scarborough, W., Armpriest, D., Building Construction: Principles, Materials, and Systems, 2017, Third Edition, Pearson, London.
2. Mubarak, S. Construction Project Scheduling and Control, 2019, Fourth Edition, Wiley, New Jersey, USA.

Reference Books

1. Varghese, P. C. Building Construction, 2016, Second Edition, Prentice Hall India, New Delhi.

Mode of Evaluation: CAT, Assignment, Quiz, FAT

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	2	3	-	2
CO4	3	-	-	-	-	-	-	-	-	-	3	2	3	-	2
CO5	3	-	-	-	-	-	-	-	-	-	3	2	3	-	2

BCLE308L	DESIGN OF STEEL STRUCTURES	L	T	P	C
		3	0	0	3
Pre-requisite	Structural Analysis	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Study the behaviour and design of structural steel connections.
2. Acquire the knowledge on fundamentals of limit state design of structural steel members subjected to compressive, tensile and bending loads.
3. Design the cold formed steel structures and industrial steel structures.

Course Outcomes

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

1. Determine the strength of bolted and welded steel connections.
2. Design an optimal section for tension, compression, and flexural members based on the strength and stability criteria.
3. Determine the cross-section geometry of plate girders and to verify its strength in accordance to standard design specification.
4. Compute the strength of cold-formed steel sections under different modes of buckling.
5. Design the components of industrial structures for various loading conditions.

Module: 1	Properties of Structural Steel and Connections	6 hours

Types of structural steel-Chemical composition of structural steel-Mechanical properties of steel-Type of loads on structures and load combinations-Strengths and serviceability limit states-Type of fasteners-Rivets, bolts, pins and welds-Shear lag-Efficiency of joints-Bolted Connection-Design of Bolted joints for combined Shear and Tension-moment resistant bolted connections-Welded connections–Effective area of welds-Design of fillet and butt welds-axially loaded and moment resistant connections.		
Module: 2	**Design of Tension Members**	**5 hours**
Tension members–Types of tension members and sections-Modes of failure-Net area–Design of tension members–Lug angles–Design of tension splice-Tension rods.		
Module: 3	**Design of Compression Members**	**6 hours**
Buckling classification-Effective length of compression member-Single angle struts-Design of compression members-Design of built up (laced and battened) columns-Design of column bases.		
Module: 4	**Design of Flexural Members**	**6 hours**
Classification of cross sections-Web buckling-Web crippling-Design of laterally supported beams-Design of laterally unsupported beams.		
Module: 5	**Design of Plate Girders and Beam-Columns**	**7 hours**
Plate girders- Design procedure-Web subjected to shear-Transverse web stiffeners-Design of plate girders-General behaviour of beam column-Equivalent moment factor-Interaction equation for local capacity check-Design of beam columns.		
Module: 6	**Design of Cold Formed Steel Structures**	**6 hours**
Introduction-Advantages of cold formed sections-Local buckling-Distortional buckling-Effective width method-Design of compression and tension members-Combined bending and compression. Introduction to direct strength method of design.		
Module: 7	**Design of Industrial Buildings**	**7 hours**
Roof trusses–Roof and side coverings–Design of purlin and elements of truss; end bearing–Selection of gantry girder - Design of gantry girder-Introduction to Pre-Engineered metal building.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**
Text Book(s)		
1. Subramanian N., Design of Steel Structures, 2016, Oxford University Press, New Delhi.		
Reference Books		
1. Duggal S. K., Limit State Design of Steel Structures, 2019, McGraw Hill Education India Pvt. Ltd. 2. Gambhir M. L., Fundamentals of Structural Steel Design, 2013, McGraw Hill Education India Pvt. Ltd. 3. IS 800:2007, Indian Standard Code of Practice for General Construction in Steel, Bureau of Indian Standards, New Delhi. 4. IS 801:1975, Indian Standard Code of Practice for Use of Cold-Formed Light Gauge Steel Structural Members in General Building Construction, Bureau of Indian Standards, New Delhi.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT		
Recommended by Board of Studies	24.02.2022	
Approved by Academic Council	No. 65	Date 17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	-	-	2	2	1	-	-	3	-	-

CO2	-	-	3	-	-	-	-	2	2	1	-	-	3	-	-
CO3	-	-	3	-	-	-	-	2	2	1	-	-	3	-	-
CO4	-	3	-	-	-	-	-	2	2	1	-	-	3	-	-
CO5	-	-	3	-	-	-	-	2	2	1	-	-	3	-	-

BCLE308P	**STEEL STRUCTURES LAB**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite	Structural Analysis	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Determine the tension capacity of bolted and welded connections.
2. Investigate the compression capacity of columns.
3. Examine the flexural capacity of laterally supported beams and laterally un-supported beams.

Course Outcomes

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

1. Investigate the tension capacity of bolted and welded connections for plate elements
2. Determine the load-carrying capacity and behaviour of steel columns and beams
3. Use modern software tools to analyse, and design steel moment-resisting frame structures

List of Experiments

1.	Tensile capacity of sections with bolted connections (Physical Test).
2.	Tensile capacity of sections with welded connections (Physical Test).

3.	Buckling behaviour of hot rolled column (Physical Test).
4.	Buckling behaviour of cold formed column (Physical Test).
5.	Flexural capacity of laterally unsupported beams (Physical Test).
6.	Flexural capacity of laterally supported beams (Software).
7.	Analysis and design of pin-jointed truss (Software).
8.	Design of moment resisting frames (Software).
9.	Design of gantry girders (Software).
10.	Design of plate girders (Software).

Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	3	-	3	-	-	2	-	2	-	3	2	3	2
CO2	-	3	3	-	3	-	-	2	-	2	-	3	2	3	2
CO3	-	3	-	-	3	-	-	2	-	2	-	3	2	3	2

BCLE309L	**ESTIMATING AND COSTING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**
Pre-requisite	Building Planning and Drawing	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Understand the types of estimates.
2. Identify the methods used for quantity estimation of different structural components.
3. Know the rate analysis and process of preparation of bills.

Course Outcomes

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

1. Choose appropriate methods for preparing different types of estimates.
2. Prepare detailed estimates for various types of buildings and roads.
3. Analysis of rates for various item of works in structures.
4. Draft different types of tender and contract documents as per client requirements.
5. Apply appropriate methods of busilding valuation and depreciation in practical scenarios

Module: 1	**Introduction to Method of Estimates**	**3 hours**
General Building Components-Standard units-Basic principles to determine quantity for detailed and abstract Estimates.		
Module: 2	**Quantity Estimation for Buildings**	**6 hours**
Estimation of residential and Industrial buildings-Short wall method and Long wall method-Centre line method-Documentation-Detailed and abstract Estimates.		
Module: 3	**Quantity Estimation for Structural Steel and RCC members**	**5 hours**
Estimation of Structural Steel for Industrial structures and RCC-Slabs-Beams-Columns-Footing for buildings.		
Module: 4	**Quantity Estimation for Roads**	**4 hours**
Earthwork Estimation-Fully in Banking and Cutting-Partly Cutting and Partly Filling-Detailed Estimate and Cost Analysis.		
Module: 5	**Rate Analysis**	**4 hours**
Analysis of Rates for various items of Work-RCC Slabs, Beams, Columns and footings.		
Module: 6	**Tender and Contract**	**3 hours**
Tender Document-Cost and Quality Control-Contracts-Various types of Contracts-Arbitration and Legal Requirements as per Central/State Public Works Department.		
Module: 7	**Valuation**	**3 hours**
Valuation-Capitalized Value-Depreciation-Building Valuation-Mortgage-Lease-Measurement Book-Case Studies.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**30 hours**

Text Book(s)

1. Dutta B. N., Estimating and Costing in Civil Engineering: Theory and Practice, Including Specifications and Valuations, 2020, Twenty Eight Edition, CBS Publishers and Distributors Pvt. Ltd., New Delhi, India.

Reference Books

1. Vazirani V. N., Chandola S. P., Civil Engineering: Estimating, Costing and Valuation (Including Quantity Surveying, Contracting & Account), 2015, Khanna Publishers, New Delhi.
2. Cartlidge D., Quantity Surveyor's Pocket Book, 2017, Third Edition, Routledge, UK.
3. Central Public Works Department (CPWD) Works Manual 2019.
4. Central Public Works Department (CPWD) Plinth Area Rates 2021.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	3	-	3	-	2

CO4	3	-	-	-	-	-	-	-	-	-	3	-	3	-	2
CO5	3	-	-	-	-	-	-	-	-	-	3	-	3	-	2

Discipline Elective

BCLE210L	AI IN CIVIL ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Acquire the concepts of Artificial Neural Network, Fuzzy logic and Genetic algorithms and also their application in civil Engineering.
2. Apply the Internet of Things (IoT) in Civil Engineering.
3. Obtain knowledge on application of machine learning in Civil Engineering.

Course Outcomes

Upon completion of the course students will be able to

1. Demonstrate the evolution of artificial intelligence and its foundational concepts
2. Apply Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms to civil engineering problems
3. Examine the fundamental concepts of machine learning and pattern recognition with emphasis on learning approaches
4. Apply Internet of Things (IoT) concepts in civil engineering systems using appropriate sensing, communication, and data processing techniques
5. Identify appropriate soft computing tools to solve non-linear real-world problems.

