| STRENGTH OF MATERIALS | | Semester | III |
|---|---|---|---|
| Course Code | **BCV301** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3+0+0+0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 Hrs. |
| Examination type (SEE) | Theory | | |

**Course Learning objectives:** This course will enable students to

- Understand the simple stresses, strains, and compound stresses in various structural components.
- Understand the bending moments and shear forces in different types of beams under various loading conditions
- Know the bending stress, shear stress, and torsional stress in beams and shafts with different cross sections
- Understand the deflection in beams and the stability of columns under different loading conditions.
- Understand the behaviour and strength of structural elements subjected to compound stresses and stresses in thin and thick cylinders.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Arrange field visits to give brief information about the water and wastewater treatment plant.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinkingand enhance the knowledge of treatment processes.
5. Adopt Problem Based Learning (PBL), which fosters students, Analytical skills, develop thinking skills suchas the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Seminars, surprise tests and Quizzes may be arranged for students in respective subjects to develop skills

**Module-1**

**Simple Stresses and Strains:** Introduction, Properties of Materials, Stress, Strain, Hooke's law, Poisson's Ratio, Stress – Strain Diagram for structural steel, Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Composite section, Volumetric strain, expression for volumetric strain, Elastic constants, relationship among elastic constants. Thermal stresses and strains, Compound bars subjected to thermal stresses, state of simple shear. **(L1, L2, L3)**

**Module-2**

**Bending moment and shear force diagrams in beams:** Introduction to types of beams, supports and loadings. Definition of shear force and bending moment, sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, development of Shear Force Diagram(SFD) and Bending Moment Diagram (BMD) with salient values for cantilever, simply supported and overhanging beams for point loads, UDL (Uniformly Distributed Load), UVL (Uniformly Varying Load), Couple and their combinations

**(L1,L2,L3)**

**Module-3**

**Bending and Shear Stresses in Beams:** Introduction, pure bending theory, Assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity. Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections.

**Torsion in Circular Shaft:** Introduction, pure torsion, Assumptions, derivation of torsion equation for circular shafts, torsional rigidity and polar modulus Power transmitted by a shaft.

**(L1, L2, L3)**

**Module-4**

**Deflection of Beams:** Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment- curvature equation. Double integration method and Macaulay's method: Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple.

**Columns and Struts:** Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns. **(L1,L2,L3)**

**Module-5**

**Compound Stresses:**

Introduction, state of stress at a point, General two dimensional stress system, Principal stresses and principal planes. Mohr's circle of stresses

**Thin and Thick Cylinders:**

Introduction, Thin cylinders subjected to internal pressure; Hoop stresses, Longitudinal stress and change in volume. Thick cylinders subjected to both internal and external pressure; Lame's equation, radial and hoop stress distribution. **(L1,L2,L3)**

**Course outcome (Course Skill Set)**

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

1. Evaluate the simple stresses, strains and compound stresses
2. Calculate the Bending moments, shear force and draw BMD, SFD for various types of beams and loadings
3. Analyse the bending stress, shear stress and torsional stress in beams and shafts with different cross sections
4. Evaluate the deflection in beams and determine the stability of the columns.
5. Evaluate the behaviour and strength of structural elements under the action of compound stresses and stresses in thin and thick cylinders.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books**

- B.C Punmia Ashok Jain, Arun Jain, "Strength of Materials", Laxmi - 2018-22 Publications, 10th Edition-2018
- R K Bansal, "A Textbook of Strength of Materials", 4th Edition, Laxmi Publications, 2010
- S.S. Rattan "Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (Sixth reprint 2013).
- Vazirani, V N, Ratwani M M. and S K Duggal "Analysis of Structures Vol. I", 17th Edition, Khanna Publishers, New Delhi.
- R.K. Rajput, "Strength of materials" S. Chand Publishing (6th Edition)
- S S Bhavikatti, "Strength of Materials" Vikas Publishing (5th Edition)
- B.S. Basavarajaiah, P. Mahadevappa "Strength of Materials" in SI Units, University Press (India) Pvt. Ltd., 3rd Edition,2010

**Web links and Video Lectures (e-Resources):**

1.Strength of Materials web course by IIT Roorkee https://nptel.ac.in/courses/112107146/

2.Strength of Materials video course by IIT Kharagpur https://nptel.ac.in/courses/105105108/

3.Strength of Materials video course by IIT Roorkee https://nptel.ac.in/courses/112107147/18

4.All contents organized http://www.nptelvideos.in/2012/11/strengthof-materials-prof.html

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Quiz (To assist in GATE Preparations)
- Demonstrations in Lab
- Virtual Lab Experiments

**CO & PSO - PO Mapping (Individual Teacher has to fill)**

| Mapping of Course Outcomes and Program specific outcomes to Program Outcomes | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | | **Program Specific Outcomes** | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
| **CO1** | | | | | | | | | | | | | | | | |
| **CO2** | | | | | | | | | | | | | | | | |
| **CO3** | | | | | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | | | | | |
| **CO5** | | | | | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | | | | | |
| **Average** | | | | | | | | | | | | | | | | |

**Level 0: Not Mapped, 1: Low Mapped, 2: Moderately Mapped 3: Highly Mapped**

**Note**: Depending on the Assessment tool used, higher order POs Can be identified by the concerned course instructor.

| Engineering Survey | | Semester | 3 |
|---|---|---|---|
| Course Code | BCV302 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | 3 |
| Examination nature (SEE) | Theory | | |

**Course Learning objectives:** This course will enable students to

- Ability to understand principles of both traditional and modern surveying applying knowledgeof mathematics.
- Ability to handle surveying equipment's and software tools to carry out field surveying, plottopographical Drawings and construction drawing
- Ability to use Total station for data capture, data storage, data transfer.
- Ability to prepare construction drawing and setting out

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Arrange field visits to give brief information about the water and wastewater treatment plant.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinkingand enhance the knowledge of treatment processes.
5. Adopt Problem Based Learning (PBL), which fosters students, Analytical skills, develop thinking skills suchas the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Seminars, surprise tests and Quizzes may be arranged for students in respective subjects to develop skills.

