VIT®

Vellore Institute of Technology

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

## SCHOOL OF CIVIL ENGINEERING

# B. Tech. Civil Engineering

(B. Tech. BCL)

Curriculum

(*2023-2024 admitted students*)

## VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

## MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

**World class Education** : Excellence in education, grounded in ethics and critical thinking, for improvement of life.

**Cutting edge Research** : An innovation ecosystem to extend knowledge and Solve critical problems.

**Impactful People** : Happy, accountable, caring and effective workforce and students.

**Rewarding Co-creations** : Active collaboration with national & international industries & universities for productivity and economic development.

**Service to Society** : Service to the region and world through knowledge and compassion.

## VISION STATEMENT OF THE SCHOOL OF CIVIL ENGINEERING

- To 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

- To Pioneer the emerging technology in Civil Engineering.
- To address the complex societal scale challenges in areas of resilient infrastructure, smart and sustainable cities, water and energy security, climate change, mobility of goods and people, and environmental protection.
- To inspire and nurture innovative leaders and entrepreneurs.

# B. Tech. Civil Engineering

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems.

2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.

3. Graduates will function in their profession with social awareness and responsibility.

4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.

5. Graduates will be successful in pursuing higher studies in engineering or management.

6. Graduates will pursue career paths in teaching or research.

# B. Tech. Civil Engineering

## 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

# B. Tech. Civil Engineering

## PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B. Tech. (Civil Engineering) programme, graduates will be able to

PSO – 01: Formulate and apply innovative, state-of-the-art practices and technologies to provide sustainable solutions to the complex civil engineering problem.

PSO – 02: Plan, analysis, design, construct and maintain the civil engineering systems in relation to environmental, economic and societal demands.

PSO – 03: Apply modern tools and techniques, sustainable materials, and management tools to serve as an engineer with professional and ethical attributes.

# B. Tech. Civil Engineering

## CREDIT STRUCTURE

### Category-wise Credit distribution

| Category | Credits |
|---|---|
| Foundation Core | 54 |
| Discipline-linked Engineering Sciences | 10 |
| Discipline Core | 52 |
| Discipline Elective | 15 |
| Projects and Internship | 9 |
| Open Elective | 12 |
| **Total Graded Credit Requirement** | **152** |
| **Non-graded Credit Requirement** | **11** |

# B. Tech. Civil Engineering

# DETAILED CURRICULUM

**Discipline-linked Engineering Sciences**

| Course Code | Course Title | L | T | P | C | Remarks |
|---|---|---|---|---|---|---|
| BCLE201L | Construction Materials | 2 | 0 | 0 | 2 | |
| BCLE202L | Fluid Mechanics | 3 | 0 | 0 | 3 | |
| BCLE202P | Fluid Mechanics Lab | 0 | 0 | 2 | 1 | |
| BCLE203L | Mechanics of Solids | 3 | 0 | 0 | 3 | |
| BCLE203P | Mechanics of Solids Lab | 0 | 0 | 2 | 1 | |