Module: 1	Artificial Intelligence (AI)	5 hours

Artificial Intelligence (AI)-Definition-Development of AI-Types of AI-Application of 304of Civil Engineering-Uncertainty and towards Learning Systems-Optimisation –AI techniques.

Module: 2	Artificial Neural network and Application of ANN in Civil Engineering	8 hours

Artificial Neural Networks-Basics of ANN–Topology-Learning Processes-Supervised and unsupervised learning. Least mean square algorithm-Structural properties-Feed forward ANN-Back propagation-Advantages of ANN-Structural Design problems in ANN-Optimisation-ANN in Water Conservation-ANN in Geotechnical Engineering-Prediction of dynamic behaviour of piles.

Module: 3	Fuzzy logic and applications	6 hours

Introduction of Fuzzy logic-Fuzzy sets-Fuzzy relations-Fuzzy rule and decision making-hybrid soft computing–Neuro fuzzy-Application of Fuzzy-Durability of self-Compacting concrete-Reservoir operation-Neuro fuzzy application in pavement and performance.

Module: 4	Genetic Algorithm (GA)	6 hours

Introduction-Biological background-Genetic algorithm (GA) vs traditional algorithm-Basic Terminologies in GA-Advantages and limitations of GA-Applications of GA-water distribution network-Construction Scheduling-Irrigation planning.

Module: 5	Machine learning and its application	6 hours

Introduction–Machine learning (ML) approaches-understanding pattern recognition-Advanced machine learning algorithm-machine learning applications-ML for Remote Sensing Image classification-passenger demand predication.

Module: 6	Internet of Things (IoT)	7 hours

Introduction–Internet of Things (IoT)-IoT Enabling Technologies-Domain Specific IoT-Smart parking-Smart lighting-Smart roads-Structural Health Monitoring-Surveillance-Emergency response-weather monitoring-air pollution monitoring-Noise pollution monitoring-Forest fire detection-River flood detection-Route generation and Scheduling-Smart irrigation.

Module: 7	Soft computing tools and platform	5 hours
Various soft computing tools-Introduction–Neural network tool box-Fuzzy logic network tool box-Genetic algorithm tool box.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture hours		**45 hours**

Text Book(s)

1. Gebrail Bekdaş, Sinan Melih Nigdeli and Melda Yücel, Artificial Intelligence and Machine Learning Applications in Civil, Mechanical, and Industrial Engineering, 2019 IGI, global. Australia.
2. Sivanandam S N and Deepa S N, Principles of Soft computing 2011, Second Edition, Wiley, USA.

Reference Books

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands on approach, 2015, University Press, UK.
2. Stuart J. Russell and Peter Norvig Artificial Intelligence A Modern approach, 2015, Pearson, India.
3. S M Yadav Application of soft computing techniques in Civil Engineering, 2018, MV learning, India.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	2
CO2	3	2	-	-	2	-	-	-	-	2	-	3	3	2	-
CO3	3	2	-	-	2	-	-	-	-	2	-	3	3	2	-
CO4	3	-	-	-	2	-	-	-	-	2	-	3	3	2	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	2

BCLE211L	URBAN PLANNING AND DEVELOPMENT	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Understand the importance of urban planning.
2. Familiarise students with the various steps involved in urban planning.
3. Learn the concepts of smart cities.

Course Outcomes

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

1. Apply concepts of city development planning to design a safe and sustainable urban environment.
2. Select suitable survey techniques and mapping methods for regional planning
3. Analyze suitable infrastructure development and management strategies.
4. Apply the principles of sustainable urban development and intelligent transport systems through the conservation of resources.
5. Exhibit smart city concepts and their implementation through digital tools and technologies.

Module: 1	**Introduction**	**5 hours**

Antiquity and origins of regional and urban growth–Characteristics, ideas and intentions of development planning–Differences in planned and unplanned urbanization–Primitive and revamping Towns into cities.

Module: 2	**Basic Methods of Planning**	**7 hours**

Objectives of planning–Classification of planning–Simple and Complex–Regional planning-Surveying techniques–Preparation of master plan and detailed development plan-Demographic methods for population statistics-Ebenezer Howard's Three magnets diagram and Social city.

Module: 3	**Infrastructure Development**	**8 hours**

Regional policies- Codes of practice in urban development, City and Town Planning Act-Housing development-Industrialization-National vision–Government projects on Housing schemes-Benefits of low income group and disabled people-National and regional significance-Urban development corporations–Urban design principles-Resurrecting manufacturing cities.

Module: 4	**Environmental Conservation and Management**	**8 hours**

Water supply-Sanitation–Storm water drainage–Solid waste management–Recycling–Renewable energy–Conservation of natural resources-Public awareness-Upgrade the environment-Recreation, Parks and Arts–Green corridors–Green building–Introduction to landscape architecture-Safety and security.

Module: 5	**Integrating Transport System**	**6 hours**

Public transport–Bridges and flyovers–Metro Traffic congestion–Solar and Electric vehicles-Cycling and walking provision–Non motorised transport (NMT)-Transportation Planning structure-Integrated Public Transport.

Module: 6	**Public Health**	**4 hours**

Healthy city–Physical and mental health challenges in urban and sub-urban areas-Quality of water and Air–Pollution–Necessary amenities during pandemic disaster environment in India.

Module: 7	**Smart Cities and Technology**	**5 hours**

Smart city developments in India and other countries–Specific priorities for smart cities-Remote sensing–GIS and GPS in urban planning-Leveraging recent technologies in enhancing urbiculture-Internet of Things (IOT).

Module: 8	**Contemporary Issues**	**2 hours**

Guest lecture from industry and R & D organisations.			
Total Lecture hours			**45 hours**
Text Book			
1. Peter Hall, Mark Tewdwr-Jones, Urban and Regional Planning, 2019, Sixth Edition, Taylor & Francis, New York, USA.			
Reference Books			
1. Richard D Knowles, Celine Rozenblat (Eds.), Sir Peter Hall: Pioneer in Regional Planning Transport and Urban Geography, 2016, First Edition, Springer Briefs on Pioneers in Science and Practice Series, Springer Publisher, Switzerland. 2. Yonn Dierwechter, Urban sustainability through smart growth: Intercurrence, Planning, and Geographies of Regional Development across Greater Seattle, 2017, First Edition, The Urban Book Series, Springer Publisher, Switzerland.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	-	-	-	-	-	3	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	2
CO3	3	2	-	-	-	2	1	-	-	-	-	-	3	-	2
CO4	3	-	-	-	-	3	2	-	-	-	-	-	3	-	2
CO5	3	-	-	-	-	2	1	-	-	-	-	-	3	-	2

BCLE212L	NATURAL DISASTER MITIGATION AND MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to :

1. Provide adequate knowledge about disaster mitigation, preparedness, response, and recovery to face disaster among government bodies, institutions, NGO's, etc.
2. Obtain the knowledge different disaster and its preparedness and mitigation methods.
3. Provide adequate knowledge about applications of space technology in disaster monitoring and information dissemination.

Course Outcomes

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

1. Identify basic safety precautions for disaster preparedness, response, and mitigation.
2. Analyze appropriate mitigation and preparedness strategies to minimize the impacts of various natural disasters.
3. Apply disaster management protocols to ensure quick and effective response during emergencies.
4. Assess the effectiveness of space and communication technologies in disaster monitoring and early warning systems.
5. Examine the current affairs on disaster management and resilience to disasters

Module: 1	Introduction to Disasters	7 hours

Natural Disasters Principles, Elements, Important Community needs-Hyogo Framework for Action (HFA)–Sendai Framework for Disaster Risk Reduction-Disaster Management System-Hazard, Vulnerability and Risk–History of Disaster Management in India-Disaster Management Act-Disaster Management Structure in India-Nodal Agencies for Disaster Management in India-Disaster Types.

Module: 2	Water and Climate Related Disasters	6 hours

Floods, Cyclones-Tornadoes and Hurricanes, Hailstorm, Cloud Burst, Heat Wave and Cold Wave, Snow Avalanches, Droughts, Famine, Sea Erosion, Thunder and Lighting – Definition, Cause, Types, Safety Precautions.

Module: 3	Geology Related Disasters	5 hours

Landslides and Mudflows, Earthquakes, Dam Failures / Dam Bursts, Mine Fires, Tsunami–Definition, Cause, Types, Safety Precautions.

Module: 4	Chemical, Nuclear and Biological Related Disasters	5 hours

Chemical and Industrial Disasters, Nuclear Disasters, Biological Disaster and Epidemics, Pest Attacks, Cattle Epidemics, Food Poisoning-Definition, Cause, Types, Safety Precautions.

Module: 5	Accident-Related Disasters	6 hours

Forest Fires, Urban Fires, Mine Flooding, Oil Spill, Major Building Collapse, Serial Bomb Blasts, Festival Disasters and Fires, Electrical Disasters and Fires, Air, Road and Rail Accidents, Boat Capsizing, Village Fire-Definition, Cause, Types, Safety Precautions.

Module: 6	Mapping and Monitoring	7 hours

Modelling, risk analysis and loss estimation–Natural disaster risk Reduction Strategies-Prevention and mitigation-Applications of Space Technology (Satellite Communications, GPS, GIS and Remote Sensing and Information / Communication Technologies (ICT) in Early warning Systems-Disaster Monitoring and Support Centre–Information Dissemination–Mobile Communications-Social Media etc through case studies.