**MODULE-1**

**Engineering surveying** – Definition & importance of surveying for Civil Engineers. Surveying types- Control survey, Topographical surveying, Construction Survey, Cadastral survey, Hydrographic survey and Underground Survey. Surveying through the ages- Chain surveying, Compass surveying and Plane Table Surveying (concepts and limitations only).

**Measurement of Distance-** Various types of tapes, Laser distance meter, Distance measuring wheel, Electronic Distance measurement, GPS. **L1,L2,L3**

## MODULE-2

**Vertical Control-** Concepts of various types of Datum – Mean Sea level, Bench marks – Temporary and Permanent.

Levelling- Terms used in levelling, Setting up of Dumpy level. Differential levelling by plane of collimation method using Dumpy level.

**Theodolite Surveying –** Terms used in Theodolite surveying. Setting up a Theodolite. Measurement of horizontal and vertical angles with Theodolite.

**Total Station Surveying** – Features, parts, accessories and advantages of Total Station. Surveying with total station – Measurement of Horizontal angle, vertical angle, distance, slope, vertical distance, multiple angles with Total station. Using Total station for Area measurement and Volume calculation. **L1,L2,L3**

## MODULE-3

**Contours -** Definition, terms used, characteristics of contours and applications of contours in civil engineering practice. Contouring using level, theodolite and total station. Plotting of contours in CAD.

**Longitudinal and cross sectioning –** Definition, importance of L/S & C/S. L/S & C/S using level, theodolite and Total station. Plotting of L/S & C/S in CAD.

**Coordinate survey with Total station** - Measurement of coordinates using total station. Creating Job files, importance of back sight data, coordinate data recording. Data transferring, data refinement and plotting in CAD. **L1,L2,L3**

## MODULE-4

**Curves** –Types of Curves- Application of curves in civil engineering. Setting out of Horizontal curve by Theodolite (Rankine's method) and using Total Station. Components of Compound, Reverse curve. Transition Curve and Combined curve. Various types of vertical curves and its applications.

**Areas and Volumes**- Methods of determining areas by trapezoidal and Simpsons' rule. Measurement of volume by prismoidal and trapezoidal formula. Earthwork volume calculations from spot levels andfrom contour maps; Earthwork calculation in Embankments.

**Construction Surveying** - Setting out works using Total Station, Setting out buildings by Centre line method. **L1, L2, L3, L4**

## MODULE-5

**GPS Surveying –** Introduction. Overview of GPS system- space, control and user segments. Reference co- ordinate systems. Absolute and Differential positioning with GPS. Gagan system in India. Types of GPS Receivers. Engineering survey using Differential GPS.

**Surveying with Drone** – Introduction, applications and advantages. Features of photogrammetric mapping method. Drone surveying requirements- Drone platform, Flight planning software, Sensor DGPS equipment and Image processing software. Types of drones and sensors. Process of drone surveying – flight planning, DGPS markers, capturing images, post processing of images using photogrammetry software and output maps.

Application and uses of Remote sensing and GIS in engineering surveying. **L1, L2, L3, L4**

**PRACTICAL COMPONENT OF IPCC**

| Sl.NO | Experiments |
|---|---|
| 1 | Use of Various types of tapes, Laser distance meter, Distance measuring wheel. |
| 2 | Differential levelling by Dumpy level by plane of collimation method |
| 3 | Measurement of horizontal and vertical angles by Theodolite. Method of repetition |
| 4 | Setting out simple curve using Rankine's method using Theodolite |
| 5 | Setting out central line of a small residential building. |
| 6 | Setting up of Total station. Features and components of Total station |
| 7 | Measurement of Distance, slope, vertical distance, horizontal and vertical angles using Total station |
| 8 | Coordinate measurement with Total station |
| 9 | Longitudinal sectioning and cross sectioning using Total station |
| 10 | Contouring and plotting with Total station |
| 11 | Demonstration of Equipment's used for chain, compass and plane table surveying |
| 12 | Visit to railway station/ large construction site to understand the importance of datum and benchmark. |

**Course outcomes (Course Skill Set):**

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

- Summarize various types of surveying and carry out distance measurement using various equipment's
- Illustrate the use and applications of levelling and theodolite
- Plot contours, longitudinal and cross sections for construction projects.
- Set curves for construction works and carry out estimation of areas and volumes.
- Demonstrate the necessary skills to carry out GPS and DRONE Surveying

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Books**


1. Punmia BC, & Jain Ashok Kumar. (2016). *Surveying* (17th ed., Vol. 1). Laxmi Publications.
2. Dr. K.R. Arora. (2019). *Surveying* (17th ed., Vol. 1). Standard Book House.
3. Charles D. Ghilani. (2012) (13th ed.). Prentice Hall


