



VIT[®]
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF CIVIL ENGINEERING

Integrated Master of Technology in Construction Technology and Management (Int. M. Tech. MTI)

Curriculum (2021-2022 admitted students)



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

Vision of the Institute:

Transforming life through excellence in education and research.

Mission of the Institute:

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.



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Vision Statement of the School of Civil Engineering

To be internationally recognized in Civil Engineering through groundbreaking contributions and exceptional leadership for sustainable development of the society.

Mission Statement of the School of Civil Engineering

- M1: Develop the curriculum and teaching methods to provide students with a comprehensive education in Civil Engineering.
- M2: Modernize laboratory facilities to facilitate innovative practices and collaborative activities, ensuring students have access to advanced equipment and resources.
- M3: Cultivate an environment conducive to research and industrial collaboration, fostering innovation among faculty members, students, and industry partners.
- M4: Dedicate efforts to develop sustainable infrastructure solutions that address pressing societal challenges, promoting community well-being and environmental preservation.



Integrated M.Tech in Construction Technology and Management

PROGRAMME OUTCOMES (POs)

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems.

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment

PO_04: Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information

PO_05: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working as a member Or in teams

PO_10: Having a good working knowledge of communicating in English – communication with engineering community and society

PO_11: Having a good cognitive load management skills related to project management and finance

PO_12: Having interest and recognise the need for independent and lifelong learning



Category Credit Detail			
Sl.No.	Description	Credits	Maximum Credit
1	FCBSM - Foundation Core - Basic Sciences and Mathematics	24	24
2	FCBES - Foundation Core - Basic Engineering Sciences	15	15
3	FCHSSM - Foundation Core - Humanities, Social Sciences and Management	15	15
4	DLES - Discipline-linked Engineering Sciences	10	10
5	DC - Discipline Core	72	72
6	DE - Discipline Elective	30	30
7	PI - Projects and Internship	35	35
8	OE - Open Elective	15	15
9	NGCR - Non-graded Core Requirement	11	11
10	BC - Bridge Course	2	2
Total Credits		216	

Foundation Core - Basic Sciences and Mathematics									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	ICHY101L	Engineering Chemistry	Theory Only	1.0	3	0	0	0	3.0
2	ICHY101P	Engineering Chemistry Lab	Lab Only	1.0	0	0	2	0	1.0
3	IMAT101L	Calculus	Theory Only	1.0	3	0	0	0	3.0
4	IMAT101P	Calculus Lab	Lab Only	1.0	0	0	2	0	1.0
5	IMAT102L	Differential Equations and Transforms	Theory Only	1.0	3	1	0	0	4.0
6	IMAT201L	Complex Variables and Linear Algebra	Theory Only	1.0	3	1	0	0	4.0
7	IMAT202L	Probability and Statistics	Theory Only	1.0	3	0	0	0	3.0
8	IMAT202P	Probability and Statistics Lab	Lab Only	1.0	0	0	2	0	1.0
9	IPHY101L	Engineering Physics	Theory Only	1.0	3	0	0	0	3.0
10	IPHY101P	Engineering Physics Lab	Lab Only	1.0	0	0	2	0	1.0

Foundation Core - Basic Engineering Sciences									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	ICSE101E	Computer Programming: Python	Embedded Theory and Lab	1.0	1	0	4	0	3.0
2	ICSE103E	Computer Programming : Java	Embedded Theory and Lab	1.0	1	0	4	0	3.0
3	IEEE102L	Basic Electrical and Electronics Engineering	Theory Only	1.0	3	0	0	0	3.0
4	IEEE102P	Basic Electrical and Electronics Engineering LAB	Lab Only	1.0	0	0	2	0	1.0
5	IMEE102P	Engineering Design Visualisation Lab	Lab Only	1.0	0	0	4	0	2.0
6	IMEE201L	Engineering Mechanics	Theory Only	1.0	2	1	0	0	3.0



Foundation Core - Humanities, Social Sciences and Management									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	IENG101L	Technical English Communication	Theory Only	1.0	2	0	0	0	2.0
2	IENG101P	Technical English Communication Lab	Lab Only	1.0	0	0	2	0	1.0
3	IENG102P	Technical Report Writing	Lab Only	1.0	0	0	2	0	1.0
4	IFLE200L	Foreign Language	Basket	1.0	0	0	0	0	2.0
5	IHSM200L	Elective	Basket	1.0	0	0	0	0	3.0
6	ISTS101P	Quantitative Skills Practice I	Lab Only	1.0	0	0	3	0	1.5
7	ISTS102P	Quantitative Skills Practice II	Soft Skill	1.0	3	0	0	0	1.5
8	ISTS201P	Qualitative Skills Practice I	Soft Skill	1.0	3	0	0	0	1.5
9	ISTS202P	Qualitative Skills Practice II	Soft Skill	1.1	0	0	3	0	1.5

Discipline-linked Engineering Sciences									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	ICLE201L	Construction Materials	Theory Only	1.0	2	0	0	0	2.0
2	ICLE202L	Fluid Mechanics	Theory Only	1.0	3	0	0	0	3.0
3	ICLE202P	Fluid Mechanics Lab	Lab Only	1.0	0	0	2	0	1.0
4	ICLE203L	Mechanics of Solids	Theory Only	1.0	3	0	0	0	3.0
5	ICLE203P	Mechanics of Solids Lab	Lab Only	1.0	0	0	2	0	1.0

Discipline Core									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	ICLE204L	Surveying	Theory Only	1.0	3	0	0	0	3.0
2	ICLE204P	Surveying Lab	Lab Only	1.0	0	0	2	0	1.0
3	ICLE205L	Environmental Engineering	Theory Only	1.0	3	0	0	0	3.0
4	ICLE205P	Environmental Engineering Lab	Lab Only	1.0	0	0	2	0	1.0
5	ICLE206E	Building Planning and Drawing	Embedded Theory and Lab	1.0	1	0	2	0	2.0
6	ICLE207L	Soil Mechanics	Theory Only	1.0	3	0	0	0	3.0
7	ICLE207P	Soil Mechanics Lab	Lab Only	1.0	0	0	2	0	1.0
8	ICLE208L	Structural Analysis	Theory Only	1.0	2	1	0	0	3.0
9	ICLE209L	Engineering Geology	Theory Only	1.0	2	0	0	0	2.0
10	ICLE301L	Concrete Technology	Theory Only	1.0	3	0	0	0	3.0
11	ICLE301P	Concrete Technology Lab	Lab Only	1.0	0	0	2	0	1.0
12	ICLE302L	Hydraulics and Hydraulic Machines	Theory Only	1.0	3	0	0	0	3.0
13	ICLE302P	Hydraulics and Hydraulic Machines Lab	Lab Only	1.0	0	0	2	0	1.0
14	ICLE303L	Foundation Engineering	Theory Only	1.0	2	1	0	0	3.0



Discipline Core									
16	ICLE304P	Reinforced Concrete Structures Lab	Lab Only	1.0	0	0	2	0	1.0
17	ICLE305L	Transportation Engineering	Theory Only	1.0	2	1	0	0	3.0
18	ICLE306L	Water Resources Engineering	Theory Only	1.0	3	0	0	0	3.0
19	ICLE306P	Water Resources Engineering Lab	Lab Only	1.0	0	0	2	0	1.0
20	ICLE307L	Construction Practices and Management	Theory Only	1.0	3	0	0	0	3.0
21	ICLE308L	Design of Steel Structures	Theory Only	1.0	3	0	0	0	3.0
22	ICLE308P	Steel Structures Lab	Lab Only	1.0	0	0	2	0	1.0
23	ICLE309L	Estimating and Costing	Theory Only	1.0	2	0	0	0	2.0
24	ICLE317L	Construction Contract Management	Theory Only	1.0	3	0	0	0	3.0
25	ICLE318L	Construction Equipment Management	Theory Only	1.0	3	0	0	0	3.0
26	ICLE319L	Construction Planning and Scheduling	Theory Only	1.0	3	1	0	0	4.0
27	ICLE320L	Construction Economics and Finance	Theory Only	1.0	3	1	0	0	4.0
28	ICLE321L	Quality Control and Safety	Theory Only	1.0	3	0	0	0	3.0
29	ICLE322L	Construction Project Management	Theory Only	1.0	3	0	0	0	3.0
30	ICLE323E	Building Information Modeling	Embedded Theory and Lab	1.1	1	0	2	0	2.0

Discipline Elective									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	ICLE210L	AI in Civil Engineering	Theory Only	1.0	3	0	0	0	3.0
2	ICLE211L	Urban Planning and Development	Theory Only	1.0	3	0	0	0	3.0
3	ICLE212L	Natural Disaster Mitigation and Management	Theory Only	1.0	3	0	0	0	3.0
4	ICLE213E	Remote Sensing and GIS	Embedded Theory and Lab	1.0	2	0	2	0	3.0
5	ICLE310L	Environmental Impact Assessment	Theory Only	1.0	3	0	0	0	3.0
6	ICLE311L	Industrial Waste Management	Theory Only	1.0	3	0	0	0	3.0
7	ICLE312L	Air and Noise Pollution Control	Theory Only	1.0	3	0	0	0	3.0
8	ICLE313L	Solid Waste Management	Theory Only	1.0	3	0	0	0	3.0
9	ICLE314L	Geotechnical Earthquake Engineering	Theory Only	1.0	3	0	0	0	3.0
10	ICLE315L	Groundwater Engineering	Theory Only	1.0	3	0	0	0	3.0
11	ICLE316L	Rock Engineering	Theory Only	1.0	3	0	0	0	3.0
12	ICLE391J	Technical Answers to Real Problems Project	Project	1.0	0	0	0	0	3.0
13	ICLE392J	Design Project	Project	1.0	0	0	0	0	3.0
14	ICLE393J	Laboratory Project	Project	1.0	0	0	0	0	3.0
15	ICLE394J	Product Development Project	Project	1.0	0	0	0	0	3.0
16	ICLE395J	Computer Project	Project	1.0	0	0	0	0	3.0
17	ICLE396J	Reading Course	Project	1.0	0	0	0	0	3.0
18	ICLE397J	Special Project	Project	1.0	0	0	0	0	3.0
19	ICLE398J	Simulation Project	Project	1.0	0	0	0	0	3.0
20	ICLE401L	Traffic Engineering	Theory Only	1.0	3	0	0	0	3.0
21	ICLE402L	Pre-stressed Concrete and Industrial Structures	Theory Only	1.0	3	0	0	0	3.0



Discipline Elective									
22	ICLE403L	Open Channel Hydraulics	Theory Only	1.0	3	0	0	0	3.0
23	ICLE404L	Construction Personnel Management	Theory Only	1.0	3	0	0	0	3.0
24	ICLE405L	Lean Construction	Theory Only	1.0	3	0	0	0	3.0
25	ICLE406L	Internal and External Infrastructure Monitoring	Theory Only	1.0	3	0	0	0	3.0
26	ICLE407L	Project Formulation and Appraisal	Theory Only	1.0	3	0	0	0	3.0
27	ICLE408L	Infrastructure development and BOT, BOOT Projects	Theory Only	1.0	3	0	0	0	3.0
28	ICLE409L	Formwork for Concrete Structures	Theory Only	1.0	3	0	0	0	3.0
29	ICLE410L	Prefabricated Techniques and Management	Theory Only	1.0	3	0	0	0	3.0
30	ICLE411L	Construction Techniques of Steel and Concrete Composite Structures	Theory Only	1.0	3	0	0	0	3.0
31	ICLE412L	Construction Techniques of Deep Foundations	Theory Only	1.0	3	0	0	0	3.0
32	ICLE413L	Flexible and Rigid Pavements	Theory Only	1.0	3	0	0	0	3.0
33	ICLE414L	Repair and Rehabilitation of Structures	Theory Only	1.0	3	0	0	0	3.0
34	ICLE415L	Occupational Health and Industrial Safety	Theory Only	1.0	3	0	0	0	3.0
35	ICLE416L	Context-Aware Computing	Theory Only	1.0	3	0	0	0	3.0
36	ICLE417L	Internet of Things (IoT) for Smart Cities	Theory Only	1.0	3	0	0	0	3.0
37	ICLE418L	Smart Infrastructure	Theory Only	1.0	3	0	0	0	3.0

Projects and Internship									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	ICLE399J	Summer Industrial Internship	Project	1.0	0	0	0	0	1.0
2	ICLE498J	Project I	Project	1.0	0	0	0	0	14.0
3	ICLE499J	Project II / Internship(one semester)	Project	1.0	0	0	0	0	20.0