Module: 7	Community Based Disaster Risk Reduction	7 hours
Psychological effects after disasters-Socio Psycho care-Managing stress–Education and Training–Establishment of capacity building among various stake holders–Government, Educational institutions, Civil Society–Use of Multi-media knowledge products for self-education.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**

Text Book(s)

1. Bhandari, R.K, Disaster Education and Management, A Joyride for Students, Teachers and Disaster Managers, 2014, Springer, India.
2. Ranke, Ulrich, Natural Disaster Risk Management-Geosciences and Social Responsibility, 2016, First Edition, Springer International Publishing.

Reference Books

1. Brian Tomaszewski, Geographic Information Systems (GIS) for Disaster Management, 2014, CRC Press, UK.
2. Harsh K. Gupta, Disaster Management, 2006, Second Edition, Indian National Science Academy.
3. Dhawan, Disaster Management and Preparedness, 2012, First Edition, CBS Publisher Pvt. Ltd.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	-	3	-	2
CO2	3	-	-	-	-	1	-	-	-	2	-	-	3	-	2
CO3	3	-	-	-	-	2	-	-	-	2	-	-	3	-	2
CO4	3	-	-	-	-	2	-	-	-	2	-	-	3	-	2
CO5	3	-	-	-	-	2	-	-	-	2	-	-	3	-	2

BCLE213E	REMOTE SENSING AND GIS	L	T	P	C
		2	0	2	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

The objectives of this course is to

1. Acquire the basic concepts of Geo-graphical Information Systems (GIS).
2. Understand the physical principles of Remote Sensing and Photogrammetry
3. Comprehend the various applications of Remote Sensing and GIS applications in the Engineering domain

Course Outcomes

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

1. Apply the concepts of EMR and sensor characteristics in resource management applications.
2. Analyze spatial data collection, conversion, and metadata creation to ensure quality for spatial analysis.
3. Solve spatial problems with buffer, overlay, proximity and network analyses functions
4. Determine object heights from aerial photographs to support image interpretation.
5. Apply geospatial techniques to address real world engineering problems

Module: 1	Basic Concepts of Remote Sensing	4 hours

Physics of Remote Sensing-Electromagnetic Radiation-Spectral reflectance of Earth's surface features-Multi concept of Remote Sensing.

Module: 2	Platforms and Sensors	4 hours

Types of platforms and spacecraft for data acquisition-IRS Satellite Sensors, LANDSAT, SPOT, IKONOS, Quickbird, Worldview II & III, etc. Resolutions-Spatial, spectral, radiometric and temporal.

Module: 3	Basic Principles of Photogrammetry	4 hours

Basic Geometric Characteristics of Aerial Photographs-Photographic Scale-Relief displacement-Tilted and oblique photographs-Flight Planning-Interpretation keys-Stereoscopy-Stereoscopes, stereoscopic view, parallax measurement and-measurement of heights.

Module: 4	Basic concepts of GIS	4 hours

Map and Mapping concepts, Geography and Geographic data-Introduction to GIS-History of the development of GIS-Definition-Projections and coordinate systems.

Module: 5	Fundamental Techniques	4 hours

Information Systems-GIS software-Modeling Real World Features-Data and Data models-Spatial and Non-spatial, Components, Data collection-Data Conversion, Metadata.

Module: 6	Spatial Analysis	4 hours

Data storage and Database Management systems-Proximity Analysis-Overlay Analysis-Buffer Analysis-Network Analysis-Digital Elevation Models.

Module: 7	Applications of Remote Sensing and GIS	4 hours

Applications of Remote sensing and GIS in various Engineering and Science fields/projects such as Integrating BIM and GIS for Visual Monitoring of Construction, Agriculture, Forest, Soil, Geology, LU/LC, Water Resources, Urban planning, etc.

Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**30 hours**

Text Book(s)

1. Lillesand T. M, Kiefer R. W., Remote Sensing and Image Interpretation, 2015, Seventh Edition, John Wiley and Sons, USA.
2. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, Geographic Information Science and Systems, 2015, Fourth Edition, John Wiley & Sons, USA

Reference Books

1. Rees, W. G., Physical principles of Remote Sensing, 2012, Cambridge University Press, UK.
2. James B. Campbell & Randolph H. Wynne., Introduction to Remote Sensing, 2011, The Guilford Press.
3. Peter A. Burrough, Rachael McDonnell, Rachael A. McDonnell, Christopher D. Lloyd., Principles of Geographic Information Systems, 2015, Oxford University Press.
4. Kang Tsung Chang, Introduction to Geographic Information Systems, 2019, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

List of Experiments

1.	Georeferencing and projection (Image to Image, Image to Map).
2.	DEM Generation.
3.	Image Subset / Clipping.
4.	Digitization, Attribute assigning, Raster to Vector formats.
5.	Map Generation with Patterns and Legends.
6.	Spatial Analysis – Overlay, Buffer.
7.	Mapping of Land use and land cover.
8.	Extraction of Topographic parameters (Slope, aspects, drainage etc.).
9.	Image Classification from satellite data sets.
10.	Network Analysis.

Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment, FAT, Oral Examination.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	2	-	-	3	-	-	-	-	2	-	2	2	2	-
CO3	2	2	-	-	3	-	-	-	-	2	-	2	-	3	-

CO4	3	2	-	-	3	-	-	-	-	2	-	2	3	3	-
CO5	3	-	-	-	3	-	-	-	-	2	-	2	2	2	3

BCLE310L	**ENVIRONMENTAL IMPACT ASSESSMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Pre-requisite	Environmental Engineering	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Understand the basic concepts and methods of EIA.
2. Know the impacts occurred to physical, biological and socioeconomic environment.
3. Draft an EIA for specific projects and understanding the mitigation and monitoring methods.

Course Outcomes

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

1. Apply EIA principles and public participation mechanisms to evaluate environmental projects.
2. Identify suitable screening, scoping, and EIA methodologies for environmental impact assessment.
3. Use appropriate assessment methods to evaluate physical environmental impacts.
4. Assess ecological and biological impacts to recommend appropriate conservation and mitigation measures.
5. Assess socioeconomic, health, traffic, and aesthetic impacts using SEIA frameworks.

Module: 1	**Conceptual Facets of EIA**	**5 hours**

Definitions and Concepts–Historical Development of EIA–Types of EIA–Grouping of Environmental Impacts–EIA Principles and Process–Environmental Impact Statement–Environmental Due Diligence.

Module: 2	**Environmental Legislation**	**5 hours**

Criteria and Standards for Assessing Significant Impact–Enforcements of Environmental Acts, Rules and Regulations–Risk Assessment–Public Participation and Involvement.

Module: 3	**Baseline Data and Environmental Setting**	**5 hours**

Conceptual approach for planning and conducting environmental impact studies–Creation of EIA database–EIA data products–Environmental setting–Environmental baseline monitoring and data generation–Land use studies.

Module: 4	**Impact Identification Methods**	**9 hours**

Criteria for the Selection of EIA Methodology–Screening–Initial Environmental Evaluation–Scoping–EIA Methods–Interaction matrix methods-Simple matrices, stepped matrices-Checklist method-Simple checklist, descriptive checklist, threshold checklist, scaling checklist-Predictive Models for Impact Assessment–Mitigation, Monitoring, Auditing, Evaluation of Alternatives and Decision Making.

Module: 5	**Assessment of Impacts on Physical Environment**	**7 hours**

Air–Generalised approach-Noise measurement-Systematic methodology for assessment of noise-Water-Developmental activities on surface and ground water-Quantity and quality impacts-Soil-Methodology for assessment of impacts on soil and Land Environments-Delineation-Land use impact.

Module: 6	**Assessment of Impacts on Biological Environment**	**6 hours**

Biological Environment–Terrestrial species-Habitats and communities-Evaluation of biological impacts-Biodiversity-Wetland Ecosystem–Biological Impact Assessment System–Impacts on vegetation and wild life-Conservation of Flora and Fauna.

Module: 7	**Assessment of Impacts on Socio-economic Environment**	**6 hours**

Valued Socioeconomic Components–Framework for SEIA-Study area lineation-Identification-Description-Procurement of Guidelines-Impact prediction-Socioeconomic Factors–Model for Socioeconomic Impact Assessment–Steps of SEIA–Traffic and Transportation Impacts–Health Impacts Assessment–Aesthetics and Liveability.			
Module: 8	**Contemporary Issues**		**2 hours**
Guest lecture from industry and R & D organisations.			
Total Lecture Hours			**45 hours**
Text Book(s)			
1. Anji Reddy Mareddy, Environmental Impact Assessment–Theory and Practice, 2017, Butterworth-Heinemann Publications, USA.			
Reference Books			
1. Larry W. Canter, Environmental Impact Assessment, 1996, Second Edition, McGraw-Hill, Inc., USA. 2. Judith Petts, Handbook of Environmental Impact Assessment – Vol. I & II, 1999, Blackwell Science Ltd., USA.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	3	-	-	2	-	-	2	-	3
CO2	3	2	-	-	-	-	3	-	-	2	-	-	2	-	3
CO3	3	2	-	-	-	-	3	-	-	2	-	-	2	-	3
CO4	3	-	-	-	-	-	3	-	-	1	-	-	2	-	3
CO5	3	-	-	-	-	-	3	-	-	1	-	-	2	-	3

BCLE311L	INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	Environmental Engineering	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Identify the fundamental physical, chemical characteristics of each target pollutant.
2. Analyse the mechanism by which the pollutant is held in solution or suspension by the waste stream.
3. Determine an efficient method by which the target pollutant can be removed from the waste stream.