**Web links and Video Lectures (e-Resources):**

1. **https://enterprise.dji.com/surveying/land-surveying**
2. **https://www.gps.gov/applications/survey/**
3. **https://www.constructionplacements.com/total-station-in-surveying-types-uses-and-applications/**
4. **https://www.youtube.com/watch?v=bbs5AEPstl4**
5. **https://www.youtube.com/watch?v=KHI4TEeexuM&list=PLLy_2iUCG87DwNVc3Mz1yYlRA42jSQ1tB&index=28**
6. **https://www.youtube.com/watch?v=Iu9vrE48_I4&list=PLLy_2iUCG87DwNVc3Mz1yYlRA42jSQ1tB&index=30**
7. **https://www.youtube.com/watch?v=RXUi2cX4CkU**
8. **https://www.youtube.com/watch?v=SVa66vO08So**

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. **Hand on use of various surveying instruments**
2. **Surveying Civil engineering block and plotting with instruments of student's choice**
3. **Setting out a single bedroom house plan in field**

**CO & PSO - PO Mapping (Individual Teacher has to fill)**

| Mapping of Course Outcomes and Program specific outcomes to Program Outcomes | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | | **Program Specific Outcomes** | | | |
| | PO 1 | PO 2 | P O3 | P O4 | P O5 | P O6 | P O7 | P O8 | P O9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
| **CO1** | | | | | | | | | | | | | | | | |
| **CO2** | | | | | | | | | | | | | | | | |
| **CO3** | | | | | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | | | | | |
| **CO5** | | | | | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | | | | | |
| **Average** | | | | | | | | | | | | | | | | |

**Level 0: Not Mapped, 1: Low Mapped, 2: Moderately Mapped 3: Highly Mapped**

**Note**: Depending on the Assessment tool used, higher order POs Can be identified by the concerned course instructor.

| ENGINEERING GEOLOGY | | Semester | 3 |
|---|---|---|---|
| Course Code | BCV303 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | |
| Examination nature (SEE) | Theory | | |

**Course objectives:**

1. To inculcate the importance of earth's interior and application of Geology in civil engineering in Geo Hazard mitigation and management
2. To create awareness among Civil engineers regarding the resources of earth
3. To provide knowledge on dynamic Geology and its importance in modifying the physical character of rocks which cause rocks suitable or unsuitable in different civil engineering projects such as Dams, bridges, tunnels and highways.
4. To educate the ground water management regarding diversified geological formations, . To highlight the concept of rain water harvesting.
5. To understand the application of Remote Sensing and GIS, Natural disaster and management and environmental awareness. To understand the subsurface using geospatial data
6. To provide decision support on the nature of the basic raw materials used in construction. To provide decision support on Lithological characters and subsurface conditions
7. To describe various geological maps and interpretation of geological data for mining and subsurface investigations.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Chalk and Talk method.
- Show Video/animation films to explain earth dyanamics and influence of geology in prime civil constructions
- Encourage collaborative (Group Learning) Learning in the class
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking process such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**MODULE-1 7 hrs**

## Introduction, the scope of earth science in Engineering.

Earth's internal structure and composition, internal dynamics and Plate tectonics, Earthquakes - types, causes, so-seismic lines, seismic zonation, seismic proof structures. Volcanic eruption - types, causes. Landslides-causes types, preventive measures; Tsunami – causes, consequences, mitigation. Cyclones - causes and management.

**MODULE-2 5 hrs**

## Earth Materials in Construction

Minerals -Industrial, rock-forming and ore minerals. Physical properties, composition.
Rocks Types, structure/Texture, mineral composition occurrence, properties.
Decorative (facing/polishing), railway ballast, rocks for masonry work, monumental/architecture, Dressing of stones, Requirement of good building stones.

**MODULE-3 7hrs**

**Earth Surface process and Resources**

Weathering, type, causes, soil insitu, drifted soil, soil profile, soil mineralogy, structure, types of soil, Black cotton soil v/s Lateritic soil; effects of weathering on monumental rocks. Soil Horizon, Soil Classification by Grain Size.

**MODULE-4 7 hrs**

**Surface and sub investigation for deep foundation**

Dip and strike, and outcrop problems(numerical problem geometrical/ simple trigonometry based), Borehole data(and problems), Faults, folds, unconformity, joints, types, recognition and their significance in Civil engineering projects like tunnel project, dam project, Reservoir site,.

**MODULE-5 5 hrs**

**Modern Tools and geophysical methods**

Rocks as aquifers, water-bearing properties igneous, sedimentary and metamorphic rocks , coefficient of permeability, factors affecting permeability, Electrical Resistivity meter, depth of water table, (numerical problems), seismic studies.

**PRACTICAL COMPONENT OF IPCC** *(May cover all / major modules)*

| Sl.NO | Experiments 8 hrs |
|---|---|
| 1 | Identification of common minerals based on Physical Properties |
| 2 | Identification of rocks used in building construction based on Physical properties |
| 3 | Solving Geological maps for suitability for aqua duct |
| 4 | Geological maps with inclined beds, suitability for tunnels/ Dams |
| 5 | Geological maps with folds, in tunnels/ Dams |
| 6 | Geological maps with unconformity , in tunnel/dam project |
| 7 | Geological maps with faults in Dams/tunnels project |
| 8 | One Day Nearest Field Visit Investigation. |

**Course outcomes (Course Skill Set):**

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

- Apply geological knowledge in different civil engineering practice.
- Acquire knowledge on durability and competence of foundation rocks, and will be able to use the best building materials.
- Students will become competent enough for the safety, stability, economy and life of the structures that they construct
- Able to solve various issues related to ground water exploration, build up dams, bridges, tunnels which are often confronted with ground water problems
- Students will become Intelligent enough to apply GIS, GPS and remote sensing as a latest tool in different civil engineering for safe and solid construction.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for

the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Note: Subject to be taught by Geologist with qualification M. Sc Geology/MPhil/ Ph. D in Geology**