Course code	Construction and Contract Management	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> To make students who take this course be able to design sound contracts by training to interpret legal provisions and effectively administer and fulfill the requirements of a contract. To be able to effectively administer contract and identify tools available for contract preparation and administration. To Understand jurisprudence to effectively administer contracts and a construction organization. To interpret the laws like Labour Laws, Tax laws and G S T requirements and guidelines of other national and international legal regulatory bodies. 					
Course Outcome					
<p>At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> Explain the various types of construction contracts and their legal aspects. Appreciate the merits and demerits of a contract form and choose the most appropriate form. Identify and develop the stages of a tender; decide the work flow and be able to define requirements of each relevant stage. Prevent failure of a contract; Understand legal recourse when a contract fails irreconcilably. Relate legal aspects of a contract and gain knowledge in tax laws. Understand and apply labour regulations to construction industry. Be aware of practice of industry in executing contracts and administrative planning. 					
Module:1	Fundamentals of Contracts	6 hours			
Definition of Contract, Legal issues in contract – Standard forms of contracts- General and special conditions of contracts- Contract pricing by the client, project management consultants and the contractor, Contract correspondence and contract closure.					
Module:2	Construction Contracts	6 hours			
Types of contracts, Documents forming a contract, General conditions of Indian contracts - International contracts - Contract administration, Law of Torts - Interpretation of contract in case of inconsistency including case study.					
Module:3	Tenders	9 hours			
Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems - World Bank Procedures and Guidelines – Tamil Nadu Transparency in Tenders Act.					
Module:4	Arbitration	5 hours			
Comparison of Actions and Laws – Agreements –Appointment of Arbitrators – Conditions of Arbitration – Arbitration Tribunals - Powers and Duties of Arbitrator – Enforcement of Award – Arbitration and Conciliation Act 1996 - Arbitration case study.					
Module:5	Legal Requirements	5 hours			
Insurance and Bonding – Types of Bonds - Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes- Claims and disputes - Dispute resolution techniques.					
Module:6	Tax Laws	6 hours			
Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local					

Government Laws for Approval – Statutory Regulations –Central Government tax systems – GST.			
Module:7	Labour Regulations	6 hours	
Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes – Workmen’s Compensation Act 1923 – Indian Factory Act 1948 – Tamil Nadu Factory Rules 1950 – Child Labour (Prohibition and Regulation) Act, 1986 - Other Labour			
Module:8	Contemporary Topics	2 hours	
Industry Expert Lecture			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Jimmie Hinze, (2013). Construction Contracts, 3 rd Edition, McGraw Hill, New Delhi.		
2.	Sharma M. R., (2013). Fundamentals of Construction Planning & Management S.K. Kataria & Sons, New Delhi.		
Reference Books			
1.	Joseph T. Bockrath and Fredric L. Plotnick, (2013). Contracts and the Legal Environment: for Engineers and Architects, 7 th Edition, McGraw Hill, New Delhi.		
2.	Markanda P.C. , Naresh Markanda and Rajesh Markanda, (2016). Law Relating to Arbitration and Conciliation, 9th Edition, Lexis Nexis, New York.		
3.	Martin Brook (2016). Estimating and Tendering for Construction Work, 5th Edition, Routledge, Taylor & Francis.		
4.	Govt. of India, Central Public Works Department, CPWD Works Manual 2014.		
Mode of Evaluation : Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Construction Equipment Management	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the various types of equipment used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects. 2. To understand the managerial economics regarding selection and use of construction equipment. 3. To understand the significance of equipment used in batching placements and road construction. 4. To provide a comprehensive information on the materials handling equipment. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. Appreciate the significance of planning and selection of equipment and its maintenance strategies. 2. Understand the detailed insights on the equipment used for earthwork. 3. Appreciate the significance of equipment used for various construction activities. 4. Understand the significance of equipment used for demolition activities. 5. Understand the importance of equipment used in asphalt and concrete plants. 6. Know about various auxiliary equipment used for different materials handling processes. 7. Appreciate various managerial economics regarding selection and use of construction equipment. 					
Module:1	Equipment Management	6 hours			
Planning for equipment – Selection of Equipment - Equipment Management in Projects - Maintenance Management.					
Module:2	Equipment for Earthwork	6 hours			
Fundamentals of Earthwork Operations - Earth Moving Operations - Types of Earthwork Equipment - Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment.					
Module:3	Equipment for Construction	7 hours			
Equipment for Dredging, Trenching, Drag line and Clamshells, Tunnelling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Equipment for Construction of High-rise building – Tunnelling – Slipforming, and Cooling Tower.					
Module:4	Equipment for Demolition	6 hours			
Excavators – Hydraulic crushers – Breakers - Hydraulic pedestal booms - Hydraulic drop hammers – Skid Steer Loaders - Planning for Demolition.					
Module:5	Asphalt and Concrete Plants	6 hours			
Aggregate production- Different Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Pumping Equipment – Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment.					
Module:6	Materials Handling Equipment	6 hours			
Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes- Industrial Trucks.					
Module:7	Equipment Economics	6 hours			
Equipment cost – Ownership cost - Operating cost – Investment on Money – Time Value of Money - Cost control of Equipment – Maintenance Cost - Depreciation Analysis –					

Replacement of Equipment - Replacement Analysis – Safety Management.			
Module:8	Contemporary Topics	2 hours	
Industry Expert Lecture			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Peurifoy, R. L., Schexnayder, C. J., Shapira, A. (2010). Construction Planning, Equipment and Methods, Indian Edition, McGraw Hill, New Delhi.		
Reference Books			
1.	Sharma, S. C. (2019). Construction Equipment and Management, Khanna Publishers, New Delhi.		
2.	Bernold, L.E., (2015). Construction Equipment and Methods: Planning, Innovation, Safety, Indian Edition, Wiley India, New Delhi.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Construction Planning and Scheduling	L	T	P	C
XXXX		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the importance of construction planning and organizational cultures and their impact on a Project. 2. To know the relationship between strategic plans and projects and also understand the types of project risks in an organization. 3. To understand the importance of a complete and accurate WBS from a planning and executing point of view. 4. To compute critical path, slack and floats for a given network diagram. 5. To obtain the knowledge of advanced scheduling techniques and to be familiar with computerized scheduling both its limitations and advantages. 6. To prepare resource scheduling such as material, equipment and manpower requirements to execute the project. 7. To work out the costs associated with different construction projects. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. Understand the importance of construction planning and organizational cultures. 2. Discuss the relationship between strategic planning and project planning. 3. Construct WBS and compute critical path, slack and floats for a given network diagram. 4. Describe the advanced scheduling techniques. 5. Prepare various types of Project Information using Database Management Systems. 6. Create scheduling for material, equipment and manpower requirements to execute the project. 7. Estimate costs associated with different construction projects. 					
Module:1	Planning	5 hours			
Construction Planning - Organizing, Staffing, directing, and controlling – Factors influence supply and demand of human resources – Role of HR manager – Personnel Principles -case studies					
Module:2	Organizing	6 hours			
Requirement of Organization – Organization structure – Organization charts – Staffing Plan - Development and Operation of human resources					
Module:3	Scheduling Techniques	6 hours			
Work Breakdown Structure (WBS) -Time Management and Scheduling -Bar chart and Gantt chart - Network methods - Network diagram - Critical Path Method -Calculation critical path , Floats/slacks -PERT – Three time estimates					
Module:4	Resource Techniques	6 hours			
Precedence Diagram Method (PDM), Project monitoring - Updating - Target Schedule, Optimum cost and time, Scheduling with uncertain durations-Calculations for Monte Carlo Schedule Simulations- Crashing and Time-Cost Trade-off					
Module:5	Project Information	7 hours			
Types of Project Information - Accuracy and Use of Information -Computerized Organization and Use of Information - Other Conceptual Models of Databases - Centralized - Database Management Systems - Databases and Applications Programs –Information - Transfer and Flow.					
Module:6	Labour and Material Utilization	6 hours			
Labour requirements, labour productivity, Equipment, Material Management, Inventory					

Control, Economic order quantity, EOQ for resource limitation, Resource scheduling - leveling and allocation			
Module:7	Cost Estimation	7 hours	
Costs Associated with Constructed Facilities - Construction Cost Estimates - Historical Cost Data - Cost Indices - Applications of Cost Indices to Estimating - Estimate based on Engineer's List of Quantities - Estimation of Operating Costs			
Module:8	Contemporary Topics	2 hours	
Industry Expert Lecture			
		Total Lecture hours:	45 hours
		Tutorial	15 hours
Text Book(s)			
1.	Prasanna Chandra, (2017). Project Planning, Analysis, Selection, Implementation and Review, 8 th Edition, McGraw-Hill, New Delhi.		
Reference Books			
1.	Chitkara, K.K, (2014). Construction Project Management, 3rd Edition, McGraw-Hill Publishing Company, New Delhi.		
2.	Alison Dykstra (2011). Construction Project Management: A Complete Introduction, Kirshner Publishing, San Francisco, USA.		
3.	Jimmie W. Hinze, (2013). Construction Planning and Scheduling, 4th Edition, Pearson, NewDelhi.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Construction Economics and Finance	L	T	P	C
XXXX		3	1	0	4
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the Economics in civil engineering. 2. To understand concept of alternatives for decision making. 3. To analyze financial returns. 4. To evaluate the value added tax. 5. To understand the concept financial management, construction costing and financial statement analysis. 					
Course Outcome					
<p>At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Understand the Economics in civil engineering. 2. Understand concept of alternatives for decision making. 3. Analyze financial returns. 4. Evaluate the value added tax. 5. Understand the concept financial management, construction costing and financial statement analysis. 					
Module:1	Economics	5 hours			
Role of Civil Engineering in Industrial Development - Support matters of Economy as related top Engineering- Market demand and supply - Quality control and Quality Production -Audit in economic law of returns, governing production.					
Module:2	Equivalence Factors	7 hours			
Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalency - Single payment in the future - Present payment compared to uniform series payments - Future payment compared to uniform series payments - Arithmetic gradient, Geometric gradient					
Module:3	Financial Returns Analysis	6 hours			
Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis.					
Module:4	Evaluating Alternative Investments	6 hours			
Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before and after depreciation – Value Added Tax (VAT) – Inflation.					
Module:5	Financial Management	7 hours			
Financial statements – Profit and loss, Balance sheets, Financial ratios, Working capital management, Inventory valuation, Mortgage Financing - International financial management-foreign currency management.					
Module:6	Construction Costing	7 hours			
Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes. Fixed contract Pricing- Cost plus pricing- Escalation clause- Construction cost control, Personnel costs, Equipment costs, Job in directs and markup.					
Module:7	Financial Statement Analysis	5 hours			
Balance sheet and Profit and Loss accounts – ratios analysis, Fund flow statement, Cash flow statement, Working Capital Management, Financial Control - Management accounting.					
Module:8	Contemporary Topics	2 hours			
Industry Expert Lecture					

	Total Lecture hours:	45 hours
	Tutorial	15 hours
Text Book(s)		
1.	Anthony Higham, Carl Bridge, Peter Farrell, (2016), Project Finance for Construction, Routledge.	
Reference Books		
1.	Steven J. Peterson, (2012). Construction Accounting and Financial Management, Pearson, USA	
2.	Senthil, L. Madan and N. Robindro Singh, (2011). Engineering Economics and Cost Analysis, Lakshmi Publications, New Delhi.	
3.	Karl E. Case, Ray C. Fair and Sharon E. Oster (2017). Principles of Economics, Pearson, New Delhi.	
4.	Leland Blank and Anthony Tarquin, (2017). Engineering Economy, 7 th Edition, McGraw Hill Education, New Delhi.	
5.	Prof. Frank Harris, Prof. Ronald McCaffer, Andrew Baldwin, Francis Edum-Fotwe (2021). Modern Construction Management, 8th Edition, Wiley - Blackwell Publications, UK.	
6.	Bose, D. C., (2010). Fundamentals of Financial management, 2 nd ed., PHI, New Delhi.	
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test		
Recommended by Board of Studies		DD-MM-YYYY
Approved by Academic Council	No. xx	Date DD-MM-YYYY

Course code	Quality Control and Safety	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To train the students in the field work so as to have first-hand knowledge of practical problems related to Construction Management in carrying out engineering tasks. 2. To develop skills in facing and solving the problems experiencing in the field. 3. To know causes of accidents related to construction activities and human factors associated with these accidents. 4. To understand the construction regulations and quality assurance in construction. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. Extract the quality plan taking quality guide lines into consideration. 2. Implement a quality system, satisfying the quality requirements and documentation process. 3. Devise a plan for construction industry, with cost implications. 4. Evaluate the reliability of adopted quality assurance system through testing process. 5. Identify the quality improvement techniques and finding ways to implement. 6. Determine the causes of accidents in construction practice. 7. Identify the hazardous area in infrastructure projects and understanding the causes. 					
Module:1	Quality Management	7 hours			
Introduction – Definitions and objectives – Factors influencing construction quality – Responsibilities and authority – Quality plan – Quality Management Guidelines – Quality circles. Relationships: Quality, Productivity, Costs, Cycle Time and Value- Managing for quality					
Module:2	Quality Systems	7 hours			
Introduction - Quality system standard – ISO 9000 family of standards – Requirements – Preparing Quality System Documents – Quality related training – Implementing a Quality system – Third party Certification- Occupational safety and health Administration (OSHA) Requirements.					
Module:3	Quality Planning	6 hours			
Quality Policy, Objectives and methods in Construction industry - Consumer's satisfaction, Ergonomics - Time of Completion - Statistical tolerance – Taguchi's concept of quality – Codes and Standards – Documents – Contract and construction programming – Inspection procedures – field quality plans/tolerance in construction-codal guidelines-Processes and products – Total QA / QC programme and cost implication.					
Module:4	Quality Assurance and Control	6 hours			
Objectives – Regularity agent, owner, design, contract and construction-oriented objectives, methods – Techniques and needs of QA/QC – Different aspects of quality – Appraisals, Factors influencing construction quality – Critical, major failure aspects and failure mode analysis, – Stability methods and tools, optimum design – Reliability testing, reliability coefficient and reliability prediction.					
Module:5	Quality Improvement Techniques	6 hours			
Selection of new materials – Influence of drawings, detailing, specification, standardization – Bid preparation – Construction activity, environmental safety, social and environmental factors – Natural causes and speed of construction – Life cycle costing – Value engineering and value analysis.					
Module:6	Accident Causes and Management Systems	6 hours			
Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with					