Course Outcomes

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

1. Use suitable sampling techniques and characterization of industrial wastes for treatment process.
2. Calculate the required capacity of physical, chemical, and biological treatment units.
3. Suggest suitable stormwater management methods to prevent groundwater contamination.
4. Select appropriate techniques used for air pollution control in various industries.
5. Choose suitable industrial solid waste treatment methods for practical applications.

Module: 1	**Evaluation and Selection of IWT Systems**	**4 hours**

Treatment Evaluation Process–Various methods for industrial wastewater–Air emissions and solid wastes.

Module: 2	**Waste Sampling and Characterization**	**5 hours**

Sampling Equipment and Preservation–Procedures and Techniques–Waste audit–Environmental audit–Wastewater Survey–Characterization–Toxicity characterization–Discharges to the air–Sampling techniques–Solid Waste.

Module: 3	**Wastewater Treatment Methods**	**6 hours**

Flow and load equalization–Solids separation and handling-Gravity Separation–Filtration–Solids Conditioning–Thickening and Dewatering– Dewatering aids-application of AOP in sludge treatment-Aerobic and Anaerobic Biological Treatment–Drying and Safe Disposal.

Module: 4	**Removal of Organic Constituents**	**7 hours**

Biological treatment–Aerobic – Anaerobic process- Nutrient removal–Chemical precipitation–Advanced Oxidation Process (AOP)–UV Enhanced Oxidation–Sonication–Wet Air Oxidation-Case studies.

Module: 5	**Industrial Storm Water Management**	**9 hours**

Storm Water Pollution Prevention Plan (SWPPP)-Preparation and implementation-Best Management Practice (BMP)-Pollutants in Structured and Non-Structured BMP, Housekeeping, salt storage, erosion prevention, spill prevention-Inspection-Frequency of inspection-Documentation-SWPP checklist and template-Prevention of groundwater contamination–Storm water collection and retention–Treatment–Recycle and Storage-Special case studies on mercury container and oil spills..

Module: 6	**Treatment of Air Pollution from Industries**	**5 hours**

Air pollution–Control–Laws–Discharges–Sample Collection–Containment–Analysis–Treatment–Systems for Control of Gaseous Pollutants.

Module: 7	**Solid Waste Treatment and Disposal**	**7 hours**

Categories–Characterization–Collection, Separation, Treatment, Transport and Disposal-Solid waste secured landfill (SLF)-Recycle/Recovery of products from Industry wastes-Suitability–Incineration–Fluidized Bed–Rotary kiln–Composting and Vermi composting of Industrial Wastes–Various Technologies.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**
Text Book(s)		
1. Nelson, L. Nemerow, Liquid Waste of Industry, Theories, Practices and Treatment, 2008, Addison Wesley Publishing Company, London.		
Reference Books		
1. Industrial Wastewater Management, Treatment and Disposal, Water Environment Federation (WEF) Manual of Practice, 2008, Third Edition, WEF Press, USA. 2. Vivek V. R., Vinay M. B, Industrial Wastewater Treatment, Recycling, and Reuse, First Edition, 2014, Butterworth-Heinemann, USA. 3. Woodard, Curran, Industrial Waste Treatment Handbook, 2006, Second Edition, Butterworth and Heinemann, USA. 4. Guidance manual for developing Best Management Practices, 1993, USEPA.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		
Recommended by Board of Studies	24.02.2022	
Approved by Academic Council	No. 65	Date 17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	2	-	-	2	-	2	3	-	-
CO2	3	-	-	-	-	1	2	-	-	2	-	2	3	-	-
CO3	3	-	-	-	-	2	3	-	-	2	-	2	-	-	3
CO4	3	-	-	-	-	2	3	-	-	1	-	1	-	-	3
CO5	3	-	-	-	-	2	3	-	-	1	-	1	-	-	3

BCLE312L	AIR AND NOISE POLLUTION CONTROL	L	T	P	C
		3	0	0	3
Pre-requisite	Environmental Engineering	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Explore the aspects and impacts of atmospheric pollution on human and environment.
2. Understand the sources, effects and measurement methods of air and noise pollution.
3. Identify, formulate and solve air and noise pollution problems.

Course Outcomes

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

1. Identify the sources, effects, and legislative measures related to air pollution.
2. Apply air quality and emissions assessment methods to measure pollution levels.
3. Interpret the principles of air pollutant dispersion, kinetics, and removal mechanisms for air pollution modelling and prediction.
4. Suggest air quality criteria, standards, indoor air pollutants, and control measures for maintaining indoor air quality.
5. Identify noise pollution sources and impacts to suggest suitable mitigation measures.

Module: 1	**Science of Air Pollution**	**5 hours**

The State of the Atmosphere–Scale and Complexity of Air Pollution–Biogeochemistry of Air Pollutants–Risks of Air Pollution.

Module: 2	**Air Quality Monitoring**	**6 hours**

Air Pollutant Emissions–Source Sampling and Emissions Measurement–Methods for measuring Air Pollutants–Gaseous pollutants (CO, Ozone, NO_2, SO_2, VOC)-Particulate matters ($PM_{2.5}$, PM_{10}) and odour-Applying and Interpreting Air Quality Monitoring Data.

Module: 3	**Meteorological Bases of Atmospheric Pollution**	**7 hours**

Basic concepts-Effects-Turbidity-Precipitation-Fog-Solar Radiation-Removal mechanism-Sedimentation, reaction, dry deposition, wet deposition, Air Pollutant Kinetics-Equilibrium and Transformation–Transport and Dispersion of Air Pollutants–Air Pollution Modelling and Prediction–Exposure and Dose Models.

Module: 4	**Air Pollution Control Technologies**	**7 hours**

Air Quality Criteria and Standards–Engineering Control Concepts–Air ventilation and circulation-Fans-Hood and Duck-Gravitational collectors-Absorption-Elements of Regulatory and Non-regulatory Control–Pollutant Specific Control Devices, Technologies and Systems–Green Principles and Air Quality.

Module: 5	**Indoor Air Quality**	**6 hours**

Indoor Air Quality Concerns–Major Indoor Pollutants–Factors affecting indoor air quality-Effects of indoor air pollutants–Measurement of Indoor Contaminants–Prevention and control Measures.

Module: 6	**Basics of Noise Pollution**	**6 hours**

Sound and Noise–Sources of Noise Pollution–Effects of Noise Pollution to Human Health & Welfare and Wildlife–Fundamentals of Sound Generation, Propagation and Measurement–Noise Standards and Regulations.

Module: 7	Noise Control and Management	6 hours
Physics of sound-Indoor and outdoor sound-Noise Prevention and Mitigation Measures–Noise Reduction-Absorptive materials, non-acoustical parameters of absorptive materials, coefficients of absorption-Noise Pollution Control and Management for Community and Industrial Noise.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**

Text Book(s)

1. Daniel Vallero, Fundamentals of Air Pollution, 2014, Fifth Edition, Elsevier's Science & Technology, Academic Press, USA.
2. Enda Murphy, Eoin A. King, Environmental Noise Pollution: Noise Mapping, Public Health, and Policy, 2014, First Edition, Elsevier's Science & Technology, USA.

Reference Books

1. Wayne T. Davis, Joshua S. Fu, Thad Godish, Air Quality, 2021, Sixth Edition, CRC Press, USA.
2. Malcolm J. Crocker, Handbook of Noise and Vibration Control, 2007, John Willey and Sons Inc., USA.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	-	-	2	-	2	2	-	3
CO2	3	2	-	-	-	-	2	-	-	2	-	1	3	-	2
CO3	3	2	-	-	-	-	3	-	-	-	-	-	2	-	2
CO4	3	1	-	-	-	-	2	-	-	2	-	1	3	-	2
CO5	3	1	-	-	-	-	3	-	-	2	-	2	2	-	3

BCLE313L	SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	Environmental Engineering	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Acquire knowledge on collection, separation, transportation and disposal of Solid Waste.
2. Approach the recovery process in cost effective manner.
3. Integrate the concepts of circular economy into Solid Waste Management.

Course Outcomes

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

1. Identify the sources, types, and characteristics of solid and hazardous wastes and their impacts on human health and the environment.
2. Use appropriate collection and transport methods for solid and hazardous wastes.
3. Classify different types of waste based on their characteristics for safe disposal.
4. Apply safe biomedical waste management practices for sustainable waste processing and resource recovery systems
5. Use circular economy concepts for resource recovery and sustainable solid waste management

Module: 1	**Sources and types of Solid Waste**	**6 hours**

Importance of Solid Waste Management-source-types-composition of solid waste-Quantities and composition of solid waste-Physical, Chemical and Biological characteristics of Solid Waste -Factors affecting solid waste generation.

Module: 2	**Storage and collection of Solid Waste**	**6 hours**

Relevant methods of storage-collection methods-tools and equipment-Collection from high and low rise apartments-routes-Handling and separation of solid waste-transportation system-organization chart for solid waste management system for particular village/town/city based on population-case studies.