**Suggested Learning Resources:**

**Books**

1. Engineering Geology, by Parthasarathy et al, Wiley publications
2. A textbook of Engineering Geology by ChennaKesavulu, Mac Millan India Ltd
3. Principle of Engineering Geology, by K.M. Bangar, Standard publishers
4. Physical and Engineering Geology, by S.K. Garg, Khanna publishers
5. Principles of Engineering Geology, by KVGK Gokhale, BS Publications

**Reference Books**

1. Introduction to Environmental Geology by Edward A Keller, Pearson publications.
2. Engineering Geology and Rock Mechanics B. P. Verma, Khanna publishers
3. Principles of Engineering Geology and Geotechnics, Krynine and Judd, CBS Publications

**Web links and Video Lectures (e-Resources):**

- **https://www.youtube.com/watch?v=aTVDiRtRook&list=PLDF5162B475DD915F**
- **https://www.youtube.com/watch?v=EBiLLJAxBuU&index=2&list=PLDF5162B475DD915F**
- **https://www.youtube.com/watch?v=sTY-ao4RZck&list=PLDF5162B475DD915F&index=3**
- **https://nptel.ac.in/courses**
- **https://youtu.be/fvoYHzAhvVM**
- **https://youtu.be/aTVDiRtRook**
- **https://serc.carleton.edu/NAGTWorkshops/hazards/events/12262004.html?serc_source=recommendation**
- https://serc.carleton.edu/NAGTWorkshops/visualization/examples/CBezanson.html?sercsource=recommendation
- **https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/14712.html**
- **https://www.earthsciweek.org/classroom-activities**
- NPTEL materials

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Field Visits
- Quiz/Assignments/Open book test to develop skills
- Encourage collaborative learning in the class
- Demonstration of Geological models and animations
- Hands on experiments with Rock and Minerals

| WATER SUPPLY AND WASTEWATER ENGINEERING | | Semester | III |
|---|---|---|---|
| Course Code | **BCV304** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3+0+0+0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | |
| Examination type (SEE) | Theory | | |

**Course Learning objectives:** This Course will enable the students to

1. Analyze the variation of water demand and to estimate water requirement for a community.
2. Study drinking water quality standards and to illustrate qualitative analysis of water.
3. Analysis of physical and chemical characteristics of water and wastewater.
4. Understand and design of different unit operations and unit process involved in water and wastewater treatment process
5. Design various oxidation processes.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Arrange field visits to give brief information about the water and wastewater treatment plant.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinkingand enhance the knowledge of treatment processes.
5. Adopt Problem Based Learning (PBL), which fosters students, Analytical skills, develop thinking skills suchas the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Seminars, surprise tests and Quizzes may be arranged for students in respective subjects to develop skills

## Module-1

**Introduction:** Water: Need for protected water supply, Demand of Water: Types of water demands - domestic demand, industrial, institutional and commercial demand, public use and fire demand estimation, factors affecting per capita demand, Variations in demand of water, Peak factor.

Design period and factors governing design period. Methods of population forecasting and numerical problems. Physico chemical characteristics of water Sampling. **L1, L2, L3**

## Module-2

**Water Treatment:** Objectives, Unit flow diagrams – Significance of each unit, Aeration process Limitations and types.

**Sedimentation** - Theory, settling tanks, types and design with numerical, Coagulation and flocculation, types of coagulants.

**Filtration:** Mechanism, theory of filtration, types of filters: slow sand, rapid sand and pressure filters. Operation and cleaning. Design of slow and rapid sand filter without under drainage system, Numerical. **L1, L2,**

## Module-3

**Disinfection**: Methods of disinfection with merits and demerits. Breakpoint chlorination, Softening: Lime soda and Zeolite process.

**Wastewater: Introduction**: Need for sanitation, methods of sewage disposal, types of sewerage systems, Treatment of municipal waste water: Waste water characteristics sampling, significance and techniques, physical, chemical and biological characteristics, Numerical on BOD.

**L1 , L2**

**Module-4**

**Treatment Process:** flow diagram for municipal waste water Treatment unit operations and process Screens: types, disposal. Grit chamber, oil and grease removal. Primary and secondary settling tanks, **Suspended growth system** - conventional activated sludge process and its modifications, numerical.

**L1,L2 ,L3**

**Module-5**

**Attached growth system** – Trickling filter, numerical on Trickling filters, bio-towers and rotating biological contactors. Principle of stabilization ponds, oxidation ditch. Sludge digesters (aerobic and anaerobic), Equalization. Thickeners and drying beds.

**L1, L2, L3**

**Course outcome (Course Skill Set)**

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

1. Estimate the average and peak water demand for a community.
2. Evaluate water quality and environmental significance of various parameters and plan suitable treatment system.
3. Design the different units of water treatment plant.
4. Design the various units of wastewater treatment plant.
5. Design of various AOPs and low cost treatment units.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment

shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text books**


- Howard S. Peavy, Donald R. Rowe, George T, "Environmental Engineering" - Tata McGra Hill, New York, Indian Edition, 2013
- S. K. Garg, Environmental Engineering Volume-I, Water supply Engineering – M/s Khanna Publishers, New Delhi2010
- B.C. Punmia and Ashok Jain, Environmental Engineering I-Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi2010.
- B C Punmia, "Environmental Engineering volume-II", Laxmi Publications 2nd, 2016
- Karia G.L., and Christian R.A, "Wastewater Treatment Concepts and Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi. 3rd, Edition, 2017
- S.K.Garg, "Environmental Engineering vol-II, Water supply Engineering", Khanna Publishers, – New Delhi, 28th edition and 2017
- CPHEEO Manual on water supply and treatment engineering, Ministry of Urban Development, Government of India, New Delhi.
- Mark.J Hammer, Water & Waste Water Technology, John Wiley & Sons Inc., New York,2008