these accident – construction regulations, contractual clauses – Pre contract activates, preconstruction meeting - design aids for safe construction – permits to work – quality assurance in construction - compensation – Recording of accidents and safety measures – Education and training			
Module:7	Hazards of Construction and Its Prevention		5 hours
Excavations, basement and wide excavation, trenches, shafts – scaffolding, types, causes of accidents, scaffold inspection checklist – false work – erection of structural frame work, dismantling – tunneling – blasting, pre blast and post blast inspection – confined spaces – working on contaminated sites – work over water - road works – power plant constructions – construction of high rise buildings.			
Module:8	Contemporary Topics		2 hours
Industry Expert Lecture			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Juran Frank, J.M. and Gryna, F.M. (2017). Quality Planning and Analysis for enterprise quality, McGraw Hill, USA.		
2.	S.K. Bhattacharjee. (2011). Safety Management in Construction, Khanna Publishers, India.		
3.	S. C. Sharma and Vineet Kumar. (2013). Safety, Occupational Health And Environmental Management In Construction, Khanna Publishers, India.		
Reference Books			
1.	Daniel J Frawley, John McPeek, Christopher Anderson. (2012). ISO 9001 Quality Procedures for Quality Management Systems, Bizmanualz, Inc., USA.		
2.	James, J.O’ Brian. (2012). Construction Inspection Handbook – Total Quality Management, Springer, Switzerland.		
3.	David V. MacCollum. (2007). Construction Safety Engineering Principles, Mc Graw Hill. USA.		
4.	Steven McCabe. (1998). Quality Improvement Techniques in Construction, Addison Wesley Longman Ltd, USA.		
5.	V. J. Davies and K. Thomasin. (1996). Construction Safety Hand Book, Thomas Telford Ltd., London, United Kingdom.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Construction Project Management		L	T	P	C
XXXX			3	0	0	3
Pre-requisite	NIL	Syllabus version				
		x.x				
Course Objectives						
1. To study the project management and role of project management in construction project. 2. To study various operations and monitoring systems in construction project. 3. To study the project direction in construction project. 4. To study the design and material management.						
Course Outcome						
At the end of the course, students will be able to 1. Understand the concept of Project, construction and project life cycle. 2. Able to organize the team for the construction project and understand the role of project management. 3. Understand the various operation and controlling system in the project management 4. Able to know about design methodology for construction and project direction stages.						
Module:1	Project and Project Management		6 hours			
Project - Concept of a project – Project quality features – Project Life cycle (PLC) – Construction Type- Stages – Tools and techniques for project management						
Module:2	Organizing and Role of Project Management		7 hours			
Project Plan - Programming - Scheduling - organization and project team - Legal and Regulatory Requirements- role of project managers- Management controlling systems						
Module:3	Working Operation		6 hours			
Effects of Project Risks on Organization- Owner-Builder Operation - Turnkey Operation - Leadership and Motivation for the Project Team						
Module:4	Monitoring systems		6 hours			
Working systems – Characteristics – class of systems – design of systems – work break down system (WBS) – project execution plan – project procedure - monitoring of projects-networks – monitoring contracts.						
Module:5	Design and Construction activity		6 hours			
Integrated System design and construction - Design Methodology - Functional Design - Construction Site Environment.						
Module:6	Project Supervision		6 hours			
Project direction – direction during production stage – value engineering review – stages – directives – project coordination.						
Module:7	Resource Management		6 hours			
Basic concept – Labour requirements – Labour productivity – site productivity – Equipment Management – Material management - functions of material management						
Module:8	Contemporary Topics		2 hours			
Industry Expert Lecture						
		Total Lecture hours:	45 hours			
Text Book(s)						
1.	Chitkara, K.K. (2014). Construction Project Management: Planning, Scheduling and Control, 3 rd Edition Tata McGraw-Hill Publishing Company, New Delhi.					
Reference Books						
1.	Prasanna Chandra, (2009). Project Planning, Analysis, Selection, Implementation and review, Tata McGraw Hill, New Delhi.					

2.	Sengutha .B, Guha .H, (2001). Construction Management and Planning, Tata McGraw Hill, New Delhi.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY



BCLE201L	CONSTRUCTION MATERIALS	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	Syllabus version			
		V. XX.XX			
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. Understand the various properties of building materials. 2. Classify stones and masonry construction. 3. Examine timber products and its applications. 4. Acquire the knowledge on various properties of cement, aggregates and mortars. 5. Analyse the various miscellaneous construction materials for its respective application.					
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-Variou s 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-Variou s 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. xx	Date	DD-MM-YYYY



BCLE202L	FLUID MECHANICS	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		V. XX.XX			
Course Objectives					
The objectives of this course is to : <ol style="list-style-type: none"> 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 : <ol style="list-style-type: none"> 1. Analyse various hydraulic systems by applying the laws of statics and resolve fluid flow governing equations by taking appropriate constraints and assumptions. 2. Measure the pipe flow discharge and major and minor losses. 3. Analyse the practical significance of open channel flows. 4. Solve the fluid problems through dimensional analysis. 5. Predict the boundary layer aspects of laminar and turbulent flows. 					
Module: 1	Introduction to Fluid Properties	5 hours			
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. xx	Date	DD-MM-YYYY



BCLE202P	FLUID MECHANICS LAB	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	Syllabus version			
		V. XX.XX			
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. Perform experiments and determine discharge in open and closed conduit. 2. Determine friction factor in flow through pipes. 3. Classify the type of flow and determine discharge.					
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. xx	Date	DD-MM-YYYY	



BCLE203L	MECHANICS OF SOLIDS	L	T	P	C
		3	0	0	3
Pre-requisite	Engineering Mechanics	Syllabus version			
v. XX.XX					
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to</p> <ol style="list-style-type: none"> 1. Understand the fundamental concept of stress and strain of deformable bodies. 2. Evaluate the problems related to pure and uniform bending of beams and other simple structures. 3. Apply the bending concepts to calculate the deflection of beams under various loading conditions. 4. Determine the effect of torsion of shafts and buckling of columns 5. Analyse the structural elements using 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. xx	Date	DD-MM-YYYY



BCLE203P	MECHANICS OF SOLIDS LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Engineering Mechanics	Syllabus version			
		V. XX.XX			
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 shear and tensile properties of steel 2. Apply bending principles to evaluate the flexural behaviour of steel and wooden beam 3. Understand the fundamental principles of stability.					
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. xx	Date	DD-MM-YYYY	



BCLE204L	SURVEYING	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		v.XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Perform surveying using different types of surveying instruments and equipments such as levels, theodolite, Total station, GPS and LIDAR. 2. Measure distances, angles, elevations and coordinates. 3. Estimate the area of given parcel of land and calculate the volume of earthwork involved in cutting and fillings. 4. Prepare longitudinal and cross section levelling, curve setting and 3D map preparation. 5. Execute project work related to surveying using modern instruments. 					
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
<p>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.</p> <p>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.</p>					
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. xx	Date DD-MM-YYYY



BCLE204P	SURVEYING LAB	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	Syllabus version			
		V. XX.XX			
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. Identify a suitable surveying technique and instrument for the given survey task. 2. Prepare maps using the survey data collected. 3. Familiarise students with the surveying softwares for map preparation.					
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. xx	Date	DD-MM-YYYY	



BCLE205L	ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Understand the significance of water and wastewater treatment for sustainable development. 2. Demonstrate an ability to identify and understand the different unit operations and processes involved in water and wastewater treatment plants. 3. Acquire knowledge on sludge treatment and disposal of sewage. 4. Categorize, separate, treat and safely dispose the solid waste. 5. Acquire knowledge on Air and Noise pollution and its effects. 					
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. xx	Date	DD-MM-YYYY



BCLE205P	ENVIRONMENTAL ENGINEERING LAB	L	T	P	C
		0	0	2	1
Pre-requisite	NIL	Syllabus version			
		V. XX.XX			
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. Demonstrate the guidelines with respect to various parameters of water and wastewater quality testing. 2. Know the concepts of sample collection and preservation procedures. 3. Apply the laboratory results for identifying and quantifying the level of contamination.					
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. xx	Date	DD-MM-YYYY	



BCLE209L	ENGINEERING GEOLOGY	L	T	P	C
		2	0	0	2
Pre-requisite	NIL	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Describe various internal structures of earth and plate tectonic movements. 2. Characterize the engineering properties of rocks, minerals and soil. 3. Assess the naturally occurring various geological hazards. 4. Apply seismic and electrical methods to investigate the subsurface of the earth. 5. Develop a native construction plan to incorporate all relevant aspects of Geology in Civil Engineering work. 					
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. xx	Date	DD-MM-YYYY



BCLE206E	BUILDING PLANNING AND DRAWING	L	T	P	C
		1	0	2	2
Pre-requisite	Engineering Design Visualization Laboratory	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Prepare building drawings as per Indian Standards. 2. Implement digital tools for drafting. 3. Plan and design layouts for residential, educational, commercial and industrial buildings as per National Building Codes and Development Control Rules. 4. Draft reinforcement detailing for the RCC structural elements. 5. Sketch the detailed plan of industrial sheds with roof trusses. 					
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. xx	Date DD-MM-YYYY



BCLE207L	SOIL MECHANICS	L	T	P	C
		3	0	0	3
Pre-requisite	Engineering Mechanics	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Identify the properties and type of soil during the site investigation 2. Suggest the type of soil compaction in the field. 3. Understand the flow patterns and stress distribution of soils. 4. Evaluate the consolidation and shear strength parameters. 5. Analyse the stability of slopes. 					
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 their 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-Taylor's 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. xx	Date	DD-MM-YYYY



BCLE207P	SOIL MECHANICS LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Engineering Mechanics	Syllabus version			
		v. XX.XX			
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 of the soil. 2. Perform grain size analysis and classify the soil according to BIS. 3. Conduct the compaction and shear strength tests.					
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. xx	Date	DD-MM-YYYY	



BCLE208L	STRUCTURAL ANALYSIS	L	T	P	C
		2	1	0	3
Pre-requisite	Mechanics of Solids	Syllabus version			
		v. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Understand the types of structures and determine the indeterminacies. 2. Analyse and draw SFD and BMD using Clapeyron's method. 3. Evaluate the deflection and reaction components using strain energy method. 4. Analyse and draw SFD and BMD using slope deflection method and Moment Distribution method. 5. Draw the influence line diagram for indeterminate beams and to analyse simple 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. xx	Date	DD-MM-YYYY



BCLE301L	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3
Pre-requisite	Construction Materials	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Identify the quality of cement and aggregates by various testing methods as per standards. 2. Evaluate the workability and strength of concrete. 3. Know the various stages of concrete in concrete production. 4. Check the durability properties of concrete. 5. Design the mix proportion of concrete. 					
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-Variou 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-Variou 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. xx	Date DD-MM-YYYY



BCLE301P	CONCRETE TECHNOLOGY LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Construction Materials	Syllabus version			
		v. XX.XX			
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. Find the various properties of cement, fine aggregate and coarse aggregate. 2. Determine the various mechanical properties of concrete. 3. Assess the quality and strength of concrete using NDT equipments.					
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. xx	Date	DD-MM-YYYY	



BCLE302L	HYDRAULICS AND HYDRAULIC MACHINES	L	T	P	C
		3	0	0	3
Pre-requisite	Fluid Mechanics	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Select and Design the turbines and pumps based on the need and purpose. 2. Identify the different components of head work and its use. 3. Interpret the various functions of hydraulic structures such as canal escape and canal outlet. 4. Describe the various zones of storage reservoir 5. Calculate the different types of forces acting on the dam and design it. 					
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-Blighs creep theory-Lanes 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. xx	Date DD-MM-YYYY



BCLE302P	HYDRAULICS AND HYDRAULIC MACHINES LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Fluid Mechanics	Syllabus version			
		V. XX.XX			
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. Identify a pump based on the need and application. 2. Determine the performance characteristics of turbines. 3. Evaluate the force exerted by the 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. xx	Date	DD-MM-YYYY	



BCLE303L	FOUNDATION ENGINEERING	L	T	P	C
		2	1	0	3
Pre-requisite	Soil Mechanics	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Create site investigation plan and bore log. 2. Evaluate safe bearing capacity of shallow foundations as per BIS and analyse its settlement. 3. Evaluate load carrying capacity of pile foundation as per BIS. 4. Analyse the stability of well foundations. 5. Compute lateral earth pressure. 					
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. xx	Date	DD-MM-YYYY



BCLE304L	DESIGN OF REINFORCED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3
Pre-requisite	Structural Analysis	Syllabus version			
V. XX.XX					
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Understand the basic design concepts. 2. Design the reinforced concrete beams, slabs, staircase and columns. 3. Design the footing. 4. Design the water tank and retaining wall. 5. Understand the serviceability limit states. 					
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. xx	Date DD-MM-YYYY



BCLE304P	REINFORCED CONCRETE STRUCTURES LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Structural Analysis	Syllabus version			
		V. XX.XX			
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. Evaluate the flexural capacity of singly and doubly reinforced beam. 2. Design of beam and columns using software & Design Sheets.					
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. xx	Date	DD-MM-YYYY	



BCLE305L	TRANSPORTATION ENGINEERING	L	T	P	C
		2	1	0	3
Pre-requisite	Surveying	Syllabus version			
		V. XX.XX			
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. Identify the most suitable highway alignment through engineering surveys. 2. Design the geometric elements and understand various traffic elements on a highway. 3. Study the traffic conditions on a road and identify basic solutions for traffic problems. 4. Perform tests and identify whether a given highway pavement material is suitable for construction. 5. Design a highway pavement using IRC method.					
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. xx	Date DD-MM-YYYY