Module: 3	**Disposal of Solid Waste**	**7 hours**

Composting-principles of composting-factors affecting composting process-methods of composting-Landfilling-methods-Leachate and its control-biogas generation-co-processing of solid waste-Incineration-products of incineration-Heat value of refuse-Energy production from waste.

Module: 4	**Hazardous Waste**	**6 hours**

Definition-classification of hazardous waste-source and generation-Household hazardous waste, Hazardous waste from urban and rural area-storage of hazardous waste-Transport and safe disposal methods-stabilization, solidification-Incineration and landfill.

Module: 5	**Resource Recovery**	**7 hours**

Engineered system for Solid Waste Management-Reuse-Recycle-Resource recovery-Hand sorting, screens, inclined and shaking tables, magnetic separation-shredding-pulping-crushing-cost effective approach–Biogas production, volatile fatty acids, alcohols and other value added products, Reject technologies–Low carbon technology.

Module: 6	**Health aspects and Hospital Waste Management**	**7 hours**

Impact solid waste during collection and separation-need of public participation-Categories and classification of biomedical waste–Need for disposal, waste segregation, labelling, handling and disposal of biomedical waste–Mercury in biomedical waste-Radioactive waste-Thermal treatment technologies–Alternative treatment technologies–Secured landfill–Pandemic effects on waste management.		
Module: 7	**Circular Economy**	**4 hours**
Introduction to the Circular Economy-Transition from Linear to Circular Economy-Sustainable Development Goals.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**

Text Book(s)

1. George Tchobanoglous and Hillary theisen, Samuel Vigil, Integrated solid waste management-Engineering Principles and Management, 1993, Mc Graw Hill, USA.

Reference Books

1. Ana Pires, Graça Martinho, Susana Rodrigues, Sustainable Solid Waste Collection and Management, 2019, Springer Publisher.
2. Salah M. El-Haggar, Sustainable Industrial Design and Waste Management Cradle-to-cradle for Sustainable Development, 2007, Elsevier Academic Press, USA.
3. Mohammad Taherzadeh, Kim Bolton, Jonathan Wong, Ashok Pandey, Sustainable Resource Recovery and Zero Waste Approaches, 2019, Elsevier Academic Press, USA.

Mode of Evaluation: CAT, Assignment, Quiz, FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	2	-	-	2	-	2	3	-	-
CO2	3	-	-	-	-	-	2	-	-	2	-	2	3	-	-
CO3	3	-	-	-	-	-	3	-	-	2	-	2	3	-	-
CO4	3	-	-	-	-	-	3	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	2	-	-	2	2	2	3	-	2

BCLE314L	GEOTECHNICAL EARTHQUAKE ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Soil Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Inculcate the fundamentals of behaviour of soil under earthquake loading.
2. Evaluate seismic hazard and liquefaction potential of site.
3. Determine the dynamic properties of the soil.

Course Outcomes

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

1. Apply the principles of earthquake occurrence to classify regions into seismic zones based on their seismic risk.
2. Determine the seismic hazard of a given site based on strong ground motion parameters.
3. Illustrate the behaviour of soil under dynamic loading conditions.
4. Calculate the effects of local soil conditions on seismic ground motion
5. Analyze liquefaction potential for structural safety and selecting suitable ground improvement techniques.

Module: 1	Engineering Seismology	6 hours

Seismic hazards-Seismology and Earthquakes-Internal structure of earth-Seismic waves-Plate tectonics-Faults-Elastic rebound theory-Location and size of earthquakes-Nature and types of earthquake loading-Seismic zones of India, Major earthquakes.

Module: 2	Strong Ground Motion	5 hours

Strong motion measurement–Seismographs–Data acquisition–Strong motion instrument arrays, Ground motion parameters-Amplitude-Peak acceleration, velocity and displacement-Frequency Content-Fourier and Power spectra-Duration, Estimation of ground motion parameters- Magnitude and distance effects-Development of Attenuation relationships-Spatial Variability of ground motions.

Module: 3	Seismic Hazard Analysis	6 hours

Identification and evaluation of earthquake sources–Geologic evidence–Fault activity-Magnitude indicators-Tectonic evidence-Historic seismicity, Instrumental seismicity, Deterministic Seismic Hazard Analysis (DSHA)-Location of sources-Epicentral and hypocentral distance-Controlling earthquake-hazard at site, Probabilistic Seismic hazard analysis (PSHA)–Spatial and size uncertainty-Recurrence relationship.

Module: 4	Dynamic Properties of Soil	7 hours

Dynamic soil properties-Factors affecting dynamic soil properties-Lab tests: Cyclic triaxial / simple shear / Torsional shear tests. Field tests: Block vibration test, Cyclic Plate load test-Geophysical Tests–Multichannel Analysis of Surface Waves (MASW) test-Seismic cross hole test.		
Module: 5	**Ground Response analysis and Local Site Effects**	**6 hours**
One dimensional ground response analysis–Linear-Evaluation of transfer function-Uniform undamped soil on rigid rock, Equivalent linear approximation of nonlinear response-Site classifications-Effects of local soil conditions on ground motion–Evidence from measured amplification functions and surface motions-Effects of topography-Design parameters and their development.		
Module: 6	**Liquefaction**	**7 hours**
Flow liquefaction and cyclic mobility-Liquefaction Susceptibility–historical, geological, compositional and state criteria, Initiation of Liquefaction-Evaluation of liquefaction potential-Cyclic stress approach-Characterization of earthquake loading-Characterization of liquefaction resistance from Standard Penetration Test (SPT)-Correction factors, Simplified procedure as per IS1893- Effects of liquefaction.		
Module: 7	**Soil Improvement**	**6 hours**
Soil improvement for remediation of seismic hazards-Densification techniques-Vibroflotation, dynamic compaction-blasting, Reinforcement techniques- stone columns-Compaction piles-Grouting techniques –Permeation, jet and intrusion grouting, Deep soil mixing techniques Drainage techniques-Verification of soil improvement-SPT and CPT.		
Module: 8	**Contemporary issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		**45 hours**
Text Book(s)		
1. Steven L. Kramer, Geotechnical Earthquake Engineering, 2014, Pearson New International Edition, USA.		
Reference Books		
1. Robert W. Day, Geotechnical Earthquake Engineering Handbook, 2002, McGraw Hill, USA. 2. IS 1893 – Part I: Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings. 3. IS 5249: Method of test for determination of dynamic properties of soil.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		
Recommended by Board of Studies	24.02.2022	
Approved by Academic Council	No. 65	Date 17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	2	-	2	2	1	-	2	2	-	-
CO3	3	-	-	-	-	-	-	-	2	1	-	2	3	-	-
CO4	3	2	-	-	-	2	-	2	-	-	-	-	3	-	-
CO5	-	3	-	-	-	2	-	2	2	1	-	2	3	-	-

BCLE315L	GROUNDWATER ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Fluid Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Acquire the basic knowledge of the residence and movement of groundwater, as well as a number of quantitative aspects.
2. Solve groundwater flow equations for confined and unconfined aquifers under steady and unsteady flow conditions and demonstrate the well construction.
3. Examine the groundwater quality standards, contamination and exploration and develop the numerical models.

Course Outcomes

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

1. Assess the movement of groundwater through aquifer properties
2. Determine aquifer properties for steady and unsteady flow conditions using groundwater flow equations
3. Demonstrate the construction, packing, protection, and rehabilitation of wells
4. Analyse water quality standards and remedial measures for contaminated groundwater.
5. Investigate groundwater using surface, subsurface techniques and numerical models for sustainable management

Module: 1	Occurrence of Groundwater	6 hours

Origin and age of groundwater–Water bearing properties of rock–Vertical distribution of groundwater-Zone of Aeration and saturation–Types of aquifers–Unconfined aquifer, confined aquifer, leaky aquifer and idealised aquifer-Storage coefficients-Groundwater basins.

Module: 2	Groundwater Movement	7 hours

Aquifer parameters-Specific yield–Transmissivity–Storativity–Determination of hydraulic conductivity–Hydraulic gradient-Darcy's law–Anisotropic and isotropic aquifers-Groundwater flow rates–flow nets–Dispersion–Groundwater flow equations.

Module: 3	Groundwater and Well Hydraulics	8 hours

Pumping test-Steady radial flow in a confined and unconfined aquifers-Dupuit's and Theim equation–Unsteady radial flow in a confined and unconfined aquifers–Theis method–Jacob's time and distance drawdown–Chow's method–Theis recovery–leaky aquifer–Hantush method-Multiple well systems.

Module: 4	Water Wells	6 hours
Construction of wells–Well drilling methods–Artificial and natural packing–Well casings and screens–Protection of wells and rehabilitation–Horizontal wells-Collector wells–Infiltration galleries–Well loss-Slug tests.		
Module: 5	**Groundwater Quality**	**6 hours**
Ground water quality measures–Graphic representations–Water quality standards–Drinking water–Industrial water–Irrigation water–Dissolved gases-Groundwater pollution sources–Remediation of contaminated groundwater.		
Module: 6	**Groundwater Investigations**	**4 hours**
Geologic methods–Remote sensing–Geophysical exploration–Test drilling–Water level measurement–Radiation and temperature logging.		
Module: 7	**Groundwater modelling and management**	**6 hours**
Necessity of groundwater models-Types of groundwater models-Simulation of two and three dimensional groundwater system-MODFLOW 2000–Inputs and processors–Concepts of basin management–Groundwater basin investigations and data collection–Conjunctive use and watershed management.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
Total Lecture hours		**45 hours**

Text Book(s)

1. Todd D.K. and Larry W. Mays., "Groundwater Hydrology", Third Edition, John Wiley & Sons, Inc, New York, 2011.

Reference Books

1. Raghunath H. M., "Ground Water", Third Edition, New Age International Pvt. Ltd., New Delhi, 2007.
2. Chahar, B. R., "Groundwater Hydrology", First Edition, McGraw Hill Education, 2014.