**Discipline Core**

| Course Code | Course Title | L | T | P | C | Remarks |
|---|---|---|---|---|---|---|
| BCLE204L | Surveying | 3 | 0 | 0 | 3 | |
| BCLE204P | Surveying Lab | 0 | 0 | 2 | 1 | |
| BCLE205L | Environmental Engineering | 3 | 0 | 0 | 3 | |
| BCLE205P | Environmental Engineering Lab | 0 | 0 | 2 | 1 | |
| BCLE209L | Engineering Geology | 2 | 0 | 0 | 2 | |
| BCLE206E | Building Planning and Drawing | 1 | 0 | 2 | 2 | |
| BCLE207L | Soil Mechanics | 3 | 0 | 0 | 3 | |
| BCLE207P | Soil Mechanics Lab | 0 | 0 | 2 | 1 | |
| BCLE208L | Structural Analysis | 2 | 1 | 0 | 3 | |
| BCLE301L | Concrete Technology | 3 | 0 | 0 | 3 | |
| BCLE301P | Concrete Technology Lab | 0 | 0 | 2 | 1 | |
| BCLE302L | Hydraulics and Hydraulic Machines | 3 | 0 | 0 | 3 | |
| BCLE302P | Hydraulics and Hydraulic Machines Lab | 0 | 0 | 2 | 1 | |
| BCLE303L | Foundation Engineering | 2 | 1 | 0 | 3 | |
| BCLE304L | Design of Reinforced Concrete Structures | 3 | 0 | 0 | 3 | |
| BCLE304P | Reinforced Concrete Structures Lab | 0 | 0 | 2 | 1 | |
| BCLE305L | Transportation Engineering | 2 | 1 | 0 | 3 | |
| BCLE306L | Water Resources Engineering | 3 | 0 | 0 | 3 | |
| BCLE306P | Water Resources Engineering Lab | 0 | 0 | 2 | 1 | |
| BCLE307L | Construction Practices and Management | 3 | 0 | 0 | 3 | |
| BCLE308L | Design of Steel Structures | 3 | 0 | 0 | 3 | |
| BCLE 308P | Steel Structures Lab | 0 | 0 | 2 | 1 | |
| BCLE309L | Estimating and Costing | 2 | 0 | 0 | 2 | |
| BCLE317L | Building Information Modeling | 1 | 0 | 1 | 2 | |

**Discipline Elective**

| Course Code | Course Title | L | T | P | C | Remarks |
|---|---|---|---|---|---|---|
| BCLE210L | AI in Civil Engineering | 3 | 0 | 0 | 3 | |
| BCLE310L | Environmental Impact Assessment | 3 | 0 | 0 | 3 | |
| BCLE311L | Industrial Waste Management | 3 | 0 | 0 | 3 | |
| BCLE312L | Air and Noise Pollution Control | 3 | 0 | 0 | 3 | |
| BCLE313L | Solid Waste Management | 3 | 0 | 0 | 3 | |
| BCLE314L | Geotechnical Earthquake Engineering | 3 | 0 | 0 | 3 | |
| BCLE315L | Groundwater Engineering | 3 | 0 | 0 | 3 | |
| BCLE316L | Rock Engineering | 3 | 0 | 0 | 3 | |
| BCLE401L | Traffic Engineering | 3 | 0 | 0 | 3 | |
| BCLE211L | Urban Planning and Development | 3 | 0 | 0 | 3 | |
| BCLE402L | Pre-stressed Concrete and Industrial Structures | 3 | 0 | 0 | 3 | |
| BCLE403L | Open Channel Hydraulics | 3 | 0 | 0 | 3 | |
| BCLE212L | Natural Disaster Mitigation and Management | 3 | 0 | 0 | 3 | |
| BCLE213E | Remote Sensing and GIS | 2 | 0 | 2 | 3 | |
| BCLE214L | Global Warming | 3 | 0 | 0 | 3 | |
| BCLE215L | Waste Management | 3 | 0 | 0 | 3 | |
| BCLE216L | Water Resource Management | 3 | 0 | 0 | 3 | |

| 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-Various properties of timber-Timber products and its applications.

| **Module: 4** | **Cement and its properties** | **4 hours** |
|---|---|---|

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

| **Module: 5** | **Aggregates and aggregate properties** | **4 hours** |
|---|---|---|

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

| **Module: 6** | **Mortars and its applications** | **4 hours** |
|---|---|---|

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

| **Module: 7** | **Miscellaneous Materials** | **4 hours** |
|---|---|---|

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

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

Guest lecture from industry and R & D organisations.

| **Total Lecture Hours** | **30 hours** |
|---|---|

| | | | |
|---|---|---|---|
| **Text Book(s)** | | | |
| 1. Varghese, P. C., Building Materials, 2015, Second Edition, PHI Learning Pvt. Ltd., New Delhi. | | | |
| **Reference Books** | | | |
| 1. Edward Allen, Joseph Iano, Fundamental Building Materials, 2014, Sixth Edition, John Wiley & Sons inc.<br>2. Rangwala, Building Construction, 2016, Charotar Publishers, India.<br>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 :