BCLE306L	WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Fluid Mechanics	Syllabus version			
		V. XX.XX			
Course Objectives					
The objectives of this course is to : <ol style="list-style-type: none">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 : <ol style="list-style-type: none">1. Explore the spatial variation of rainfall and abstractions, hydrological models to estimate the stream flow and design of storm using various techniques.2. Predict the aquifer parameters and yield from groundwater resources for different hydro-geological boundary conditions.3. Determine the optimum method of irrigation for judicious use of water resources.4. Design the Minor irrigation structures.5. Assess the reservoir sedimentation using modern techniques and implement the mitigation measure.					
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		
<ol style="list-style-type: none">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		
<ol style="list-style-type: none">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. xx	Date DD-MM-YYYY



BCLE306P	WATER RESOURCES ENGINEERING LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Fluid Mechanics	Syllabus version			
		V. XX.XX			
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. Analyse and assess the reservoir losses, runoff and flood. 2. Analyse ground water based on its quality. 3. Analyse and design the Minor irrigation structures.					
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. xx	Date	DD-MM-YYYY	



BCLE307L	CONSTRUCTION PRACTICES AND MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
v. XX.XX					
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Discuss the basic principles and practices involved in construction. 2. Select the suitable construction technique for different types of construction. 3. Acquire a knowledge on special construction. 4. Prepare construction plans and project Work Break down Structure. 5. Schedule complex construction projects using different scheduling methods. 					
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. xx	Date DD-MM-YYYY



BCLE308L	DESIGN OF STEEL STRUCTURES	L	T	P	C
		3	0	0	3
Pre-requisite	Structural Analysis	Syllabus version			
		V. XX.XX			
Course Objectives					
The objectives of this course is to : <ol style="list-style-type: none"> 1. Study the behavior 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 : <ol style="list-style-type: none"> 1. Design the Connections. 2. Design the tension members, compression members and flexural members. 3. Design the Plate Girders and Beam-Columns. 4. Design the Cold Formed Steel Structures. 5. Design the Industrial Structures. 					
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. xx	Date DD-MM-YYYY



BCLE308P	STEEL STRUCTURES LAB	L	T	P	C
		0	0	2	1
Pre-requisite	Structural Analysis	Syllabus version			
		v. XX.XX			
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. Understand the tension capacity of bolted and welded connections. 2. Know the compression capacity of columns. 3. Interpret the flexural capacity of laterally supported beams and laterally un-supported beams.					
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. xx	Date	DD-MM-YYYY	



BCLE309L	ESTIMATING AND COSTING	L	T	P	C
		2	0	0	2
Pre-requisite	Building Planning and Drawing	Syllabus version			
V. XX.XX					
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Gain knowledge on methods of estimates of buildings. 2. Know the concepts to prepare a detailed estimate for different types of structures. 3. Evaluate the rate for various items of works in different types of structures. 4. Develop the tender document as per the requirement of public works department. 5. Prepare valuation reports, analyse the cost and quality control in construction. 					
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. xx	Date	DD-MM-YYYY



BCLE210L	AI IN CIVIL ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		v. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of the course students will be able to</p> <ol style="list-style-type: none"> 1. Gain a historical perspective of AI and its foundations 2. Apply ANN, Fuzzy logic, GA, ML in Civil Engineering domain. 3. Solve real world problems using artificial intelligence. 4. Implement the IoT applications in Civil Engineering discipline. 5. Enhance the computational knowledge in various disciplines of Civil Engineering 					
Module: 1	Artificial Intelligence (AI)	5 hours			
Artificial Intelligence (AI)-Definition-Development of AI-Types of AI-Application of AI of 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)		
<ol style="list-style-type: none">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		
<ol style="list-style-type: none">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. xx	Date DD-MM-YYYY



BCLE310L	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3
Pre-requisite	Environmental Engineering	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Understand the importance of EIA for the project execution. 2. Obtain knowledge on the role of government in approving the projects and the laws to be enforced. 3. Examine suitable methods in handling the data collected during the EIA processes. 4. Assess the impacts that could occur for physical, biological and socioeconomic environment by the project. 5. Mitigate, monitor and draft an EIA report. 					
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. xx	Date	DD-MM-YYYY



BCLE311L	INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	Environmental Engineering	Syllabus version			
v. XX.XX					
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to</p> <ol style="list-style-type: none"> 1. Understand the treatment evaluation processes and select the suitable sampling technique, and characterize the industrial wastes. 2. Assess the treatment capacity of each physical, chemical and biological method. 3. Prevent groundwater contamination by adopting suitable storm water methods. 4. Investigate the air discharges and suggest the suitable techniques to various industries. 5. Implement the suitable industrial solid waste treatment methods practically. 					
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. xx	Date DD-MM-YYYY



BCLE312L	AIR AND NOISE POLLUTION CONTROL	L	T	P	C
		3	0	0	3
Pre-requisite	Environmental Engineering	Syllabus version			
		v. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Understand the sources, effects and legislations of air pollution. 2. Gain familiarity with the air quality and emissions assessment. 3. Predict the exposure concentrations, air quality status and trends. 4. Apply the fundamental principles of air quality control for the engineering design of air pollution control equipment. 5. Understand the sources, impacts, assessment and mitigation measures of noise pollution. 					
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. xx	Date	DD-MM-YYYY



BCLE313L	SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	Environmental Engineering	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Identify the various sources of Solid Waste 2. Execute suitable methods of collection and transportation of Solid Waste 3. Implement an action plan for disposal of Solid Waste 4. Assess the cost effectiveness for recovery and handle hospital waste. 5. Involve in the concepts of circular economy in 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-Hagggar, 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. xx	Date DD-MM-YYYY



BCLE314L	GEOTECHNICAL EARTHQUAKE ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Soil Mechanics	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Understand the magnitude and intensity scales of earthquake. 2. Assess strong ground motion parameters and the seismic hazard of a given site. 3. Evaluate dynamic properties of soil of a given site. 4. Assess the response of the site for given seismic input motion. 5. Measure the factor of safety against liquefaction of a given site and select suitable ground improvement technique to mitigate seismic hazard. 					
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. xx	Date DD-MM-YYYY



BCLE315L	GROUNDWATER ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Fluid Mechanics	Syllabus version			
		v. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Obtain the origin, distribution and movement of groundwater, rock properties and aquifer system. 2. Solve the equations for steady and unsteady flow through confined and unconfined aquifers 3. Demonstrate the construction, packing, protection and rehabilitation of wells. 4. Analyse the water quality standards, sources of groundwater pollution and the remedial measures to be adopted to control contaminated groundwater. 5. Examine groundwater occurrence through surface and subsurface methods and apply numerical model for various application along with better understanding of aquifer characteristics. 					
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. xx	Date DD-MM-YYYY



BCLE316L	ROCK ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Soil Mechanics	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Classify the rock and the applications of rock mass. 2. Interpret the importance of various physical, mechanical and time dependant properties of rock. 3. Comprehend the stress and strain behaviour in rock. 4. Evaluate the strength and deformability characteristics of rock. 5. Know the art of tunnelling and its various methods. 					
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. xx	Date DD-MM-YYYY



BCL401L	TRAFFIC ENGINEERING	L	T	P	C
		3	0	0	3
Pre-requisite	Transportation Engineering	Syllabus version			
		v. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Describe the various traffic stream parameters and its relationships. 2. Perform traffic studies and analyse traffic data using probability and statistics concepts. 3. Estimate traffic flow capacity and analyse level of service of a highway section. 4. Prepare various traffic control and management measures. 5. Analyse accident data and perform accident black spot identification. 					
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. xx	Date DD-MM-YYYY



BCLE211L	URBAN PLANNING AND DEVELOPMENT	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		V. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Describe the importance of proper urban planning and housing schemes for a healthy city. 2. Explain the steps involved in planning a city using remote sensing and GIS. 3. Discuss the public transport and non-motorized transport facilities for a city. 4. Describe the importance of environment and natural resources in urban planning. 5. Illustrate smart cities developments in India and other countries. 					
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. xx	Date	DD-MM-YYYY



BCLE402L	PRE-STRESSED CONCRETE AND INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3
Pre-requisite	Design of Reinforced Concrete Structures	Syllabus version			
		v. XXXX			
Course Objectives					
The objectives of this course is to : <ol style="list-style-type: none"> 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 : <ol style="list-style-type: none"> 1. Enumerate on basic concepts and principles of pre-stressing. 2. Calculate the different types of losses in pre-stress and deflections in beams. 3. Analyse the pre-stressed concrete beams under various stages of loading. 4. Design pre-stressed concrete beams for flexure, shear and torsion at ultimate limit state. 5. Apply the concepts of pre-stressing 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. xx	Date	DD-MM-YYYY



BCLE403L	OPEN CHANNEL HYDRAULICS	L	T	P	C
		3	0	0	3
Pre-requisite	Fluid Mechanics	Syllabus version			
		v. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Identify the various types of channel flows. 2. Compute the flow rate, pressure distribution, and specific energy of flow in channels. 3. Solve various numerical in critical, uniform, gradually and rapidly varied open channel flows. 4. Classify the different types of flow profiles in open channels. 5. Analyse the 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-Chezy'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. xx	Date DD-MM-YYYY



BCLE212L	NATURAL DISASTER MITIGATION AND MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		v. XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Understand the safety precautions and how to handle the disasters. 2. Develop skills in different disasters and its mitigation methods. 3. Examine how quickly to response and prepared for different disasters. 4. Understand how the space and communication technology used in disaster monitoring and early warning. 5. Learn 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)		
<ol style="list-style-type: none">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		
<ol style="list-style-type: none">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. xx	Date DD-MM-YYYY



BCLE213E	REMOTE SENSING AND GIS	L	T	P	C
		2	0	2	3
Pre-requisite	NIL	Syllabus version			
		v. XX.XX			
Course Objectives					
<p>The objectives of this course is to</p> <ol style="list-style-type: none"> 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					
<p>Upon completion of this course, the student will be able to</p> <ol style="list-style-type: none"> 1. Select the type of remote sensing technique for the required purpose. 2. Analyse the basic components of GIS. 3. Perform spatial analysis and prepare thematic maps 4. Classify the photogrammetry methods and compute elevations from parallax measurements 5. Apply the concepts of GIS and Remote Sensing in Engineering and Science Fields 					
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. xx	Date	DD-MM-YYYY



BCLE214L	GLOBAL WARMING	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		v. XX.XX			
Course Objectives					
The objectives of this course is to : <ol style="list-style-type: none"> 1. Learn atmospheric dynamics and transport of heat. 2. Evaluate climate changes using models and predict global warming. 3. Acquire the concept of mitigation measures for global warming. 					
Course Outcomes					
Upon completion of this course, the student will be able to : <ol style="list-style-type: none"> 1. Understand the principles of atmospheric dynamics and demonstrate the intimidations of global warming at global and regional level. 2. Understand the need for mitigation and vulnerability assessment of regional and global warming. 3. Critically evaluate the scientific insights of the IPCC, global policies on global warming and mitigation. 4. Develop climatic models to predict global warming. 5. Relate knowledge of science and engineering for mitigation of global warming. 					
Module: 1	Introduction				5 hours
Introduction to global warming–Significance of ozone in environment–Depletion of ozone layer–Greenhouse gases–Vienna convention and Montreal protocol–Role of hydrological cycle with greenhouse gases–Carbon cycle.					
Module: 2	Characteristics of atmosphere and its effects				8 hours
Physical and chemical characteristics of atmosphere–Biogeochemistry–Atmospheric stability–Temperature profile of the atmosphere–Temperature inversion effects–Isobaric heating and cooling–Adiabatic lapse rates–Radiation, convection and advections–Sun & solar radiation–Energy balance–Terrestrial radiation and the atmosphere.					
Module: 3	Elements of global warming				7 hours
Total carbon dioxide emissions by energy sector–industrial, commercial, transportation, residential–Impacts–air quality, hydrology, green space–Causes of global and regional climate change–Changes in patterns of temperature, precipitation and sea level rise–Greenhouse effect.					
Module: 4	Impacts of global warming				7 hours
Roots of global warming–Temperature alteration in the atmosphere–Melting of ice Pole–sea level rise–Impacts on Ecosystem–Water Resources–Methods and Scenarios–Uncertainties in the impacts of global warming–Risk of irreversible changes –Vulnerability assessment.					
Module: 5	Forecasting global warming with climate change models				6 hours
Developing climate models–Climate system model–Climate simulation and drift–Evaluation of climate model simulation–Regional (RCM)–Global (GCM)–Global average response to warming–Climate change observed to date.					
Module: 6	Global Policies and regulations towards global warming				5 hours
National and national legislative frameworks–UNFCCC–IPCC–Kyoto protocol–Kyoto mechanisms, clean development mechanisms, IPCC details and actions–Carbon credits–International and Regional cooperation.					
Module: 7	Mitigation measures of global warming				5 hours
Carbon sequestration and Carbon capture and storage (CCS)–Clean development mechanism (CDM)–Carbon trading–Future clean technology–Renewable and alternative energy, Green building, eco-friendly plastic.					