**Web links and Video Lectures (e-Resources):**

**Lecture 01: Background and Course Introduction https://youtu.be/yDnrv-oGSBc**
**Lecture 02: Water Sources and Availability https://youtu.be/K4Vty0cmybI**
**Lecture 03: Water Uses https://youtu.be/9H7dPkWOsjA**
**Lecture 04: Water Supply Key Issues and Concerns https://youtu.be/JueYGPbsflw**
**Lecture 05: Urban water services and water supply systems https://youtu.be/bCKm9KkcQtw**
**Lecture 06: Urban water services and water supply systems https://youtu.be/s0hy0ZlM1bA**
**Lecture 07: Components of Water Demand https://youtu.be/mVmErXpIp64**
**Lecture 08: Fluctuations in Water Demand https://youtu.be/qXUwy5OnX9Q**
**Lecture 09: "Concept of Design Period and Design Population Need to Forecast Population Population Forecasting Methods https://youtu.be/QyLdA_qhUog Lecture 10: Demand Forecasting and Design Capacities https://youtu.be/rKTwjvx7E8A**
**Lecture 11: Water Sources and Collection of Water https://youtu.be/TvEGgZw1El4**
**Lecture 12: Surface Water Intakes https://youtu.be/GcQOyAdG5OM**
**Lecture 13: Surface Water Intakes Systems https://youtu.be/r1oJtm_SXz4**
**Lecture 14: Groundwater Intake https://youtu.be/Zo1p7uRDEmM**
**Lecture 15: Well Interferences, Well losses and Efficiency https://youtu.be/dRU5M_WICU0 Lecture 16: Raw water Conveyance and Pumping https://youtu.be/iQwEoEhujTc**
**Lecture 17: Practice Problems https://youtu.be/e5bduQiz5NY Lecture 18 : Raw Water Storage https://youtu.be/WZlI7kWoUjE**
**Lecture 19 : Treated Water Storage https://youtu.be/BuZ48afjd04**
**Lecture 20 : Placement, Design and Construction of Storage Reservoirs https://youtu.be/nQCZbXaBb1o**

**Lecture 24 : Philosophy of Water Treatment** https://youtu.be/6I-eBqE7Hew
**Lecture 25 : Water Treatment Units Screening and Aeration**
https://youtu.be/QsWp_HIZqPs
**Lecture 26 : Water Treatment Units Sedimentation** https://youtu.be/T1M4Ecjwq7Q
**Lecture 27 : Practice Problems On Sedimentation** https://youtu.be/Zlh2mpOjIMU
**Lecture 28: Coagulation and Flocculation: Theory** https://youtu.be/aAo2bBaF0yU
**Lecture 29: Coagulation and Flocculation: Selection and Application** https://youtu.be/44p0lN31ogo
**Lecture 30: Coagulation and Flocculation: Design Operation and Process Control** https://youtu.be/v0TDfCz_jLU
**Lecture 31: Filtration Theory and Slow Sand Filters** https://youtu.be/nuJQe9F_2zI
**Lecture 32: Rapid Sand Filter: Filter Media and Components** https://youtu.be/3qw3sKcuQlY
**Lecture 33: Rapid Sand Filters and Pressure Filters** https://youtu.be/PEX_0DebrSQ
**Lecture 34: Practice Problems Coagulation Flocculation and Filtration** https://youtu.be/73jxsBCDuq4
**Lecture 35: Disinfection Basic** https://youtu.be/d4UG9Xivuik
**Lecture 36: Chlorination** https://youtu.be/L3eSkeOU3jY

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Activity Based Learning (Suggested Activities in Class)/ Practical Based learning http://nptel.ac.in
- https://swayam.gov.in
- https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham

## CO & PSO - PO Mapping (Individual Teacher has to fill)

| Mapping of Course Outcomes and Program specific outcomes to Program Outcomes | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | | **Program Specific Outcomes** | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
| **CO1** | | | | | | | | | | | | | | | | |
| **CO2** | | | | | | | | | | | | | | | | |
| **CO3** | | | | | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | | | | | |
| **CO5** | | | | | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | | | | | |
| **Average** | | | | | | | | | | | | | | | | |

**Level 0: Not Mapped, 1: Low Mapped, 2: Moderately Mapped 3: Highly Mapped**

**Note**: Depending on the Assessment tool used, higher order POs Can be identified by the concerned course instructor.

| COMPUTER AIDED BUILDING PLANNING AND DRAWING | | Semester | 3 |
|---|---|---|---|
| Course Code | **BCV305** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 100 |
| Examination type (SEE) | practical | | |

**Course objectives:**

- Gain skill set to prepare Computer Aided Engineering Drawings using a software
- Understanding the details of construction of different building elements
- Visualize the completed form of the building and the intricacies of construction based on the engineering drawings
- Get familiarization of practices used in Industry.