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

**Course Outcomes**

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

1. 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.<br>2. Streeter. V., Wylie, B., Bedford, K.W., Fluid Mechanics, 2017, McGraw Hill, New Delhi.<br>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.<br>(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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.<br>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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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** |
|---|---|---|

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

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

| **Module: 5** | **Calculation of Area and Volume** | **5 hours** |
|---|---|---|

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

| **Module: 6** | **Curve Surveying** | **5 hours** |
|---|---|---|

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

| | | |
|---|---|---|
| **Module: 7** | **Software Applications in Mapping** | **4 hours** |
| Preparation of Topographic Map-Contour Map-TIN model and Generation of 3D Surface-Preparation of Longitudinal & cross section of roads using Software–Introduction to GIS. | | |
| **Module: 8** | **Contemporary issues** | **2 hours** |
| Guest lecture from industry and R & D organisations. | | |
| **Total Lecture Hours** | | **45 hours** |

**Text Book(s)**

1. S. K. Duggal, Surveying Vol. I & II, 2013, Fourth Edition, Tata McGraw Hill, New Delhi.

**Reference Books**

1. Jerry Nathanson, Michael T. Lanzafama, Philip Kissam, Surveying Fundamentals and Practices, 2016, Seventh Edition, Pearson, UK.
2. Wolf. P. R., Ghilani C. G., Elementary Surveying: An Introduction to Geomatics, 2012, Pearson Prentice Hall, USA.

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

| | | | |
|---|---|---|---|
| **Recommended by Board of Studies** | 24.02.2022 | | |
| **Approved by Academic Council** | No. 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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.<br>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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.<br>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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.<br>2. Gurcharan Singh, Civil Engineering Drawing, 2009, Standard Publishers, New Delhi.<br>3. BIS SP-7, National Building Code of India, 2016, Govt. of India, New Delhi.<br>4. IS 962:1989 (Reaffirmed: 2017)–Code of Practice for Architectural and Building Drawings.<br>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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. Identify the 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 theirs applications for isotropic soils.

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

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

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

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

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

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

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

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

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

Guest lecture from industry and R & D organisations.

| **Total Lecture Hours** | **45 hours** |
|---|---|

**Text Book(s)**

<table>
<tr><td colspan="4">1. Braja M. Das, Principles of Geotechnical Engineering, 2014, Eighth Edition, Cengage Learning Pvt. Ltd., New Delhi.</td></tr>
<tr><td colspan="4">Reference Books</td></tr>
<tr><td colspan="4">1. Holtz D., Kovacs, W. D., An Introduction to Geotechnical Engineering, 2011, Second Edition, Prentice Hall, USA.<br>2. Gopal Ranjan, A. S. R. Rao, Basic and Applied Soil Mechanics, 2005, New Age International Publishers, New Delhi.</td></tr>
<tr><td colspan="4">Mode of Evaluation: CAT, Assignment, Quiz, FAT.</td></tr>
<tr><td>Recommended by Board of Studies</td><td colspan="3">24.02.2022</td></tr>
<tr><td>Approved by Academic Council</td><td>No. xx</td><td>Date</td><td>DD-MM-YYYY</td></tr>
</table>

| 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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.<br>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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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-Various workability tests-Admixtures-Chemical admixtures-Mineral admixtures.

| Module: 3 | Strength of Concrete | 6 hours |
|---|---|---|

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

| Module: 4 | Various stages of Concrete | 6 hours |
|---|---|---|

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

| Module: 5 | Durability of Concrete | 6 hours |
|---|---|---|

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

| Module: 6 | Mix Design | 6 hours |
|---|---|---|

Concrete mix design–Factors to be considered for mix design-Variables in proportioning-Different methods of mix design-Indian Standard Method IS 10262.