Module: 8	Contemporary issues	2 hours
Guest lecture from industry and R & D organisations.		
Total Lecture Hours		45 hours
Text Book(s)		
<ol style="list-style-type: none">1. Robin Moilveen, Fundamentals of weather and climate, 2010, Second Edition, Oxford University Press, UK.2. Neelin David J, Climate Change and Climate Modelling, 2011, First Edition, Cambridge University Press, UK.		
Reference Books		
<ol style="list-style-type: none">1. Thomas Stocker, Introduction to Climate Modelling, Advances in Geophysical and Environmental Mechanics and Mathematics. 2011, Springer, UK.2. Robert T. Watson, Marufu C. Zinyowera, Impacts, Richard H. Moss, Adaptation and mitigation of climate change-Scientific Technical Analyses, 1996, Cambridge University Press, Cambridge, USA.3. J.M. Wallace, P.V. Hobbs, Atmospheric Science, 2006, Second Edition, Elsevier / Academic Press, USA.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		
Recommended by Board of Studies	24.02.2022	
Approved by Academic Council	No. xx	Date DD-MM-YYYY



BCLE215L	WASTE MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
v. XX.XX					
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 1. Understand the different sources of the waste. 2. Analyse the socio-economic and environmental factors for waste management. 3. Imply the shift of waste management in the closed loop approach. 					
Course Outcomes					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Understand the potential impacts of waste management. 2. Develop the environmental, social and economic framework towards sustainable development. 3. Apply sustainable development tools in regulating the waste management. 4. Implement life cycle analysis in waste management. 5. Involve in the concepts of closed loop approach and circular economy. 					
Module: 1	Introduction to Waste Management	5 hours			
<p>Perspective of waste generation–Sources, impacts, characteristics, segregation and disposal of waste-Linear economy –Urbanization and new challenges in waste management–Problems associated with the waste-Relevant Regulations.</p>					
Module: 2	Municipal Solid Waste Management	7 hours			
<p>Sources; composition; generation-Rates; collection of waste; separation-Transfer and transport of waste-Treatment and disposal options-Landfill-Bio-mining-Incineration-Biomedical waste-Source, generation and classification-Waste management and reduction techniques.</p>					
Module: 3	Hazardous Waste Management	6 hours			
<p>Characterization of waste-Compatibility and flammability of chemicals-Storage-Transport-Secured Landfills-Treatment techniques-Fundamental concepts on fate and transport of chemicals-Health effects.</p>					
Module: 4	Radioactive Waste Management	6 hours			
<p>Sources, measures and health effects-Nuclear power plants and fuel production-Waste generation from nuclear power plants–Low level and high level waste-Management-Radiation standard by ICRP and AERB-Regulatory framework.</p>					
Module: 5	Wastewater Management	5 hours			
<p>Sources and characteristics of wastewater–Primary wastewater treatment–Secondary wastewater treatment–Sludge treatment alternatives–Industrial wastewater treatment–Zero Liquid Discharge–Wastewater disposal methods.</p>					
Module: 6	Emerging waste	9 hours			
<p>Sources and Characteristics of Plastic waste, marine plastic waste, microplastic, E-waste, Agriculture waste, Glass waste, Metal waste, Oil and gas exploration and production of waste, Space waste, Construction material waste-Recycling non-biodegradable waste, Tyre recycling, End of life textiles, Recovery of value added products, Reuse of waste.</p>					
Module: 7	Closed Loop Approach Towards Circular Economy	5 hours			
<p>Introduction to the Circular Economy-Transition from Linear to Circular Economy-Closed loop supply chain–Integrated waste refinery-Sustainable Development Goals (SDGs)-Circular Economy policies towards Sustainable Development.</p>					
Module: 8	Contemporary issues	2 hours			
<p>Guest lecture from industry and R & D organisations.</p>					



Total Lecture Hours		45 hours
Text Book(s)		
1. Salah M. El-Haggar, Sustainable Industrial Design and Waste Management Cradle-to-cradle for Sustainable Development, 2007, Elsevier Academic Press, USA.		
Reference Books		
1. Trevor M. Letcher and Daniel A. Vallero, Waste- A Handbook for Management, 2019, Second Edition, Elsevier Academic Press, USA. 2. Alexandros Stefanakis and Ioannis Nikolaou, Circular Economy and Sustainability Volume 2: Environmental Engineering, 2021, First Edition, Elsevier Academic Press, USA.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT.		
Recommended by Board of Studies	24.02.2022	
Approved by Academic Council	No. xx	Date DD-MM-YYYY



BCLE216L	WATER RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		V.XX.XX			
Course Objectives					
<p>The objectives of this course is to :</p> <ol style="list-style-type: none"> 1. Acquire the basic principles of water resources and its planning and management. 2. Enhance the knowledge on recent technologies in assessing the water resources. 3. Identify the challenges facing water management in varied climate types around the world. 					
Course Outcomes					
<p>Upon completion of this course, the student will be able to :</p> <ol style="list-style-type: none"> 1. Understand the planning of water resources and need for water resource management. 2. Understand the water resource potential in global, India scenario and explore the water resources using different technologies. 3. Acquire a knowledge international and national water law and its policy. 4. Explain the concept of water in agricultural and economic aspects. 5. Predict the future trends of water demand and its management during crisis. 					
Module: 1	Water, A Multi-Dimensional Resource	5 hours			
Water resources planning-Multi-dimensional management-Water withdrawal and consumption by sector-Stress, international policy-Climate change, oceans, challenges and need for water resource management.					
Module: 2	Global and Indian Scenario for Water Resources	4 hours			
Surface Water and Groundwater Global and Indian Scenario-Quality of water resources-Water use and sustainable reuse methods-Usable water resources by continent and country-Water footprint.					
Module: 3	Water Resources Assessment	5 hours			
Network design-Stream flow gauging-Weir design-Gauges-Current gauging-Salt dilution-Geophysical exploration-Test drilling-Application of remote sensing techniques.					
Module: 4	Water in Agricultural Systems	7 hours			
Water for food production, virtual water trade for achieving global water security, irrigation efficiencies, irrigation methods and current water pricing, water for livestock and processing, water pollution from agricultural production					
Module: 5	Water Economics	8 hours			
Economic characteristics of water good and services-Nonmarket monetary valuation methods-Water economic instruments-Policy options for water conservation and sustainable use, pricing, distinction between values and charges-Private sector involvement in water resources management.					
Module: 6	Water Legal and Regulatory Settings	8 hours			
National and International Framework for Water Law; Basic structure of water law- An overview of water law in India -Evolution of water law, key features of water law, evolving water law and policy-Water policy for Irrigation, decentralization and participation in irrigation management, and the policy measures proposed to establish water user associations. National level initiatives for regulation of groundwater, State groundwater laws and rainwater harvesting.					
Module: 7	Demand Management	6 hours			
Balancing supply and demand-Economic theory of supply and demand-management by use of tariffs-Timing, long-term, operational time-frame-Crisis management-Cost of water-Future trends-Economic value of water-Loss control-Water harvesting.					



Module: 8	Contemporary issues	2 hours	
Guest lecture from industry and R & D organisations.			
Total Lecture Hours			45 hours
Text Book(s)			
1. David Stephenson, Water Resources Management, 2004, A. A. Balkema Publishers, Netherlands.			
Reference Books			
1. Louis Theodore, Ryan Dupont R., Water Resource Management Issues, Basic Principles and Applications, 2020, CRC Press, Taylor & Francis Group, New York.			
2. Philippe Cullet and Sujith Koonan, Water Law in India- An Introduction to Legal Instruments, 2017. Second Edition, Oxford University Press, New Delhi.			
3. Subramanya. K., Engineering Hydrology, 2020, Fifth Edition, McGraw Hill Education Pvt. Ltd., New Delhi.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT.			
Recommended by Board of Studies	24.02.2022		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course code	Construction Personnel Management	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	Construction Project Management	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> To understand the principles of project life cycle and legal and regulatory requirements. To be familiar with modern trends in the project management and project risks in organization. To know the elements of the Human Resource function and improve the productivity of human resources. To understand the awareness on fundamentals of human behaviour under varying stress conditions and laws related to labour welfare measures. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> Explain the principles of project life cycle and role of project managers. Discuss the modern trends in the project management and solve the project risks in organization. Know the human resources planning and policies through proper selection and training methods. Apply the different strategies and approaches used in the resolution of conflict. Analyse the organizational behaviour related to group dynamics and team working. Suggest the laws related to labour welfare measures. Apply the principles and techniques of human resource management and solution to personnel issues. 					
Module:1	The Owners Perspective	6 hours			
Introduction - Project Life Cycle - Types of Construction - Selection of Professional Services - Construction Contractors - Financing of Constructed Facilities - Legal and Regulatory Requirements - Changing Environment of the Construction Industry - Role of Project Managers. Managing labour on construction sites.					
Module:2	Project Management	6 hours			
Project Management - Productivity in construction, Analysis of productivity, Productivity measurement – Modern trends - Effects of Project Risks on Organization - Organization of Project Participants -Traditional Designer-Constructor Sequence - Professional Construction Management - Owner-Builder Operation					
Module:3	Human Resources	6 hours			
Staffing Plan - Development and Operation of human resources - Managerial Staffing – Recruitment – Selection strategies – Placement and Training.					
Module:4	Human Relations	6 hours			
Basic individual psychology – Approaches to job design and job redesign – Self managing work teams – Intergroup – Conflict in organizations – Leadership-Engineer as Managerial aspects of decision making – Significance of human relation and organizational structure.					
Module:5	Organizational Behaviour	6 hours			
Individual in organization – Motivation – Personality and creativity – Group dynamics, Team working – Communication and negotiation skills.					
Module:6	Welfare Measures	6 hours			
Compensation-Wages and Salary, Employee Benefits– Safety and health – General Provident Fund – Employees Provident Fund – Group Insurance – Housing - Pension – Laws related to welfare measures.					
Module:7	Management and Development Methods	7 hours			
Employee appraisal and assessment- Employee services- Safety and Health-Discipline and Discharge Special human resource problems, Performance appraisal-Employee Hand Book And Personnel Manual-Job descriptions and organization structure and Human relations-					

Productivity of Human resources.			
Module:8	Contemporary Topics	2 hours	
Industry Expert Lecture			
Total Lecture hours:			45 hours
Text Book(s)			
1.	Khanka S.S (2010). Organizational Behaviour, S Chand & Company, New Delhi.		
2.	Stephen P. Robbins and Timothy A. Judge., (2017). Essentials of Organizational Behaviour, Pearson, New Delhi.		
Reference Books			
1.	Andrew Dainty, Martin Loosemore (2012). Human Resource Management in Construction: Critical Perspectives, Routledge Publications.		
2.	David A. Decenzo, Stephen P. Robbins, Susan L. Verhulst, (2015). Human Resource Management, Wiley publication, London.		
3.	Gary Santorella, (2017). Lean Culture for the Construction Industry: Building Responsible and Committed Project Teams, Productivity Press.		
4.	Alberto Munguia Mireles, (2014). Highway Construction and Inspection Field book: Project Construction Management Book, Universe.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Lean Construction	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To know the evolution of lean production paradigms. 2. To understand and apply the principles of lean construction. 3. To study and improve the lean-based productivity techniques in the construction operations. 4. To apply the lean system for production planning and control. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. Understand the concepts of construction management system in accordance to lean technology. 2. Apply the basics of lean management, and understanding the evolution from manufacturing sector to construction sector. 3. Devise a plan for construction industry with cost implications. 4. Evaluate the reliability of adopted quality assurance system through testing process. 5. Identify the quality improvement techniques and finding ways to implement. 6. Determine the causes of accidents in construction practice. 7. Identify the hazardous area in infrastructure projects and understanding the causes. 					
Module:1	Lean Concepts and Fundamentals	5 hours			
Introduction and overview of the construction project management -Review of Project Management and Productivity Measurement Systems – Productivity in Construction– Daily Progress Report-The state of the industry with respect to its management practices – construction project phases - Essential features of contemporary construction management techniques - The problems with current construction management techniques– Current production planning.					
Module:2	Lean Management	7 hours			
Introduction to lean management – Toyota’s management principle-Evolution of lean in construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design – Lean project delivery system- Forms of waste in construction industry – Waste Elimination.					
Module:3	Lean Design	7 hours			
Basics in lean design and thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.					
Module:4	Lean construction tools and techniques	6 hours			
Value Stream Mapping – Work sampling – Last planner system – Flow and pull based production – Look ahead schedule – constraint analysis – weekly planning meeting- Daily Huddles – Root cause analysis – Continuous improvement – Just in time.					
Module:5	Lean assembly	6 hours			
Material and Information flow mapping- Value stream map-Waste removal operations-Value adding-Supply chain response matrix-Forrester effect mapping-Quality filter mapping-decision point analysis-Value adding-Information flow analysis.					
Module:6	Lean and Sustainability	6 hours			
Relationship between Lean and Green- Productivity enhancement through elimination of Waste-environmental impact, savings and even potential revenues of sustainable lean initiatives					
Module:7	Lean Construction Implementation	6 hours			
Lean construction implementation- Enabling lean through information technology – Lean in design - Design Structure Matrix Location Based Management System-Digitization and Lean					