Mode of Evaluation: CAT, Assignment, Quiz and FAT.

Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	-	-	-	-	2	3	-	-
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	2	-	-	-	-	2	3	-	2
CO4	3	2	2	-	-	-	3	-	-	-	-	2	3	-	3
CO5	3	-	2	-	-	-	3	-	-	-	-	2	3	-	3

BCLE316L	ROCK ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Soil Mechanics	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Provide basic knowledge on Rock Mechanics.
2. Deliver a comprehensive understanding in the properties of rock and rock mass.
3. Understand the stresses and deformations around the excavation, in-situ stresses and failure mechanisms in rocks.

Course Outcomes

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

1. Apply knowledge of rock classification to select suitable rock masses for engineering applications.
2. Determine the physical, mechanical, and time-dependent properties of rocks for engineering applications.
3. Analyze the stress–strain behavior of rocks under different loading conditions.
4. Analyze the strength and deformability characteristics of rocks under engineering conditions.
5. Determine rock mass behavior using rock mechanics principles and evaluate their implications in tunnel design.

Module: 1	Engineering Classification of Rocks & Rock Mass	7 hours

Classification systems in rock engineering-Classification of intact rocks-Classification of rock mass-Terzaghi's rock load, RQD-Rock structure rating-Geological strength index-Applications of rock mass classification in rock engineering-Geo-physical methods.

Module: 2	Physico-Mechanical & Time Dependant Properties of Rock	7 hours

Physical, strength properties of Rock (Compressive, Tensile, Shear and Triaxial strength)-Strength indices of rock (slake durability index, point load strength index, rebound hammer)-Static and dynamic elastic constants of rock-Abrasivity of rock and its determination-Creep strain, time-dependent deformation-Time-dependent strength reduction.

Module: 3	Concept of Stress and Strain in Rock	6 hours

Analysis of stress-Analysis of strain-Constitutive relations-Strain energy-Stress-strain behaviour of isotropic and anisotropic rock-Parameters influencing strength/stress-strain behaviour.

Module: 4	Strength and Deformability of Rock Mass	6 hours

In situ shear tests-Evaluation of shear strength-In situ bearing strength test-In situ deformability tests-Plate loading test, plate jacking test and borehole jack tests.

Module: 5	Stability of Rock Slopes	6 hours

Introduction to Rock slopes causes of landslides, Modes of failure, Methods of analysis-Prevention and control of rock slope failure-Rock bolting-Rock Anchors-Instrumentation for Monitoring of Landslides-Improvement of slope stability and protection.			
Module: 6	**Foundation on Rocks**		**6 hours**
Shallow foundations-Pile and well foundations-Basement excavation-Foundation construction-Allowable bearing pressure.			
Module: 7	**Tunnelling**		**5 hours**
Scope and application-Historical developments, art of tunnelling-Types and purpose of tunnels-Factors affecting choice of excavation technique-Rock stresses and deformation around tunnels-Rock support interaction-Tunnel driving methods.			
Module: 8	**Contemporary Issues**		**2 hours**
Guest lecture from industry and R & D organisations.			
Total Lecture Hours			**45 hours**
Text Book(s)			
1. Ramamurthy T., Engineering in Rocks for Slopes, Foundation and Tunnels, 2007, PHI Pvt. Ltd., New Delhi.			
Reference Books			
1. Jaeger, Cook, Zimmerman, Fundamentals of Rock Mechanics, 2007, Fourth Edition, Blackwell Publishing, USA.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	2	-	-	-	-	-	-	3	-	-
CO3	-	3	-	-	-	2	-	-	-	-	-	-	3	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3		-	-	-	2	-	-	-	-	-	-	2	-	2

BCLE391J	TECHNICAL ANSWERS TO REAL PROBLEMS PROJECT	L	T	P	C
		0	0	0	3
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. To gain an understanding of real-life issues faced by society.
2. To study appropriate technologies in order to find a solution to real life issues.
3. Students will design system components intended to solve a real-life issue.

Course Outcome:

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

1. Analyze real-life societal challenges through surveys and direct interaction with the community.
2. Apply systematic problem-solving approaches and appropriate technologies to develop feasible solutions for identified real-world issues
3. Design appropriate system components or processes to address identified real-life issues and prepare a comprehensive report.

Module Content

Students are expected to perform a survey and interact with society to find out the real life issues.

Logical steps with the application of appropriate technologies should be suggested to solve the identified issues.

Subsequently the student should design the related system components or processes which

is intended to provide the solution to the identified real-life issues.

General Guidelines:

1. Identification of real-life problems
2. Field visits can be arranged by the faculty concerned
3. Maximum of 3 students can form a team (within the same/different discipline)
4. Minimum of eight hours on self-managed team activity
5. Appropriate scientific methodologies to be utilized to solve the identified issue
6. Solution should be in the form of fabrication/coding/modelling/product design/process design/relevant scientific methodology(ies)
7. Consolidated report to be submitted for assessment
8. Participation, involvement and contribution in group discussions during the contact hours will be used as the modalities for the continuous assessment of the theory component
9. Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility
10. Contribution of each group member to be assessed

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No.65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	3	-	-	3	-	-	3	3	-	-
CO2	3	2	-	3	2	-	-	-	3	-	2	3	-	3	-
CO3	-	2	-	-	2	2	3	2	3	3	-	3	-	3	3

BCLE392J	**DESIGN PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**3**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. Students will be able to upgrade a prototype to a design prototype.
2. Describe and demonstrate the techniques and skills necessary for the project.
3. Acquire knowledge and better understanding of design systems.

Course Outcome:

1. Develop the ability to design a prototype or working model for civil engineering applications
2. Utilize modern techniques, engineering skills, and tools necessary for design projects.
3. Prepare a detailed technical report to effectively present the results of the developed solution.

Module Content

Students are expected to develop new skills and demonstrate the ability to develop prototypes to design prototype or working models related to an engineering product or a process.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.			
Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	-	3	2	3	3	-	-	3	3	-	-
CO2	2	3	3	2	3	3	2		3	-	-	3	-	3	-
CO3	-	-	-	-	-	-	-	-	3	3	-	3	-	-	3

BCLE393J	**LABORATORY PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**3**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			
Course Objectives:					
1. The student will be able to conduct experiments on the concepts already learnt. 2. Analyse experimental data. 3. Present the results with appropriate interpretation.					
Course Outcome:					
1. Conduct practical experiments to validate the theoretical concepts 2. Analyse and interpret data generated from the practical experiments 3. Prepare technical reports and research articles based on experimental results.					
Module Content					

Students are expected to perform experiments and gain hands-on experience on the theory courses they have already studied or registered in the ongoing semester. The theory course registered is not expected to have laboratory component and the student is expected to register with the same faculty who handled the theory course. This is mostly applicable to the elective courses. The nature of the laboratory experiments is depended on the course.
Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	3	3	-	-	-	3	-	-	-	3	-	-
CO2	-	3	-	3	3	-	-	-	3	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	-	3	3	-	3	-	-	3

BCLE394J	**PRODUCT DEVELOPMENT PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**3**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. Students will be able to translate a prototype to a useful product.
2. Apply relevant codes and standards during product development.
3. The student will be able to present his results by means of clear technical reports.

Course Outcome:

1. Develop a viable prototype or working model useful to society or industry.
2. Validate the product in a relevant environment in accordance with Technology Readiness Levels (TRL).
3. Prepare technical reports and research articles based on validated results.

Module Content	
Students are expected to translate the developed prototypes / working models into a product which has application to society or industry.	
Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews	

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No.65	Date	17-03-2022

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	-	3	3	-	-	3	-	-	-	3	-	-
CO2	-	3	-	3	-	2	2	3	-	-	3	-	-	3	-
CO3	-	-	-	-	-	-	-	-	-	3	-	3	-	-	3

BCLE396J	**READING COURSE**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**3**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. The student will be able to analyse and interpret published literature for information pertaining to niche areas.
2. Scrutinize technical literature and arrive at conclusions.
3. Use insight and creativity for a better understanding of the domain of interest.

Course Outcome:			
1. Analyze published literature/books providing information related to niche areas/focused domains. 2. Examine technical literature, resolve ambiguity, and develop conclusions. 3. Prepare technical reports by synthesizing knowledge and applying insight to enhance understanding of the domain of interest.			
Module Content			
This is oriented towards reading published literature or books related to niche areas or focussed domains under the guidance of a faculty.			
Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – Report to be submitted, presentation and project reviews.			
Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No.65	Date	17-03-2022

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	-	-	-	-	3	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3

BCLE397J	**SPECIAL PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**3**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			
Course Objectives:					
1. Students will be able to identify and solve problems in a time-bound manner. 2. Describe major approaches and findings in the area of interest. 3. Present the results in a clear and concise manner.					
Course Outcome:					

1. Identify engineering problems using appropriate knowledge, methods, and analytical approaches. 2. Apply scientific approaches, fundamental concepts, and recent research developments to address problems in the area of interest 3. Prepare clear and concise research articles for publication in conference proceedings/peer-reviewed journals.
Module Content
This is an open-ended course in which the student is expected to work on a time bound research project under the supervision of a faculty. The result may be a tangible output in terms of publication of research articles in a conference proceeding or in a peer-reviewed Scopus indexed journal.
Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	3	2	-	3	-	-	3	3	-	-
CO2	-	2	2	3	3	2	-	2	3	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	3	3	3	-	3	-	-	3

BCLE398J	**SIMULATION PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**3**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			
Course Objectives:					
1. Students will be able to simulate a real system. 2. Identify the variables which affect the system. 3. Describe the performance of a real system.					