| Module: 7 | Special Concrete | 7 hours |
|---|---|---|

Polymer concrete composites-Recycled aggregate concrete-Fibre-reinforced concrete-Ferro cement-High performance concrete-Self compacting concrete-Light weight concrete.

| Module: 8 | Contemporary Issues | 2 hours |
|---|---|---|

Guest lecture from industry and R & D organisations.

| | | | |
|---|---|---|---|
| **Total Lecture Hours** | | | **45 hours** |
| **Text Book(s)** | | | |
| 1. Neville A. M., Brooks, J. J., Concrete Technology, 2017, Second Edition, Pearson, London, UK. | | | |
| **Reference Books** | | | |
| 1. Mehta P. K., Concrete: Microstructure, Properties and Materials, 2014, McGraw-Hill, New Delhi.<br>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**

The objectives of this course is to :

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

**Course Outcome**

Upon completion of the course students will be able to

1. 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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.<br>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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.<br>2. Varghese P. C., Advanced Reinforced Concrete Design, 2005, Second Edition, Prentice Hall India Learning Private Ltd., New Delhi.<br>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 :

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

**Course Outcomes**

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

1. 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**

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

**Reference Books**

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

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

| | | | |
|---|---|---|---|
| **Recommended by Board of Studies** | 24.02.2022 | | |
| **Approved by Academic Council** | No. 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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.<br>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 :

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 :

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.<br>2. Gambhir M. L., Fundamentals of Structural Steel Design, 2013, McGraw Hill Education India Pvt. Ltd.<br>3. IS 800:2007, Indian Standard Code of Practice for General Construction in Steel, Bureau of Indian Standards, New Delhi.<br>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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.<br>2. Cartlidge D., Quantity Surveyor's Pocket Book, 2017, Third Edition, Routledge, UK.<br>3. Central Public Works Department (CPWD) Works Manual 2019.<br>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**

The objectives of this course is to :

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

**Course Outcomes**

Upon completion of the course students will be able to

1. 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)**

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

**Reference Books**

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

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

| | | | |
|---|---|---|---|
| **Recommended by Board of Studies** | 24.02.2022 | | |
| **Approved by Academic Council** | No. 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**

The objectives of this course is to :

1. Understand the basic concepts and methods of EIA.
2. Know the impacts occurred to physical, biological and socioeconomic environment.
3. Draft an EIA for specific projects and understanding the mitigation and monitoring methods.

**Course Outcomes**

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

1. 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.<br>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**

The objectives of this course is to :

1. Identify the fundamental physical, chemical characteristics of each target pollutant.
2. Analyse the mechanism by which the pollutant is held in solution or suspension by the waste stream.
3. Determine an efficient method by which the target pollutant can be removed from the waste stream.

**Course Outcomes**

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

1. 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**

The objectives of this course is to :

1. Explore the aspects and impacts of atmospheric pollution on human and environment.
2. Understand the sources, effects and measurement methods of air and noise pollution.
3. Identify, formulate and solve air and noise pollution problems.

**Course Outcomes**

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

1. 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**

The objectives of this course is to :

1. Acquire knowledge on collection, separation, transportation and disposal of Solid Waste.
2. Approach the recovery process in cost effective manner.
3. Integrate the concepts of circular economy into Solid Waste Management.

**Course Outcomes**

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

1. Identify the 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.<br>2. Salah M. El-Haggar, Sustainable Industrial Design and Waste Management Cradle-to-cradle for Sustainable Development, 2007, Elsevier Academic Press, USA.<br>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**

The objectives of this course is to :

1. Inculcate the fundamentals of behaviour of soil under earthquake loading.
2. Evaluate seismic hazard and liquefaction potential of site.
3. Determine the dynamic properties of the soil.

**Course Outcomes**

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

1. 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.