concepts – Sustainability through lean construction approach			
Module:8	Contemporary Topics	2 hours	
Industry Expert Lecture			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Lincoln H. Forbes, Syed M. Ahmed. (2020). Lean Project Delivery and Integrated Practices in Modern Construction, Routledge., USA.		
2.	Patricia Tzortzopoulos, Mike Kagioglou, Lauri Koskela. (2020). Lean Construction- Core Concepts and New Frontiers, Routledge, USA.		
Reference Books			
1.	Corfe, C. and Clip, B. (2013). Implementing lean in construction: Lean and the sustainability agenda, CIRIA, United Kingdom.		
2.	Shang Gao, Sui Pheng Low. (2014). Lean Construction Management: The Toyota Way, Springer., Switzerland.		
3.	Luis Alarcón. (1997). Lean Construction, CRC Press, USA.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Project Formulation and Appraisal	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand about the project formulation. 2. To workout the costing and appraisal of construction projects. 3. To find effective options to develop the finance model of project through its life cycle. 4. To identify the private sector participation in infrastructure development projects. 					
Course Outcome					
<p>At the end of the course, the students will be able to</p> <ol style="list-style-type: none"> 1. Explain the aspects in the project life cycle. 2. Identify the factors impacting the time value of money. 3. Identify the factors affecting the operational expenses during formulation of the project. 4. Relate the various risks in the appraisal of a project at various stages. 5. Identify the suitable financial models and financing agencies for the financial structure of the project. 6. Understand implication of various infrastructure development models. 					
Module:1	Project Formulation	6 hours			
Capital investments - Generation and Screening of Project Ideas - Project identification-Project evaluation an overview, the project cycle, planning, project selection and appraisal, project quality factors and basic needs the measurement of project performance					
Module:2	Project Initiation	5 hours			
Capital budgeting – feasibility study– market, technical, financial, economic and ecological – Market and Demand analysis- Detailed technical analysis.					
Module:3	Time Value of Money	6 hours			
Time Value of Money –Future value of single amount, Present value of single amount, Future value of an annuity, Present value of an annuity-Simple interest-Compound interest - project cash Flows.					
Module:4	Project Costing	6 hours			
Investment Criteria- Discounting criteria - Net Present Value (NPV), Benefit Cost Ratio (BCR), Internal Rate of Return (IRR) – Break Even Analysis - Non-Discounting criteria - Pay Back Period, Accounting Rate of Return (ARR) - Urgency - Investment analysis in practice.					
Module:5	Project Appraisal	9 hours			
Investment Appraisal – International Practice of Appraisal – Analysis of Risk – Different Methods – Selection of a Project and Risk Analysis in Practice - Specific regulations/statuary acts practiced in India and abroad.					
Module:6	Project Financing	5 hours			
Project Financing – Means of Finance – Financial Institutions – Special Schemes – Key Financial Indicators – Ratios - Financial management, resource mobilization and sustainability of the project, use of application software.					
Module:7	Private Sector Participation	6 hours			
Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT - Scope of Technology Transfer - Technology Transfer and Foreign Collaboration - Case Study.					
Module:8	Contemporary Topics	2 hours			
Industry Expert Lecture					
	Total Lecture hours:	45 hours			
Text Book(s)					

1.	Prasanna Chandra, (2019). Projects – Planning, Analysis, Selection, Financing, Implementation, and Review, Ninth Edition, McGraw Hill, New Delhi.		
Reference Books			
1.	Kerzner, Harold (2017). Project Management: A Systems Approach to Planning, Scheduling, and Controlling, Twelfth Edition, Wiley India, New Delhi.		
2.	Ambrish, G. (2017). Project Appraisal and Financing, PHI India, New Delhi.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Infrastructure Development and BOT, BOOT Projects	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To know the infrastructure development polices available in State and Central Governments of India. 2. To obtain the knowledge of different types of risks in National and International Infrastructure Projects. 3. To develop a management plan for critical infrastructure essential for the needs of society. 4. To study the integrated framework used for successful infrastructure planning and management. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. Interpret polices available in State and Central Governments of India and their application in infrastructure development. 2. Discuss the challenges in privatization of water supply, power and road transportation Infrastructure in India 3. Apply the concepts of project appraisal techniques for the development and management of public infrastructure projects and determine feasible project milestones. 4. Assess the various risks on infrastructure privatization and identify the methods for the management of risks. 5. Describe the interplay between engineering project, infrastructure management and sustainability in the complex real-world situations. 6. Identify the principles of strategic planning and risk analysis in successful project and infrastructure management. 7. Explain the case studies of International projects and select project management practices to meet the needs of stakeholders. 					
Module:1	An Overview of Infrastructure Engineering	7 hours			
Overview on infrastructure development polices of central and state governments in India. Programmes and initiatives for development of roads, railways, airports, ports & harbour and urban infrastructure in India					
Module:2	Role of Public and Private Sector	7 hours			
A Historical Overview of Infrastructure Privatization, The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization, Challenges in Privatization, Water Supply, Power, Infrastructure, Technology implementation, Road Transportation Infrastructure in India – Case studies					
Module:3	Infrastructure Planning	7 hours			
Overview of various planning tools - Project appraisal by financial analysis, economic analysis, Life cycle analysis and environmental and societal impact assessments - Political and social perspectives of infrastructure planning - Concept of sustainable infrastructure development.					
Module:4	Infrastructure Implementation Risks	6 hours			
Mapping and Facing the Landscape of Risks in Infrastructure Projects, Accounting for risk and uncertainty, Core Economic and Demand Risks, Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Challenges in Construction and Maintenance of Infrastructure – Case studies.					
Module:5	Environmental and Social Impact Assessment Aspects	5 hours			
Categories, Attributes and Parameters, Identification of Environmental and Social Impacts					

over Project Area and over Project Cycle. Special Considerations Involving Land and Water Interrelationships - Environmental Laws and Regulations			
Module:6	Strategies for Successful Infrastructure Project Implementation		5 hours
Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects. Governments Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions.			
Module:7	Private Sector Participation		6 hours
International projects - Detailed Project Reports (DPR) / Build Own Operate (BOO) / Build Own Operate Transfer (BOOT) Projects / Build Operate and Transfer (BOT) - Case studies.			
Module:8	Contemporary Topics		2 hours
Industry Expert Lecture			
Total Lecture hours:			45 hours
Text Book(s)			
1.	Mohammed M. Ettouney, Sreenivas Alampalli, (2016). Risk Management in Civil Infrastructure in: Civil Infrastructure Health and Sustainability Series, CRC Press, London		
Reference Books			
1.	Amareshwar Mishra and G C Tripathi, (2014). Management of Risk in Infrastructure Projects, GABD Publications, New York.		
2.	Riki Therivel, Graham Wood, (2018).Methods of Environmental and Social Impact Assessment, 4 th edition, Routledge.		
3.	Jeffrey Delmon (2015), Private Sector Investment in Infrastructure: Project Finance, PPP Projects and PPP Frameworks, Wolters Kluwer.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Formwork for Concrete Structures	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To develop the conceptual understanding of design, construction and erection of formwork. 2. To impart the knowledge about the different types of formwork used for special structures. 3. To know the latest methods of form construction. 4. To understand the erection of forms for various structural elements. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. Carryout the detailed planning and design of formworks used for the construction of different structures. 2. Identify the suitable materials for formwork. 3. Calculate the various loads on the formwork and its accessories. 4. Execute the different techniques used for construction and erection of formwork. 5. Analyze the form work for shell type structures. 6. Carryout the detailed planning of slip forms and scaffolds. 					
Module:1	Planning for Formwork	6 hours			
Introduction –Types of formwork- Forms for foundations, columns, beams walls etc.,- General objectives of formwork building - Detailed planning - Calculation of labour constants, Scaffold frames - Framed panel formwork.					
Module:2	Materials for Formwork	6 hours			
Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood - Steel – Aluminum.					
Module:3	Formwork Accessories and Pressures	6 hours			
Formwork Accessories -Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls					
Module:4	Design of Forms and Shores	6 hours			
Design Principles - Allowable stresses - Design of Wall forms - Slab forms - Beam forms - Column forms - Design Tables for Wall formwork - Slab formwork - Column formwork - Slab props - Stacking Towers - Free standing and restrained - Rosett Shoring - Shoring Tower - Heavy Duty props.					
Module:5	Building and Erecting the Formwork	6 hours			
Carpentry Shop and job mill - Forms for Footings - Slab form systems - Sky deck and Multiflex - Customized slab table - Standard Table module forms - Swivel head and uniportal head - Assembly sequence - Cycling with lifting fork - Moving with table trolley and table prop - Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.					
Module:6	Forms for Domes and Tunnels	6 hours			
Hemispherical, Parabolic, Translational shells - Typical barrel vaults - Folded plate roof details - Forms for Thin Shell roof slabs design considerations - Strength requirements - Tunnel forming components - Curb forms, invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method - Pressures on tunnels - Continuous Advancing Slope method - Form construction - Shafts.					
Module:7	Slip forms and Scaffolds	7 hours			
Slip forms - Principles -Types - advantages - Functions of various components - Planning -					

Desirable characteristics of concrete - Common problems faced - Safety in slip forms - Special structures built with slip form Technique - Types of scaffolds - Putlog and independent scaffold - Single pole scaffolds - Truss suspended - Gantry and system scaffolds.			
Module:8	Contemporary Topics		2 hours
Industry Expert Lecture			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Oberlender G.D and Peurifoy R. L. (2010). Formwork of Concrete Structures, 4 th Edition McGraw Hill Education, New Delhi.		
2.	Christopher Souder, (2014). Temporary Structure Design, Wiley Publications, London.		
Reference Books			
1.	Kumar. NeerajJha, (2017). Formwork for Concrete Structures, McGraw Hill Education, New Delhi.		
2.	Leonard Koel , (2015). Concrete Formwork, American Technical Publisher, USA.		
3.	ACI 347R-14: Guide to Formwork for Concrete, ACI Committee 347, American Concrete Institute.		
Mode of Evaluation: Continuous Assessment Test, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Prefabricated Techniques and Management	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the prefabrication techniques. 2. To know the prefabrication elements and their design. 3. To learn the working principles of various joints and connections. 4. To study the standards, methodology, production, transportation, assembling construction sequence & techniques of precast buildings. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. Describe various structural systems and standard organizing requirements. 2. Identify and differentiate structural behaviour of building elements. 3. Design building elements and applications. 4. Describe the working principles of various joints and connections. 5. Apply principles and assembling process. 6. Identify the various tools in assembling and erection of buildings. 					
Module:1	Prefabricated Systems	7 hours			
Types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization - prefabrication systems and structural schemes- Disuniting of structures - Structural behaviour of precast structures - Specific requirements for planning and layout of prefabrication plant - IS Code specifications.					
Module:2	Precast Elements	7 hours			
Handling and erection stresses- Application of prestressing of roof members- Floor systems- Two way load bearing slabs, pre stressed beam, Precast column- precast shear walls- Wall panels, hipped plate and shell structures					
Module:3	Prefabricated Design	7 hours			
Designing and detailing prefabricated units- Industrial structures- Multistory buildings - Water tanks- Silos and bunkers - Application of prestressed concrete in prefabrication.					
Module:4	Joints	6 hours			
Basic mechanism- Dimensioning and detailing of joints for different structural connections- compression joint-shear joint - tension joint, effective sealing of joints for water proofing.					
Module:5	Connections	6 hours			
Pin jointed connection-moment resisting connections- beam to column connection - column to foundation connections					
Module:6	Prefabricated Buildings	6 hours			
Production, Transportation and erection- Shuttering and mould design- Dimensional tolerances- Erection of R.C. Structures- Total prefabricated buildings assembly Process					
Module:7	Machinery and Equipment	4 hours			
Plant machinery- casting yard- casting and stacking					
Module:8	Contemporary Topics	2 hours			
Industry Expert Lecture					
Total Lecture hours:					45 hours
Text Book(s)					
1. Kim S. Elliot (2017). Precast Concrete Structures, CRC Press, London.					
Reference Books					
1. Handbook of Precast Concrete Buildings (2016). ICI publications					

2.	Ryan E. Smith, (2010). Prefab Architecture: A Guide to Modular Design and Construction, John Wiley and Sons, London.		
3.	Hubert Bachmann and Alfred Steinle, (2011). Precast Concrete Structures, Wiley VCH Publisher.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Construction Techniques of Steel and Concrete Composite Structures	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the concept of steel-concrete composite construction and their applications in engineering. 2. To understand the various types of connections in steel and steel-concrete composite construction. 3. To learn the methodology, construction sequence and techniques of framed industrial structures. 4. To know the basic concept of sandwich construction. 					
Course Outcome					
At the end of the course, the student will be able to					
<ol style="list-style-type: none"> 1. Envisage the behaviour of steel-concrete composite members. 2. Perform limit state design for steel structures. 3. Identify suitable connections in steel structures and provide connection details. 4. Prepare and propose suitable construction sequence and techniques for framed industrial structures. 5. Identify and propose suitable materials for sandwich constructions. 					
Module:1	Composite Construction	3 hours			
Introduction to Steel - Concrete Composite Construction - Theory of Composite Structures - Applications- IS Codal provisions.					
Module:2	Composite Beams	7 hours			
Introduction to Composite beams - Ultimate moment behaviour – Types and load transferring mechanism of Shear connectors - Types, merits and behaviour of profiled decking - Design consideration for simply supported and continuous composite beam (with or without profile deck).					
Module:3	Composite Columns	7 hours			
Introduction to composite columns and its types - Advantages - Design parameters and checks for structural adequacy - Resistance of encased composite column cross section and infilled composite column cross section under compression - Effective elastic flexural stiffness - Design of composite column under axial compression, uniaxial bending and biaxial bending.					
Module:4	Composite Floors	7 hours			
Introduction to composite floors - Benefits - Sheeting parallel to span - Sheeting perpendicular to span - Ponding effect - Structural elements - Bending resistance - Shear resistance - Serviceability criteria - Design of Composite floors					
Module:5	Composite Trusses	7 hours			
Configuration of trusses - Behaviour and application of composite truss - Loads and analysis of trusses - Design of composite trusses.					
Module:6	Connections	7 hours			
Types of connections - Fabrication and assembly of composite members- Connection Design Philosophies -Design of connections in the composite structures - Shear connections - Design of connections in composite trusses.					
Module:7	Sandwich Construction	5 hours			
Basic design concept of sandwich construction – Materials used for sandwich construction – Failure modes- Applications.					
Module:8	Contemporary Topics	2 hours			
Industry Expert Lecture					