| Sl.NO | Experiments |
|---|---|
| 1 | **Drawing Basics:** Selection of scales for various drawings, thickness of lines, dimensioning, abbreviations and conventional representations as per IS:962. |
| 2 | **Drawing Tools:** Lines Circle, Arc, Poly line, Multiline, Polygon, Rectangle, Spline, Ellipse, Modify tools: Erase, Copy, Mirror, Offset, Array, Move, Rotate, Scale, Stretch, Lengthen, Trim, Extend, Break, Chamfer and Fillet, |
| 3 | **Using Text:** Single line text, Multiline text, Spelling, Edit text |
| 4 | **Special Features:** View tools, Layers concept, Dimension tools, Hatching, Customizing Toolbars, Working with multiple drawings. |
| 5 | **Drawings of Different Building Elements:** Refer NBC before practice<br>a> Footing/ Foundation – Foundation dimension for Isolated, combined footing, Standard dimension and cross section of footing<br>b> Size stone Masonry – Size of single and double bond stone, Sections at wall foundation<br>c> Brick Masonry – Size of standard Burnt Brick, Solid Cement Block, Hollow Cement block, Other bricks used in current practice |
| 6 | Principles of planning, Planning regulations and building bye-laws, factors affecting site selection, Functional planning of residential and public buildings, design aspects for different public buildings. Recommendations of NBC. |
| 7 | Draw a building plan for single and double bed room accommodation for a given site dimension. Students have to go through Building Bye Laws and regulations |
| 8 | Prepare the centre line drawing for marking the single and double bedroom house as in in exercise 6 |
| 9 | Prepare a complete sanction plan for the exercise 6 as per the bye law. Also study the requirements to plan Residential Building, School building, Hospital Building, Offices |
| 10 | Drawing of plan with electrical, plumbing and sanitary services using CAD software |
| 11 | Drawing standard sections for Lintel and chajja, RCC Slabs, Columns and beams. |
| 12 | Drawing different types of staircases – Dog legged, Open well – plan and section |

**Course outcomes (Course Skill Set):**
At the end of the course the student will be able to:

- Prepare, read and interpret the drawings in a professional set up.
- Know the procedures of submission of drawings and Develop working and submission drawings for building.
- Plan of residential or public building as per the given requirements..

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted

between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**


- MG Shah, CM Kale, SY Patki, "Building drawing with an integrated approach to Built Environment Drawing", Tata McGraw Hill Publishing co. Ltd, New Delhi.
- Gurucharan Singh, "Building Construction", Standard Publishers, & distributors, New Delhi.
- Malik RS and a Meo GS, "Civil Engineering Drawing", Asian Publishers/Computech Publication Pvt Ltd

| Rural, Urban Planning and Architecture | | Semester | 3 |
|---|---|---|---|
| Course Code | BCV306A | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To make the student understand about the past and present architecture of different parts of the world
- Rural and urban planning and growth and circulation of patterns and effect of increase in urbanization
- The basic planning required for urban and rural centres with respect to physical and social aspects
- Student s to visit the different place of architecture monuments to understand the concept
- To understand different types of architecture and planning

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The architecture of India has to be understood and few exercises must be given.
2. Student has to visit different cities to understand architecture and planning concepts
3. Online courses to understand the basics
4. YouTube videos
5. Power point presentations

**Module-1**

Introduction: Aim and importance of Architecture, Architecture as a fine art. Role of an architect and an engineer.

Essential principles and qualities of architecture with examples

Factors of architecture: Mass, Form, Colour, Solids, and Voids, Uniformity, Balance and Symmetry, Painting with examples.

**Module-2**

Architectural influence of the following: Association, Tradition, Climate, Materials, Topography, Religion social customs and aspiration of time.

Architectural characteristics of the following architecture with examples. 1. Egyptian, 2. Greek, 3. Roman, 4. Buddhist, 5. Hindu, 6. Jain, 7. Chalukyan, 8. Modern architecture

Factors that have influence present day Modern Architecture, Aesthetic difference between the past and present Architecture.

Students are advised for a technical tour related Architecture and town planning to gain additional knowledge in this subject

**Module-3**

Human settlements, Rural and urban pattern of growth, Factors that promote growth and development of Rural and urban areas

Ancient Town Planning in India: Principles of town planning and circulation pattern with examples

**Module-4**

**Industrialisation: Impact on town planning, Urbanisation causes, its effect on town and cities, remedial measures both in urban and rural planning**

**Circulation pattern in cities: Urban roads and streets, their fuctional classification, traffic survey data and its use in town planning**

Contemporary objectives and methods of planning of town: Development plans for cities, objectives and stages involved in their preparation and implementation, space standards for planning.

**Course outcome (Course Skill Set)**

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

1. Understand importance of architecture in rural and urban planning
2. Understand Influence of architecture
3. Design infrastructure for rural and urban region
4. Plan and design rural and urban roads

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**


1. History of Architecture – Fletcher
2. Urban pattern – Galliaon
3. Indian architecture – Vol. I & II – Perey Brown
4. Principle of town and country planning – Lewis Keeble
5. Urbanization and Urban Syatems in India, Ramachandran R, Oxford University Press, New Delhi.
6. Town planning – Rangwala, Charothar Publication


**Web links and Video Lectures (e-Resources):**

| |
|---|
| • . |
| **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**<br>• |

| Geospatial Techniques in Practice | | Semester | 3 |
|---|---|---|---|
| Course Code | **BCV306B** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Introduce the concept of various geospatial technologies used in the industry
- Help to acquire basic idea about the processing and mapping with modern surveying equipment.
- Elaborate proven concepts, business practices and applications of geospatial technology.
- Explain learners understand how geospatial concepts are leveraged in handling real world business challenges of engineering and construction industry.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The online courses available should be shared with students
2. YouTube videos
3. Power point presentations
4. Visit to Survey of India office to collect more information

**Module-1**

**Need of Geospatial technology in Industry:** Geospatial in Day to Day Life, Spatial thinking, Evolution of location technology and importance of geography and maps. Need for spatial information, Terminologies, logic, language and formats of spatial technology. Location perspective of construction industry, Overview of Geospatial technology in tenders, Design and execution and Construction lifecycle management. Fundamentals and components of Geospatial Engineering, Surveying and Conventional survey equipment Vs Modern surveying equipment Components. Digital Land Surveying Needs.