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| **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**

The objectives of this course is to :

1. Acquire the basic knowledge of the residence and movement of groundwater, as well as a number of quantitative aspects.
2. Solve groundwater flow equations for confined and unconfined aquifers under steady and unsteady flow conditions and demonstrate the well construction.
3. Examine the groundwater quality standards, contamination and exploration and develop the numerical models.

**Course Outcomes**

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

1. 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.

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|---|---|---|
| **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.<br>2. Chahar, B. R., "Groundwater Hydrology", First Edition, McGraw Hill Education, 2014. | | |
| **Mode of Evaluation:** CAT, Assignment, Quiz and FAT. | | |

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|---|---|---|---|
| **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**

The objectives of this course is to :

1. Provide basic knowledge on Rock Mechanics.
2. Deliver a comprehensive understanding in the properties of rock and rock mass.
3. Understand the stresses and deformations around the excavation, in-situ stresses and failure mechanisms in rocks.

**Course Outcomes**

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

1. 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.

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|---|---|---|
| **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**

The objectives of this course is to :

1. Identify the traffic stream characteristics and learn the traffic data collection techniques & analyze it.
2. Learn the concepts of highway capacity and level of service and its importance in traffic engineering
3. Familiarise with the traffic control devices and traffic management measures and enable them to understand the importance of road safety.

**Course Outcomes**

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

1. 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.

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|---|---|---|
| **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.

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| **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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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).

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| **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.<br>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. | | |

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| **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 :

1. Learn the principles, materials, methods and systems of pre-stressing.
2. Apply the various concepts for analysis and design of pre-stressed concrete beams.
3. Acquire the knowledge on applications of pre-stress in industrial, prefabricated and long span structures.

**Course Outcomes**

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

1. 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.<br>2. Arthur H. Nilson, Design of Pre-stressed Concrete, 1987, John Wiley & Sons, Canada.<br>3. IS: 1343: Indian Standard code of practice for Prestressed concrete, BIS, New Delhi.<br>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**

The objectives of this course is to :

1. Introduce various numerical techniques and their applications in open channel flow.
2. Demonstrate the open channel flow concepts in design and analysis of irrigation channels.
3. Model the uniform, gradually and rapidly varied flows in open channels.

**Course Outcomes**

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

1. 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-Chezzy's and Manning's formula-Determination of Manning's roughness coefficient-Conveyance of a channel section-Section factor-Flow in channel sections with composite roughness-Determination of normal depth and velocity-Determination of normal and critical slopes-Computation of flood discharge-Uniform surface flow.

| **Module: 5** | **Gradually Varied Flow** | **7 hours** |
|---|---|---|

Basic assumptions-Dynamic equation of gradually varied flow-Characteristics of flow profiles-Classification and analysis of flow profiles-Method of single point-Transitional depth-Methods of computation: graphical integration method-Direct integration method-Direct step method for natural channels.

| **Module: 6** | **Rapidly Varied Flow** | **7 hours** |
|---|---|---|

Characteristics of the flow-Hydraulic jump and its use as energy dissipator-Hydraulic jump-Jump in horizontal rectangular channels-Types of jump-Basic characteristics of jump-Surface profile-Length and location of jump-Jump as energy dissipator-Control of jump.

| | | |
|---|---|---|
| **Module: 7** | **Unsteady Varied Flow** | **4 hours** |
| Gradually varied unsteady flow-Dynamic equation for unsteady flow-Solution for unsteady flow equation-Rapidly varied unsteady flow-Uniformly progressive flow-Moving of hydraulic jump-Surge. | | |
| **Module: 8** | **Contemporary Issues** | **2 hours** |
| Guest lecture from industry and R & D organisations. | | |
| **Total Lecture Hours** | | **45 hours** |

**Text Book**

1. Ven Te Chow, Open Channel Hydraulics, 2009, Fifth Edition, The Black burn Press, New Jersey, USA.

**Reference Books**

1. Richard H French, Open Channel Hydraulics, 2007, Fourth Edition, Water Resources Publications LLC, Colorado, USA.
2. K. Subramanya, Flow in open channels, 2019, Fifth Edition, McGraw Hill Education, New Delhi.