		Total Lecture hours:		45 hours
Text Book(s)				
1.	Johnson R.P. (2012), Composite Structures of Steel and Concrete: Beams, Slabs, Columns and Frames for Buildings, Wiley India Pvt. Ltd.			
2.	Brian Uy and Zhong Tao (2018), Behaviour and Design of Composite Steel and Concrete Building Structures, CRC Press.			
Reference Books				
1.	Panchal D R, (2014). Composite Steel-Concrete Structures, Scholars Press.			
2.	IS 11384, Code of practice for composite construction in Structural Steel and Concrete.			
3.	IS 800: 2007, Code of practice for General construction in Steel.			
4.	Institute for Steel Development and Growth (INSDAG), Kolkata -Teaching Materials.			
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test				
Recommended by Board of Studies		DD-MM-YYYY		
Approved by Academic Council		No. xx	Date	DD-MM-YYYY

Course code	Construction Techniques of Deep Foundations	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the various types of deep foundations. 2. To know the various methods and techniques involved in the construction of deep foundations. 3. To understand the safety requirements in the construction of deep foundations. 4. To know the concept of sheet piles, coffer dams, diaphragm wall and reinforced earth walls. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. Understand the various types of deep foundations. 2. Know the various methods and techniques involved in construction of deep foundations. 3. Understand the management and safety requirements in construction of deep foundations. 4. Comprehend the concept of sheet piles and coffer dams. 5. Know the protection system in diaphragm wall. 6. Analyze the soil reinforcement interaction in reinforced earth walls. 					
Module:1	Deep foundations	6 hours			
Introduction - Preliminary investigations - subsurface exploration, data interpretation and estimation of various sub-soil properties - Types of deep foundations - Requirements for deep foundations - Codal provisions on safety requirements for deep foundations.					
Module:2	Bored piles	6 hours			
Classification of bored piles - Construction methods and construction sequences of bored piles - Equipment's used for boring, drilling and concreting - Piling supervision and quality assurance - Design considerations and pile capacity.					
Module:3	Driven piles	6 hours			
Classification of driven piles - Selection of type of piles and method of installation - Pile driving equipment's - Construction and quality assurance of driven piles - Advantages and disadvantages of driven piles - Pile damages and pile integrity test - Design considerations and pile capacity.					
Module:4	Well Foundations	5 hours			
Types of wells or caissons - Different shapes of well - Drilled shafts and caissons - Methods and construction sequences - Design procedure -Advantages and disadvantages of well foundation.					
Module:5	Diaphragm wall	5 hours			
Deep excavations and protection systems - Applications of diaphragm wall -Diaphragm wall construction methods - Design procedure - Advantages and disadvantages of diaphragm wall.					
Module:6	Sheet piles and Coffor Dams	8 hours			
Sheeting and bracing systems in shallow and deep open cuts in different soil types – Cantilever sheet piles, Anchored sheet piles - Construction methods and sequences- Design procedure; Merits and demerits - Types of Coffor dams- Coffor dams components and construction sequences - Design procedure for cellular coffer dam - merits and demerits.					
Module:7	Reinforced Earth Walls	7 hours			
Introduction- Behaviour of reinforced earth walls- Advantages of reinforced earth walls- - Materials for reinforced earth structures - Soil reinforcement interaction - Internal and external stability conditions - Design criteria - Field applications of reinforced earth walls.					
Module:8	Contemporary Topics	2 hours			
Industry Expert Lecture					

		Total Lecture hours:		45 hours
Text Book(s)				
1.	Bowles, J. E., (2011). Foundation Analysis and Design, 7 th Edition, McGraw Hill Book Co., New York.			
Reference Books				
1.	Huang A.B., Yu H.S, (2018). Foundation Engineering Analysis and Design, CRC Press, Taylor & Francis group.			
2.	Fang. H.Y., (2012). Foundation Engineering Handbook, Springer Science and Business Media.			
3.	Varghese. P. C., (2009). Design of Reinforced Concrete Foundations, Prentice Hall of India, New Delhi.			
4.	Murthy. V. N. S., (2009). Soil Mechanics and Foundation Engineering – CBS Publications, Delhi.			
5.	Tomlinson M and Woodward J. (2008). Pile Design and Construction Practice” 5 th Edition. Taylor and Francis.			
6.	BIS 2911 (Part 1/Sec 1, Sec 2, Sec 3 and Sec 4) (2010). Design and construction of pile foundations-code of practice (Driven cast in-situ concrete piles), Bureau of Indian Standards, New Delhi.			
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test				
Recommended by Board of Studies		DD-MM-YYYY		
Approved by Academic Council		No. xx	Date	DD-MM-YYYY

Course code	Flexible and Rigid Pavements	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	Transportation Engineering	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To identify the materials for pavement construction. 2. To design flexible and rigid pavements. 3. To know the methods of constructing pavements and identifying pavement distresses. 4. To understand the basics of pavement management system. 					
Course Outcome					
<p>At the end of the course, students will be able to</p> <ol style="list-style-type: none"> 1. Evaluate the suitability of soil for being used as subgrade for pavements and propose methods to prepare a stable subgrade. 2. Choose suitable materials for pavement and design bituminous and cement concrete mixtures. 3. Design a flexible and rigid pavement structure using IRC method. 4. Describe methods of flexible and rigid pavement construction. 5. Identify pavement distresses and evaluate pavements based on functional and structural conditions. 6. Describe the concepts of Pavement Management System. 					
Module:1	Subgrade and Soil Stabilization	6 hours			
Significance of subgrade soil – soil classification – evaluation of soil strength – properties, laboratory and in-situ soil tests – subgrade stabilization – physical and chemical methods – usage of alternate materials, fibers and geo-synthetics					
Module:2	Pavement Materials	7 hours			
Fundamental properties and standard tests for aggregates, bitumen and cement, and their types – Different types of granular and bituminous mixes – Mix design: Marshall and Superpave concepts – Properties and testing of bituminous mixtures and pavement quality concrete – New materials like polymer, rubber.					
Module:3	Flexible Pavement Design	6 hours			
Stresses in flexible pavements – Visco-elastic theory and layered system concepts – Different pavement design methods – Group Index, CBR, McLeod, Kansas, IRC, Asphalt Institute, AASHTO, etc. – Introduction to flexible pavement design software.					
Module:4	Rigid Pavement Design	6 hours			
Stresses and deflections in rigid pavements – Westergaard's analysis – Load, temperature and frictional stresses – Types of joints – Stresses in dowel and tie bars – Design of slab and joints – IRC method of design – Introduction to rigid pavement design software.					
Module:5	Pavement Construction	7 hours			
Earth work grading – Construction of embankments and cuttings – Preparation of subgrade and quality control tests – Methods of construction and field control checks for various types of flexible pavement layers – Methods of construction of various layers and joints in rigid pavement – Usage of new technologies like, Recycled Asphalt Pavement, Warm Mix Asphalt					
Module:6	Pavement Evaluation	6 hours			
Distresses in flexible and rigid pavements –functional and structural condition evaluation techniques – roughness, skid resistance, Benkelman beam deflection – Maintenance and rehabilitation techniques – Overlay design, white topping.					
Module:7	Pavement Management Systems	5 hours			
Introduction to Pavement Management System – Structure and components – Pavement performance prediction concepts and various models – Ranking and Optimization Methodologies – Design alternatives and selection.					
Module:8	Contemporary Topics	2 hours			
Industry Expert Lecture					

		Total Lecture hours:		45 hours	
Text Book(s)					
1.	Mallick, R.B. and El-Korchi, T. (2018). Pavement Engineering: Principles and Practice, 3 rd edition, CRC Press, Florida.				
2.	Huang, Y. H. (2004). Pavement Analysis and Design, 2 nd Edition, Pearson Prentice Hall, New Jersey.				
Reference Books					
1.	Haas, R., Hudson, W. R. and Falls, L.C. (2015). Pavement Asset Management, Wiley, New Jersey.				
2.	Kumar, R.S. (2015). Pavement Evaluation and Maintenance Management System, Universities Press (India) Private Limited, Hyderabad.				
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test					
Recommended by Board of Studies			DD-MM-YYYY		
Approved by Academic Council		No. xx	Date	DD-MM-YYYY	

Course code	Repair and Rehabilitation of Structures	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To impart broad knowledge in the area of repair and rehabilitation of structures. 2. To understand about various causes of deterioration of structures. 3. To obtain the knowledge about corrosion of structures. 4. To understand the properties of repair materials. 5. To know the various repair techniques and strengthening methods. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. To know the importance of the maintenance of the structures. 2. Describe the causes of deterioration of concrete, steel, masonry and timber structures. 3. Identify the effect of corrosion on structures. 4. Explain the different techniques to assess the condition of the structures. 5. Describe the various properties and applications of repair materials. 6. Explain the techniques for repairing. 7. Discuss the strengthening of distressed buildings 					
Module:1	Maintenance of Structures	7 hours			
Importance of maintenance - Types of maintenance - Decay of structures - Role of the Maintenance Engineer – Quality Assurance for concrete construction - Design and construction errors.					
Module:2	Deterioration of Structures	6 hours			
Causes of deterioration of concrete, steel, masonry and timber structures - surface deterioration - efflorescence - Causes and preventive measures.					
Module:3	Corrosion of Structures	6 hours			
Corrosion mechanism – Types of Corrosion - Effects of cover thickness and cracking – Methods of corrosion protection.					
Module:4	Inspection and Assessment of Distressed structures	6 hours			
Visual inspection – Non-destructive tests – Ultrasonic pulse velocity method – Rebound hammer technique – Acoustic Emission Test – Pullout tests – Core test – Forensic Structural Engineering					
Module:5	Materials for Repair	6 hours			
Special concretes and mortar - Concrete chemicals - Special elements for accelerated strength gain - Expansive cement- Polymer concrete – Ferro cement, Fibre reinforced concrete – Fibre reinforced plastics.					
Module:6	Techniques for Repair	6 hours			
Techniques for repairing of spalling and disintegration of structures - Grouting –Autogenous healing- Pre-packed concrete- Protective surface coating.					
Module:7	Strengthening of distressed buildings	6 hours			
Repairs to overcome low member strength – Deflection - Chemical disruption - Weathering wear - Fire leakage - Marine exposure- Use of FRP.					
Module:8	Contemporary Topics	2 hours			
Industry Expert Lecture					
Total Lecture hours:					45 hours
Text Book(s)					
1. Modi, P.I., Patel, C.N. (2016). Repair and Rehabilitation of Concrete Structures, PHI					

	India, New Delhi.		
Reference Books			
1.	IABSE, (2010). Case Studies of Rehabilitation, Repair, Retrofitting, and Strengthening of Structures, Volume 12, Structural Engineering Documents (SED), Switzerland.		
2.	Varghese, P.C. (2014), Maintenance, Repair & Rehabilitation and Minor Works of Buildings, PHI India, New Delhi.		
3.	Bhattacharjee, J. (2017), Concrete Structures Repair Rehabilitation And Retrofitting, CBS Publishers & Distributors, New Delhi.		
Mode of Evaluation: Continuous Assessment Test, Quizzes, Assignments, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course code	Occupational Health and Industrial Safety	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. Applying the knowledge to successfully lead, influence, and accomplish the safety goals and objectives of the industries. 2. Communicating and collaborating effectively inside a different work environment. 3. Understanding the ethical and professional ways of working inside the industry. 4. Understand and create awareness among personals handling. 					
Course Outcome					
<p>At end of the course, students can be able to</p> <ol style="list-style-type: none"> 1. Understand the various occupational health concerns and safety policies and strategies to follow 2. Identify and analyse the various hazards and assess the risks to solve occupational health and safety problems 3. Acquire the techniques, skills, and modern scientific and technical tools necessary for professional practice of occupational safety and health; 4. Understand professional and ethical responsibility in occupational safety and health; 5. Develop the expertise to design and conduct survey/investigations, as well as to analyse and interpret data in the field of occupational safety and health; 6. Demonstrate knowledge of the contemporary issues surrounding occupational safety and health 					
Module:1	Health and Safety Management	6 hours			
Principles of health and safety management-- reasons for effective health and safety management-- factors influencing standards and policies-Occurrence of accident – sequence – injuries – occupational injuries – industrial accidents- Assessment and evaluation of risks, Environmental management system (EMS).					
Module:2	Identification and assessment of Hazards	8 hours			
Managing occupational health, Hazard identification – types – reporting system – audits – root cause analysis – hazard operability (HAZOP) and hazard analysis (HAZAN)- job hazard analysis – Life cycle analysis.					
Module:3	Occupational Injuries and Illness	6 hours			
Bureau of labour statistics – occupational trauma death – injuries – injury and death cost – temperature extremes – ionizing radiation – noise induced hearing loss – vibrations – chemical hazards – flammable combustible liquids – biological monitoring.					
Module:4	Industrial Hygiene and Ergonomics	6 hours			
Occupational illness prevention – industrial modes of entry of contaminants – types of air contaminants – exposure monitoring – units of concentration – limits of exposure – ergonomic risk factors – physical work activities and conditions.					
Module:5	Workplace and Work Equipment safety	6 hours			
Workplace welfare requirements and specific workplace issues, Workplace machinery safety, Electrical safety, Fire and explosions.					
Module:6	Accident Investigation and Analysis	6 hours			
Hazard prevention and control –awareness devices – personal protective equipment – safe operating procedures – fleet safety-Application of virtual reality.					
Module:7	OSHA Compliance	5 hours			
OSHAS 18001 and OSHMS – employer’s responsibilities – violations – medical and exposure records – employer liability – worker’s compensation.					
Module:8	Contemporary Topics	2 hours			
Industry Expert Lecture					