Course Outcome:			
1. Implement the concepts to simulate and analyse the working of a real system. 2. Analyse the various variables affecting the performance and behaviour of a system. 3. Evaluate the performance of a real system and prepare a comprehensive technical report.			
Module Content			
The student is expected to simulate and critically analyse the working of a real system. Role of different variables which affect the system has to be studied extensively such that the impact of each step in the process is understood, thereby the performance of each step of the engineering process is evaluated.			
Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews.			
Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	-	-	-	-	-	-	3	-	-	-	3	-	-
CO2	-	3	-	3	3	-	-	-	3	-	-	-	-	3	-
CO3	-	-	-	-	-	-	-	3	3	3	-	3	-	-	3

BCL401L	**TRAFFIC ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Pre-requisite	Transportation Engineering	**Syllabus version**			
		1.0			

Course Objectives

The objectives of this course is to :

1. Identify the traffic stream characteristics and learn the traffic data collection techniques & analyze it.
2. Learn the concepts of highway capacity and level of service and its importance in traffic engineering
3. Familiarise with the traffic control devices and traffic management measures and enable them to understand the importance of road safety.

Course Outcomes

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

1. Calculate traffic stream characteristics and apply relationships among macroscopic and microscopic traffic flow parameters.
2. Interpret traffic data using traffic data collection studies and basic probability and statistical methods.
3. Calculate highway capacity and determine level of service for highway sections using standard procedures.
4. Apply traffic control principles to prepare basic traffic control layouts and management measures.
5. Apply basic traffic safety concepts to process accident data, identify accident-prone locations, and recommend standard safety improvement measures.

Module: 1	**Introduction to Traffic Engineering**	**5 hours**

Elements of Traffic Engineering-Traffic components and its characteristics-Road users and Vehicles-Visual characteristics of Drivers-Concepts of Mobility and Accessibility.

Module: 2	**Traffic Stream Characteristics**	**7 hours**

Traffic Stream Parameters–Macroscopic–Flow, Speed and Density–Microscopic–Headways and Spacing–Relationships among the Macroscopic and Microscopic Parameters–Traffic Stream Models–Linear (Greenshields) and Non-linear (Greenberg, Underwood, Northwestern) models–Applications of stream models–Shock waves.

Module: 3	**Traffic Data Collection and Analysis**	**8 hours**

Traffic Data Collection Methodologies–Manual and Automated Traffic Data Collection-Types of Traffic Studies–Use of Loop Detectors, Videos and Sensors for Measurement of Volume, Speed, Density–Moving Observer and GPS Methods for Travel Time and Delay Studies at Mid-Blocks and Intersections–Accident Studies–Parking Studies–Supply and Demand Surveys

Module: 4	**Statistical Applications in Traffic Engineering**	**4 hours**

Overview of Probability Functions and Statistics–Applications of Discrete and Continuous Probability Distributions in Speed and Accident studies–Poisson and Normal distribution.

Module: 5	**Highway Capacity and Level of Service**	**7 hours**

Introduction to Highway Capacity and Level of Service (LOS) concept–Computation of Capacity and LOS for Different Types of Facilities using HCM guidelines–Base Capacity and Various Adjustment Factors for Capacity and LOS computation for Freeways–Indian Highway Capacity Manual (Indo-HCM) guidelines–Single Lane, Intermediate Lane and Two Lane Interurban Bidirectional Roads-Multilane Divided Interurban Highways.

Module: 6	**Traffic Control Devices and Traffic Management**	**8 hours**

Traffic Signs, Road Markings and Traffic Signals–Types of Traffic Signal–Warrants for Signalization and Design of Traffic Signal-Traffic Management Measures-Transportation System Management (TSM) and Transportation Demand Management (TDM)–Traffic simulation.

Module: 7	**Highway Traffic Safety**	**4 hours**

IRC Road safety code-Accident Statistic-Accident Data Collection and Record Systems-Identification of Accident Hot Spots-Site Analysis-Development of Countermeasures-Road Safety Auditing–Bicycle and pedestrian safety.

Module: 8	**Contemporary Issues**	**2 hours**

Guest lecture from industry and R & D organisations.

Total Lecture Hours	**45 hours**

Text Book(s)

1. Roger P. Roess, Elena S. Prassas, William R. McShane, Traffic Engineering, 2019, Fifth Edition, Pearson, USA.			
Reference Books			
1. Beverly Thompson Kuhn, Transportation Engineering: A Practical Approach to Highway Design, Traffic Analysis, and Systems Operation, 2019, First Edition, McGraw-Hill Education, USA.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	1	-	1	3	-	2
CO2	3	-	-	-	-	1	-	-	2	1	-	1	2	-	2
CO3	3	-	1	-	-	1	1	-	2	1	-	-	2	-	-
CO4	3	-	2	-	-	2	1	-	2	1	-	-	2	-	-
CO5	3	-	1	-	-	2	1	-	-	-	-	1	2	-	2

BCLE402L	**PRE-STRESSED CONCRETE AND INDUSTRIAL STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Pre-requisite	Design of Reinforced Concrete Structures	**Syllabus version**			

		1.0

Course Objectives

The objectives of this course is to :

1. Learn the principles, materials, methods and systems of pre-stressing.
2. Apply the various concepts for analysis and design of pre-stressed concrete beams.
3. Acquire the knowledge on applications of pre-stress in industrial, prefabricated and long span structures.

Course Outcomes

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

1. Apply the basic concepts and principles of prestressing to assess the behaviour of prestressed concrete members.
2. Determine the different types of prestress losses and beam deflections under specified conditions.
3. Analyze the structural behaviour of prestressed concrete beams under various stages of loading.
4. Design prestressed concrete beams to flexural, shear, and torsional effects based on ultimate limit state conditions.
5. Apply the concepts of prestressing in industrial and prefabricated structures.

Module: 1	**Introduction to Pre-stressed Concrete**	**5 hours**
Introduction–Development of Pre-stressed Concrete-General Principles of Pre-stressed Concrete-Classification and types of pre-stressing-Stages of loading-Materials–Concrete and Steel stress-strain characteristics-End anchorages.		
Module: 2	**Losses in Pre-stress and Deflection**	**5 hours**
Losses in Pre-stress–Immediate losses–Time dependant losses-Calculation of deflection in un-cracked section-Immediate deflection and long-term deflection.		
Module: 3	**Analysis of Members**	**6 hours**
Analysis for elastic flexural stresses at various stages of loading in determinate beams–Stress, strength and load balancing concepts-Permissible stresses–Cracking moment–Kern limits–Location of thrust line.		
Module: 4	**Design for Flexure**	**8 hours**
Basis of design-Fully pre-stressed beams-Flexural design based on limit state of serviceability–Type 1 and Type 2 structures-Flexural design based on limit state of collapse (as per IS Code)–Strain compatibility method.		
Module: 5	**Design for Shear and Torsion**	**7 hours**
Diagonal shear and flexural shear failures–Resistance against shear–Cracked section–Uncracked section–Calculation for transverse reinforcement-Equilibrium torsion & compatibility torsion–Modes of failure under combined bending, shear and torsion.		
Module: 6	**Applications in Industrial Structures**	**7 hours**
Applications of Pre-stressed concrete–Multi-span floor system-Circular pre-stressing-Liquid storage tanks, silos, axial pre-stressing–Sleepers, Columns, Composite construction-Bridge decks.		
Module: 7	**Applications in Prefabricated Structures**	**5 hours**
Introduction to pre-fabricated structures-Advantages of prefabricated structures-Types of precast and pre-stressed members–Handling and erection stresses–Connections details–Shear friction method for connection design.		
Module: 8	**Contemporary Issues**	**2 hours**
Guest lecture from industry and R & D organisations.		
	Total Lecture Hours	**45 hours**

Text Book(s)

1. Raju, N. K., Prestressed Concrete, 2018, Sixth Edition, Tata McGraw-Hill, New Delhi.

Reference Books

1. N. Rajagopalan., Prestressed Concrete, 2017, Second Edition, Narosa Publishers, New Delhi. 2. Arthur H. Nilson, Design of Pre-stressed Concrete, 1987, John Wiley & Sons, Canada. 3. IS: 1343: Indian Standard code of practice for Prestressed concrete, BIS, New Delhi. 4. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, BIS, New Delhi.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	2	-	-	-	-	2	-	-
CO2	3	-	-	-	-	-	-	2	-	-	-	-	3	-	-
CO3	-	3	-	-	-	-	-	2	-	-	-	-	3	-	-
CO4	-	3	2	-	-	-	-	2	-	-	-	-	3	-	-
CO5	3	-	-	-	-	-	-	2	-	-	-	-	2	-	-

BCLE403L	**OPEN CHANNEL HYDRAULICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Pre-requisite	Fluid Mechanics	**Syllabus version**			

		1.0

Course Objectives

The objectives of this course is to :

1. Introduce various numerical techniques and their applications in open channel flow.
2. Demonstrate the open channel flow concepts in design and analysis of irrigation channels.
3. Model the uniform, gradually and rapidly varied flows in open channels.