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

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|---|---|---|---|
| **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**

The objectives of this course is to :

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

**Course Outcomes**

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

1. 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.

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|---|---|---|
| **Module: 8** | **Contemporary Issues** | **2 hours** |
| Guest lecture from industry and R & D organisations. | | |
| | **Total Lecture Hours** | **45 hours** |

**Text Book(s)**

1. Bhandari, R.K, Disaster Education and Management, A Joyride for Students, Teachers and Disaster Managers, 2014, Springer, India.
2. Ranke, Ulrich, Natural Disaster Risk Management-Geosciences and Social Responsibility, 2016, First Edition, Springer International Publishing.

**Reference Books**

1. Brian Tomaszewski, Geographic Information Systems (GIS) for Disaster Management, 2014, CRC Press, UK.
2. Harsh K. Gupta, Disaster Management, 2006, Second Edition, Indian National Science Academy.
3. Dhawan, Disaster Management and Preparedness, 2012, First Edition, CBS Publisher Pvt. Ltd.

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

| | | | |
|---|---|---|---|
| **Recommended by Board of Studies** | 24.02.2022 | | |
| **Approved by Academic Council** | No. 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**

The objectives of this course is to

1. Acquire the basic concepts of Geo-graphical Information Systems (GIS).
2. Understand the physical principles of Remote Sensing and Photogrammetry
3. Comprehend the various applications of Remote Sensing and GIS applications in the Engineering domain

**Course Outcomes**

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

1. 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. |

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| **Total Laboratory Hours** | **30 hours** |

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

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| **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 :

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 :

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.

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|---|---|---|
| **Module: 8** | **Contemporary issues** | **2 hours** |
| Guest lecture from industry and R & D organisations. | | |
| **Total Lecture Hours** | | **45 hours** |
| **Text Book(s)** | | |
| 1. Robin Moilveen, Fundamentals of weather and climate, 2010, Second Edition, Oxford University Press, UK.<br>2. Neelin David J, Climate Change and Climate Modelling, 2011, First Edition, Cambridge University Press, UK. | | |
| **Reference Books** | | |
| 1. Thomas Stocker, Introduction to Climate Modelling, Advances in Geophysical and Environmental Mechanics and Mathematics. 2011, Springer, UK.<br>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.<br>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**

The objectives of this course is to :

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**

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

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** |
|---|---|---|

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.

| **Module: 2** | **Municipal Solid Waste Management** | **7 hours** |
|---|---|---|

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.

| **Module: 3** | **Hazardous Waste Management** | **6 hours** |
|---|---|---|

Characterization of waste-Compatibility and flammability of chemicals-Storage-Transport-Secured Landfills-Treatment techniques-Fundamental concepts on fate and transport of chemicals-Health effects.

| **Module: 4** | **Radioactive Waste Management** | **6 hours** |
|---|---|---|

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.

| **Module: 5** | **Wastewater Management** | **5 hours** |
|---|---|---|

Sources and characteristics of wastewater–Primary wastewater treatment–Secondary wastewater treatment–Sludge treatment alternatives–Industrial wastewater treatment–Zero Liquid Discharge–Wastewater disposal methods.

| **Module: 6** | **Emerging waste** | **9 hours** |
|---|---|---|

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.

| **Module: 7** | **Closed Loop Approach Towards Circular Economy** | **5 hours** |
|---|---|---|

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.

| **Module: 8** | **Contemporary issues** | **2 hours** |
|---|---|---|

Guest lecture from industry and R & D organisations.

| | | | |
|---|---|---|---|
| **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.<br>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**

The objectives of this course is to :

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**

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

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.<br>2. Philippe Cullet and Sujith Koonan, Water Law in India- An Introduction to Legal Instruments, 2017. Second Edition, Oxford University Press, New Delhi.<br>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 |