	Total Lecture hours:		45 hours
Text Book(s)			
1.	Charles D. Reese (2017). Occupational Health and Safety Management, A Practical Approach, 3 rd Edition, CRC Press, London.		
2.	Mark A. Friend, and James P. Kohn (2014). Fundamentals of Occupational Safety and Health, 6 th edition, Bernen Press.		
Reference Books			
1.	Robert H. Friis (2015). Occupational Health And Safety For The 21St Century, 1 st Edition, Jones and Bartlett Publishers, Inc.		
2.	C Ray Asfahl and David W. Rieske (2021). Industrial Safety and Health Management, 7 th Edition, Pearson.		
Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test.			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Context-Aware Computing	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the basic concepts of Context Awareness. 2. To study the concepts in Distributed and Heterogeneous context. 3. To understand the principles of dynamic current negotiation. 4. To study the concepts of Context-aware mobile and pervasive systems and its security issues. 					
Course Outcome					
At the end of the course, students will be able to					
<ol style="list-style-type: none"> 1. Understand the significance of context-aware technology and modelling. 2. Appreciate the importance of context-awareness and mobile and ubiquitous computing. 3. Appreciate the importance of pervasive computing with regards to context-aware computing. 4. Understand the concept of distributed and heterogeneous context for ambient intelligence. 5. Appreciate the dynamic current negotiation in web environments. 6. Comprehend the importance of context aware systems and its security features. 					
Module:1	Context-aware technology and Product	6 hours			
Definition of context – context-aware technology - Context modelling - Interaction Design - context-aware product – Challenges.					
Module:2	Context-Awareness	6 hours			
Human-Computer Interaction – Context - Mobile and Ubiquitous computing – human factors - functionality – versatility - context-aware systems – GIS and GPS - Augmented Reality					
Module:3	Mobile Computing	6 hours			
Mobile computing environment – Functions – System Architecture - Design considerations – content architecture -CC/PP exchange protocol -context manager - Data management in Wireless Application Environment (WAE) - Coda file system- Caching schemes- Mobility Quality of Service (QoS) - Mobile social networking and crowd sensing - Mobile affective computing					
Module:4	Pervasive Computing	6 hours			
Pervasive Computing - Principles, Characteristics- Interaction transparency - Context aware - Automated experience capture – System Architecture for pervasive computing - Pervasive devices.					
Module:5	Distributed and Heterogeneous Context for Ambient Intelligence	6 hours			
Fundamental Concepts – Ontology Representation and Reasoning about Context – Ontology Alignment Approaches – Campus Approach - Event based social network - Smart Homes and Intelligent Buildings					
Module:6	Dynamic Current Negotiation in Web Environments	6 hours			
Ubiquitous web – System Description – System Deployment – Collaborative Optimizations- Context Acquisition – Provisioning.					
Module:7	Context Aware Systems and Security	7 hours			
Elements of a context aware pervasive system- Architecture- Infrastructure, Middleware, Tool Kits – context for mobile device users – Location based Services – Location based social networks (LBSN), LBSN Recommendation - Ambient services – context aware mobile services – Mobile code and policy – Multi agent technology. Traditional Security issues – models – context aware security systems – context aware safety.					

Module:8	Contemporary Topics	2 hours	
Industry Expert Lecture			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Temdee, P., Prasad, R. (2018). Context-Aware Communication and Computing: Applications for Smart Environment, Springer Series in Wireless Technology, Springer, Switzerland.		
Reference Books			
1.	Dargie, D. (Ed) (2009). Context-Aware Computing and Self-Managing Systems, CRC Press, USA.		
2.	Gajjar, M. (2017). Mobile Sensors and Context-Aware Computing, Morgan Kaufmann, USA.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY

Course code	Internet of Things (IoT) for Smart Cities	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To understand the Concept of Internet of Things (IoT) . 2. To know the various applications of Internet of Things in Smart Cities. 3. To understand the Urban IoT. 4. To understand the concept of Smart Cities. 					
Course Outcome					
At the end of the course, the students will be able to					
<ol style="list-style-type: none"> 1. Understand the principles, landscape, and architecture of Internet of things (IoT). 2. Classify the IoT standards and protocols. 3. Identify the different IoT devices for smart city. 4. Understand the various characteristics and barriers of smart city. 5. Understand the smart city planning and development. 6. Understand the different elements in smart city and its application to the public services. 					
Module:1	Internet of Things	6 hours			
Evolution of Internet of Things- M2M Communication- IoT landscape and architecture- IoT Ecosystem-Sensors- Smart objects- Big data- Block chain- IoT Cloud					
Module:2	IoT standards and protocols	6 hours			
Communication technologies for IoT networks- IoT data protocols- Wireless communications - Case analysis					
Module:3	IoT devices	6 hours			
Connected appliances- Smart home security systems- Wearable health devices- Autonomous farming- Smart factory equipment- Wireless and logistics trackers- Ultra-high speed wireless internet- Biometric cyber security scanners					
Module:4	Smart Cities	6 hours			
Characteristics of smart cities- IoT solutions for smart cities- Urban IoT- Political, technical and economic barriers					
Module:5	Smart Cities Planning and Development	6 hours			
Dimension of smart cities- Global standards- Benchmarks-Practise codes-Smart city planning, development, financing and governance					
Module:6	Smart City Vision	6 hours			
Safe, secure and sustainability- Smart public services- Structural health of buildings- Waste management- Air quality and noise monitoring- Emergency and disaster management- Traffic management- City energy consumption- Smart parking- Smart lighting- Automation and salubrity of public buildings					
Module:7	Smart Cities in Globe and India	7 hours			
Smart city a new digital deal- Smart community- Case studies, international and national cities					
Module:8	Contemporary Topics	2 hours			
Industry expert lecture					
		Total Lecture hours:		45 hours	
Text Book(s)					
1.	Elias Tragos, Henrich C. Pohls, (2016). Designing, Developing, and Facilitating Smart Cities: Urban Design to IoT Solutions, Springer.				
Reference Books					
1.	Hongjian Sun, Chao Wang, Bashar I. Ahmad, (2018). From Internet of Things To Smart				

	Cities Enabling Technologies, Taylor and Francis.		
2.	Tommi Inkinen, Tan Yigitcanlar, Mark Wilson, (2021). Smart Cities and Innovative Urban Technologies, Routledge Taylor and Francis Group.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course code	Smart Infrastructure	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To develop a basic understanding about various types of infrastructure 2. To understand the principles of smart infrastructure 3. To understand the integration of digital technology in infrastructure systems 4. To understand the concept of smart city and associated challenges 					
Course Outcome					
<p>At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Realize and integrate various elements of smart infrastructure systems. 2. Utilize various types of sensing technology for smart infrastructure monitoring. 3. Analyse data for Transportation, Water Resources and Environmental Infrastructure using AI and ML. 4. Design, analyse and implement health monitoring technology for smart infrastructure. 5. Identify components of infrastructure and prepare infrastructure plan for smart city. 					
Module:1	Infrastructure Systems	5 hours			
Examples of infrastructure systems: Water supply and distribution, Transport systems, Energy management, Building infrastructure, Waste Management. Need for making these infrastructures smart.					
Module:2	Principles of Smart Infrastructure	4 hours			
Collection of data, analysis of data, Feedback and Adaptability – Advantages and functionalities of smart infrastructure					
Module:3	Data Acquisition	8 hours			
Sensors for different applications – Basic Principles and interpretation of their outputs, Sensors – Inertial Sensors, Fibre Optic Sensing, Optical Sensors including 2D and 3D Camera. Use of satellite images and Drones for sensing. IOT, Networking, Fog and Cloud for data acquisition. Sensor placement. Case studies for selected infrastructures.					
Module:4	Analysis of Data for Transportation, Water Resources and Environmental Infrastructure	8 hours			
Review of data processing for interpretation and decision-making using machine learning and AI, machine learning and AI applications in transportation problems (e.g. planning public transport, road traffic prediction, traffic incident detection) and environmental (e.g. air pollution management), Application of machine learning in water distribution networks (monitoring, alarm generation, urban water resource management).					
Module:5	Analysis of Data for Building Infrastructure	4 hours			
AI for Building Management, Use of ML for structural health management, damage assessment, Energy efficiency in buildings, Foundation settlement.					
Module:6	Control Applications in Infrastructure	8 hours			
Introduction to basics of control systems including feedback control, feedback control in the field of structural dynamics (tool to protect bridges, buildings against wind, earthquake, etc.), life-cycle management of infrastructure, introduction to pollution control systems.					
Module:7	Design for adaptability	6 hours			
Design of smart infrastructure with adaptive capabilities, Design of smart city considering infrastructures of energy, mobility, health and sustainability and their growing interdependencies.					
Module:8	Contemporary Topics	2 hours			
Industry Expert Lecture					

	Total Lecture hours:	45 hours
Text Book(s)		
1.	Raj, P., & Raman, A. C. (2015). Intelligent Cities: Enabling Tools and Technology. CRC Press, Taylor & Francis Group.	
2.	Meneguetto, R. I., De Grande, R. E., & Loureiro, A. A. (2018). Intelligent transport system in smart cities. Springer: Cham, Switzerland.	
Reference Books		
1.	Deakin, Mark, Al Waer, Husam (Eds.) (2012). From Intelligent to Smart Cities, Routledge, Taylor & Francis, USA and Canada.	
2.	Song, H., Srinivasan, R., Sookoor, T., & Jeschke, S. (2017). Smart cities: foundations, principles and applications. John Wiley & Sons.	
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test		
Recommended by Board of Studies		DD-MM-YYYY
Approved by Academic Council	No. xx	Date DD-MM-YYYY

Course code	Internal and External Infrastructure Monitoring	L	T	P	C
XXXX		3	0	0	3
Pre-requisite	NIL	Syllabus version			
		x.x			
Course Objectives					
<ol style="list-style-type: none"> 1. To learn the various assessment and monitoring procedures of infrastructure system. 2. To understand the application of various process in infrastructure monitoring. 3. To study the various models and security arrangements for infrastructure. 4. To acquire the decision-making skills based on forecast model. 					
Course Outcome					
<p>At the end of the course, the students will be able to</p> <ol style="list-style-type: none"> 1. Determine various components of the infrastructure monitoring process. 2. Classify the risk assessments and identify the approaches to minimise risk. 3. Determine the class of assets and its management process. 4. Identify the design life influence and its reliability on infrastructure. 5. Designing deterioration modelling to make decisions on infrastructure management. 6. Determine the infrastructure resilience and security. 					
Module:1	Infrastructure monitoring	6 hours			
Definitions- Infrastructure monitoring components-risk vs danger vs hazard- System adopted to evaluate the performance					
Module:2	Risk Assessment	6 hours			
Structural Risk Assessment – Machinery Risk Assessment – Electrical Safety Risk Assessment -Risk Assessment in Tools and Equipment- Five step approach to risk assessment -Implementing Risk assessment					
Module:3	Operations and Maintenance	6 hours			
Monitoring of infrastructure – Notification and recording observations-Scalable Monitoring system-Profiling and Monitoring in infrastructure-Inner workings and its documentation					
Module:4	Asset Management Process	6 hours			
Elements of Asset Management Process-Commercial roof management-case studies on asset management systems					
Module:5	Condition Assessment	6 hours			
Design service life-Condition assessment of infrastructure-Aid manual inspection- case studies on distress examples.					
Module:6	Deterioration Modelling	7 hours			
Simple Decision Making and Forecasting from Condition Assessment- Regression Models-Markov Deterioration Models- Artificial Neural Network Deterioration Models- Failure Rates and Survival Probabilities- Fault Tree Analysis					
Module:7	Interdependence, Resiliency and Security	6 hours			
Infrastructure Interdependencies- Improving Infrastructure Resiliency- Infrastructure Security- Preparing for and Responding to Emergencies					
Module:8	Contemporary Topics	2 hours			
Industry expert lecture					
Total Lecture hours:					45hours
Text Book(s)					
1	Alvin Goodman , Makarand Hastak. (2015). Infrastructure Planning, Engineering and Economics, ASCE Press, USA				
2	John Kelly, Steven Male, Drummond Graham. (2015). Value Management and Construction Projects, Wiley Blackwell, USA.				
3	W. Hudson, Ralph Haas, Waheed Udd. (1997). Infrastructure Management: Integrating				

	Design, Construction, Maintenance, Rehabilitation and Renovation, Mc Graw Hill, USA.		
Reference Books			
1	Sreenivas Alampalli. (2011). Infrastructure Health in Civil Engineering, CRC Press, USA.		
2	McDonald P. (2001). Fundamentals Of Infrastructure Engineering Civil Engineering Systems, Francis and Taylor. USA.		
3	Mohammed Ben-Daya, Uday Kumar, D.N. Prabhakar Murthy. (2016). Introduction to Maintenance Engineering Modelling Optimization, and Management, Wiley, Germany.		
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies		DD-MM-YYYY	
Approved by Academic Council		No. xx	Date DD-MM-YYYY