Course Outcomes

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

1. Apply open channel flow principles for flow regimes, channel geometry, and velocity–pressure distribution
2. Calculate flow rate, pressure distribution, and specific energy in open channel flow
3. Analyze critical, uniform, gradually varied, and rapidly varied flows
4. Classify flow profiles in open channel flow with hydraulic characteristics
5. Analyze the characteristics of hydraulic jump and its applications in canal engineering

Module: 1	**Open Channels and their Properties**	**6 hours**

Description-Types of flow-State of flows-Regimes of flow-Kinds of open channels- Open channel geometry-Geometric elements of channel sections-Velocity distribution in a channel section-Wide open channel-Measurement of velocity-Velocity distribution coefficients-Determination of velocity distribution coefficients-Pressure distribution in a channel section-Effect of slope on pressure distribution.

Module: 2	**Energy and Momentum Principles**	**6 hours**

Energy in open channel flows-Specific energy-Criterion for a critical state of flow-Interpretation of local phenomena-Energy in non-prismatic channel-Momentum in open channel flow-Specific force-momentum principle applied to non-prismatic channel.

Module: 3	**Critical Flow: Its Computation and Applications**	**5 hours**

Critical flow-Section factor for critical flow computation-Hydraulic exponent for critical flow computation-Computation of critical flow-Control of flow and flow measurement.

Module: 4	**Uniform Flow and Computation**	**7 hours**

Qualifications for uniform flow-Velocity of a uniform flow-Chezzy's and Manning's formula-Determination of Manning's roughness coefficient-Conveyance of a channel section-Section factor-Flow in channel sections with composite roughness-Determination of normal depth and velocity-Determination of normal and critical slopes-Computation of flood discharge-Uniform surface flow.

Module: 5	**Gradually Varied Flow**	**7 hours**

Basic assumptions-Dynamic equation of gradually varied flow-Characteristics of flow profiles-Classification and analysis of flow profiles-Method of single point-Transitional depth-Methods of computation: graphical integration method-Direct integration method-Direct step method for natural channels.

Module: 6	**Rapidly Varied Flow**	**7 hours**

Characteristics of the flow-Hydraulic jump and its use as energy dissipator-Hydraulic jump-Jump in horizontal rectangular channels-Types of jump-Basic characteristics of jump-Surface profile-Length and location of jump-Jump as energy dissipator-Control of jump.

Module: 7	**Unsteady Varied Flow**	**4 hours**

Gradually varied unsteady flow-Dynamic equation for unsteady flow-Solution for unsteady flow equation-Rapidly varied unsteady flow-Uniformly progressive flow-Moving of hydraulic jump-Surge.

Module: 8	**Contemporary Issues**	**2 hours**

Guest lecture from industry and R & D organisations.			
Total Lecture Hours			**45 hours**
Text Book			
1. Ven Te Chow, Open Channel Hydraulics, 2009, Fifth Edition, The Black burn Press, New Jersey, USA.			
Reference Books			
1. Richard H French, Open Channel Hydraulics, 2007, Fourth Edition, Water Resources Publications LLC, Colorado, USA. 2. K. Subramanya, Flow in open channels, 2019, Fifth Edition, McGraw Hill Education, New Delhi.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	2	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	2	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	2	-	-	-	-	-	3	-	-
CO5	3	2	-	-	-	-	2	-	-	-	-	-	3	-	-

Projects and Internship

BCLE399J	SUMMER INDUSTRIAL INTERNSHIP	L	T	P	C
		0	0	0	1
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Course Outcome:

1. Apply professional and ethical responsibilities in civil engineering practice through real-world construction projects.
2. Perform field tasks and technical activities by considering global, economic, environmental, and societal aspects.
3. Analyse infrastructure project workflows with respect to quality standards, safety requirements, and relevant codes of practice.
4. Prepare and present a comprehensive internship report highlighting observations, learning outcomes, and practical exposure gained during the internship.

Module Content

Four weeks of work at industry site.
Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	3	-	3	-	-	-	3	-	-	3
CO2	3	-	-	-	2	3	3	-	-	-	2	2	3	-	-
CO3	-	-	-	-	-	2	3	3	-	-	-	3	-	3	-
CO4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	3

BCLE497J	PROJECT - I	L	T	P	C
		0	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product/process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

1. Identify and formulate a problem based on literature review and real-world requirements.
2. Conduct experimental investigations and/or analytical studies to develop and evaluate potential solutions for societal needs
3. Utilize modern engineering tools and techniques for modeling, simulation, and analysis of the proposed system.
4. Prepare and present a technical report demonstrating design methodology, results, and conclusions.

Module Content

Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

Can be individual work or a group project, with a maximum of 3 students.

In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.

Publications in the peer reviewed journals / International Conferences will be an added advantage.

Mode of Evaluation: Assessment on the project - project report to be submitted, presentation and project reviews

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	3	3	-	3	3	-	2
CO2	3	3	3	3	2	3	2	2	3	-	-	-	-	3	-
CO3	-	3	2	2	3	-	-	2	3	-	2	2	-	3	-
CO4	2	2	2	-	-	-	-	-	3	3	-	2	2	-	3

BCLE498J	PROJECT – II / INTERNSHIP	L	T	P	C
		0	0	0	5
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

1. Formulate the problem statement based on domain knowledge, scientific literature and research gaps.
2. Apply domain knowledge to define project objectives and methodology.
3. Design suitable experimental/ analytical/computational methods to investigate civil engineering problems.
4. Analyze project results to establish conclusions considering cost-effectiveness, ethical practices, project management, and sustainability.
5. Demonstrate effective teamwork by collaborating with team members to achieve project goals.
6. Prepare a technical project report and communicate the project findings clearly through oral presentation.

Module Content

1. Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage.

Mode of Evaluation: Assessment on the project - project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	-	-	-	-	-	-	-	-	2	-	-	3	-	-
CO3	2	3	3	3	3	3	3	3	-	2	-	-	-	3	-
CO4	-	3	3	3	3	3	3	3	-	2	3	2	-	3	3
CO5	-	-	-	-	-	-	-	-	3	3	-	3	-	-	3
CO6	-	-	-	-	-	-	-	-	3	3	-	3	-	-	3

Course Code	Course Title	L	T	P	C
BCLE499J	ONE SEMESTER INTERNSHIP	0	0	0	14
Pre-requisite	**Nil**	**Syllabus version**			
		1.0			

Course Objectives

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcomes

1. Apply the civil engineering concepts in real world projects.
2. Analyse the field tasks and technical activities using modern tools
3. Conduct investigations on solution iterations for real-time problems.
4. Manage project workflows adhering to quality, safety, sustainability and ethical standards.
5. Prepare a comprehensive internship report based on observations, learning outcomes, and practical exposure.

Module Content | **(Project Duration: 9 months)**

1. This is a capacity-linked opportunity during which the students are expected to take up research work for a period of 9 months duration. Students who meet all their course and credit requirements as specified in their curriculum may have a lighter credit load when they reach their 7th semester. Such students, still maintaining a CGPA of 9.00 and above, may opt to work on an existing research project available in the University related to their programme in lieu of their Student Project (3 credits Project—I and 5 credits Project—II / Internship).

2. The research work should be carried out for a minimum period of 9 months and be adequate in originality. This research-oriented project work is expected to result in a journal publication (Scopus indexed) or product development or filing of a patent. A separate evaluation committee will evaluate such Student Projects constituted for the purpose.

3. Considering the quantity and quality of work put in by the student, the committee may recommend the award of One Semester Internship (14 credits) with an 'S' grade. The concerned faculty members offering the project may make financial support, if any, available through their research funds for One Semester Internship, subject to the availability and provision of the work carried out.
4. The advantage to the student will be that his/her CGPA will improve, given that fourteen credits are awarded with an 'S' grade. Prior manual registration with the approval of the Dean of the Programme School is necessary.
5. One Semester Internship will be treated as an individual student project. Any interested student with a CGPA of ≥ 9.00 may get approval from the respective School Dean and proceed to work on this project. If the Committee is not
6. satisfied with the student's research project work, then the project shall be graded like any other regular B.Tech. Student Project work for 8 credits (3
7. credits for Project – I and 5 credits for Project – II), and a suitable performance grade may be awarded. In such a situation, no entry will be made in the Grade Sheet about One Semester Internship (14 credits), and it will be presumed that the Registration made for One Semester Internship will be cancelled.

Mode of Evaluation: Both Outcome and review-based assessment on the project report to be submitted, presentation, and project reviews.

Mode of Evaluation: Assessment on the project - project report to be submitted, presentation and project reviews.

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	-	-	-	3	3	-	-
CO2	-	3	-	2	3	-	-	-	-	-	-	-	-	3	-
CO3	2	-	-	3	2	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	3	3	3	3	-	3	-	-	-	3
CO5	-	-	-	-	2	-	-	-	-	3	-	3	-	-	3