**Module-2**

**Total Station and Global Navigation Satellite System (GNSS):** Basics of Surveying, Introduction to Survey and Mapping, Geospatial Surveying Equipment, Demo of Total Station Equipment, Setting out and mapping, Advanced geospatial solutions, GNSS Overview of components, working and signal structure of Global navigation System.

**Module-3**

**Geospatial Engineering and technology:** Remote Sensing Technologies, Types of remote sensing, Sensors and its types, Application of sensors & platforms, Image Acquisition, Applications of Remote Sensing. 3D scanning, Principles and the science behind photogrammetry, LiDAR, RADAR and SONAR. Introduction to Platforms and working.

**Module-4**

**Geographical Information System:** Basics of GIS, Vector & Raster data models, Types and components of a Map. Hardware for GIS, DEM and TIN Data products, Attribute Data Types. Basic GIS data conversions, conversions from non-spatial formats to spatial formats. Demo of Conversion of Excel to GIS, Demo of Conversion of CAD TO GIS, Demo of Downloading and Geo-referencing Topo sheets and Raster files.

**Module-5**

**Applications and Future trends of Geospatial Technologies:** Application of GIS - Spatial Analysis, Catchment Area delineation, Overlay Analysis, Cluster Analysis, Hotspot Analysis and View shed Analysis. Future Trends of Geospatial Technologies. Case Study 1 -Benefit Realization - Case Study 2 Advancements in Modern Survey & Mapping Technologies, Advancements in Spatial Analytics – Geo Intelligence, Future Trends, Geospatial Technology - Way Forward.

**Course outcome (Course Skill Set)**

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

1. Comprehend different geospatial techniques in the Construction Industry.
2. Understand the application of geospatial equipment like Total Station, GNSS, LIDAR, UAV (Drones), etc.,
3. Evaluate the various spatial analysis operations by using GIS Environment
4. Create a map layout with all essential cartographic elements in GIS Environment.
5. Illustrate the various geospatial emerging trends of GIS in Industry.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

- T. P. Kanetkar and S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2010, 24th edition.

- James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, McGraw Hill 2001
- Satheesh Gopi, R. Sathikumar, N. Madhu, — Advanced Surveying, Total Station GPS and Remote Sensing — Pearson education, 2nd Edition,2017.
- George Joseph and C. Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018
- M. Anij Reddy. Textbook of Remote Sensing and Geographical Information systems. BS Publications, 2012.


**Web links and Video Lectures (e-Resources):**

E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- ArcGIS Online Open source
- QGIS Open source
- GPS co-ordinates app Open source
- Total Station Demo
- GNSS Demo

| Sustainable Design Concept for Building Services | | Semester | 3 |
|---|---|---|---|
| Course Code | **BCV306C** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To facilitate learners to understand sustainable building designs and its parameters such as energy and water efficiency, Comfort in buildings, and waste management.
- To expose the learners to shading systems, thermal and visual comfort.
- To impart fundamental knowledge on Life cycle assessment and Green ratings and certifications.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Videos to teach, providing activities and assignments.
2. Power Point presentation during online expert sessions.
3. Hands-on software exercises through virtual classrooms.

**Module-1**

**Introduction to Sustainability and Climatology:** Overview of Sustainability – Global energy scenario, carbon footprint and climate action, Net zero in carbon offsetting, Water neutral, Sustainable construction and resource management. Green buildings - Selection of site – preservation and planning, Influence of climate on buildings, Basics of climatology, Earth – Sun relationship, Solar angles and sun path diagram, Design of shading systems.

**Module-2**

**Comfort in Buildings:** Thermal comfort – Basics of Thermodynamics, Convection/radiation heat transfer, Heat gain through various elements of a building, Thermal comfort models and case studies Acoustics – Building acoustics, measures, defects and prevention of sound transmission Indoor Air Quality – Effects, design consideration and integrated approach for IAQ management Visual comfort – Enhancement strategies for Daylighting and Artificial

**Module-3**

**Energy, water efficiency and waste management in buildings:** Energy efficiency – Energy efficiency in building envelope and energy efficient HVAC and Lighting as per Energy conservation building code (ECBC) 2017, Energy simulation, Energy management system – Renewable energy and Energy Audit. Water Efficiency – Planning and design of water management system, Rain water harvesting, Water efficient design and fixtures, Treatment and reuse and Water efficient landscape system.

Waste management – Types of waste and its treatment methods, Construction and demolition waste management, Waste management in residential, commercial buildings, healthcare facilities.

**Module-4**

**Life Cycle Assessment of Buildings and Green project management:** Materials – Green product certifications, features of sustainable building materials and sustainable alternatives for structural, envelope and finishing materials. Low carbon cement, Zero emission bricks and lean construction practices. Life cycle assessment and its types – Modelling and Analysis,

Greenhouse gas emission. Different phases of Green building project management.

**Module-5**

**Sustainable rating systems:** Green building rating systems- LEED, BREEAM and others, Indian Green building rating systems – IGBC & GRIHA. IGBC criteria for certification -site selection credits, pre-design credits, detailed design credits, pre-construction credits, construction credits, post construction credits.

**Course outcome (Course Skill Set)**

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

1. Comprehend sustainable design, climatology, shading system and analyze heat transfer mechanism in buildings.
2. Assess the design considerations and parameters for thermal comfort, visual comfort, indoor air quality and acoustics.
3. Develop solutions for energy efficiency, water efficiency and waste management in buildings.
4. Adopt green project management methodology and evaluate building life cycle assessment.
5. Implement green practices during construction and operation phase of the buildings for achieving green rating.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. HarharaIyer G, Green Building Fundamentals, Notion Press
2. Dr. Adv. HarshulSavla, Green Building: Principles & Practices
3. IGBC Green new building rating system - version 3.0 - Abridged reference guide
4. The Sustainable Habitat Handbook (6 Volume Set), GRIHA Version 2019
5. National Building Code – 2016, Volume 1&2, Bureau of Indian Standards
6. Energy Conservation Building Code – 2017 (with amendments up to 2020), Bureau of Energy Efficiency

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- ECO – NIWAS by Ministry of Power, Free Web tool to practice energy conservation
- Roof top solar energy calculator, Free Web tool to calculate solar power available

| Fire Safety in Buildings | | Semester | 3 |
|---|---|---|---|
| Course Code | **BCV306D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To understand the importance fire safety
- To learn various techniques involved in fire safety
- To design fire resistant buildings using proper materials and methods

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The online courses available should be shared with students
2. YouTube videos
3. Power point presentations
4. Visit to fire stations and understand various fire accidents.

**Module-1**

Fire: Introduction, Basic concepts of fire protection, Fire as a process of combustion, planning for fire protection, fire resistance Ventilation and fuel controlled fire, process of combustion: flashover condition, effect of fire on construction material, design of fire resistance steel structure, concrete structure

**Module-2**

Fire safety: urban planning, escape and refuge, internal planning, detection and suppression Introduction to lift design, design of lift system, expected stop and floor of reversal, different cases, simulation, arrangements and escalators

**Module-3**

Introduction to flow system: water supply, constant demand, variable demand and diversity factor, control systems Flow in pipe networks and fixture units, design of water supply distribution system, flow in waste water pipes

**Module-4**

Introduction to HVAC: governing equations to HVAC process, numerical problem on HVAC system, psychometric chart, equation based approach Electrical systems: design of electrical systems, intelligent building, life cycle cost and basics of building maintenance, stages of maintenance management, planning for building maintenance, periodicity of maintenance management, estimation of repair cycle, cost profile of maintenance, lamp replacement, building inspection, planned and Ad-hoc maintenance

**Module-5**

Condition survey and health evaluation of buildings, diagnosis of building by visual survey, case studies of visual survey, effect of corrosion and alkali aggregate reaction, sampling and choice of test location Non-destructive testing, core strength test, carbonation and chloride measurement, electrical method of progress measurement Repair, rehabilitation, retrofit, periodicity and economics of condition survey, interpretation of test results

**Course outcome (Course Skill Set)**

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

1. Understand types of fire, combustion process and fire resistance
2. Plan for fire safety and design of lifts
3. Design flow network in buildings
4. Design of electrical systems and maintenance
5. Perform health evaluation of buildings and suggest remedies

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**


1. J A Purkiss, Fire Safety Engineering: Design of Structures, ISBN 13 978-8131220085, Elsevier, 2009
2. V K Jain, Fire Safety in Buildings, ISBN-13 978-938980219, New Age International Private Limited; Third edition, 2020
3. Fire protection, services and maintenance management of building, NPTEL video lecture, IIT, Delhi
4. Bureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989.
5. Markus,T.A. & Morris, E.N., "BUILDING CLIMATE AND ENERGY" Pitman publishing limited. 1980.
6. Croome,J.D .& Roberts,B.M.,"AIR CONDITIONING AND VENTILATION OF BUILDINGS, VOL-1".Pergamon press.
7. Building Services Design - T.W.MEVER
8. Building Engineering & System Design - F.S.MERRIT & J. AMBROSE
9. SP-35 (1987): Handbook of Water supply & drainage-BIS
10. N.B.C.-2007 BIS

11. Concept of building fire safety - D.EGAN.
12. Design of fire resisting structures - H.L. MALHOTRA.

**List of reference materials/books/**

1. An introduction to fire dynamics -D.DRYSDALE
2. Structural fire protection Edt by T.T.LIE
3. Elevator technology - G.C.BARNEY
4. HEATING VENTILATING AND AIR CONDITIONING Analysis and Design - Faye C. McQuiston and Jerald D. Parker.
5. Building Maintenance Management-R.LEE
6. Developments In Building Maintenance -I.EJ. GIBSON
7. Concrete Structures: materials, Maintenance And Repair D.CAMPBELL,ALLEN & H.ROPER

**Web links and Video Lectures (e-Resources):**

- https://archive.nptel.ac.in/courses/105/102/105102176/
  .

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Assignment students: A case study of fire hazard in building and restoration procedure adopted

| Data analytics with Excel | | Semester | 3 |
|---|---|---|---|
| Course Code | BCV358A | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 100 |
| Examination type (SEE) | practical | | |

**Course objectives:**

- Understand the use of Spreadsheet for data collection and analysis.
- Evaluate the equations using Excel functions
- Learn the data quality and consistency of data

| Sl.NO | Experiments |
|---|---|
| 1 | Introduction to Data Analysis Using Spreadsheets: Fundamentals of spreadsheet applications, Excel interface, and learn how to navigate around a worksheet and workbook. |
| 2 | Using Excel Spreadsheets: Perform basic spreadsheet tasks, such as viewing, entering and editing data, and moving, copying and filling data. Learn about the fundamentals of formulas, and learn about the most common functions used by a data analyst. Finally, you will learn how to reference data in formulas. |
| 3 | Cleaning & Wrangling Data Using Spreadsheets: Importance of data quality, how to import file data in to Excel, fundamentals of data privacy, remove duplicate and inaccurate data, and how to remove empty rows in your data.. |
| 4 | How to deal with inconsistencies in your data and how to use the Flash Fill and Text to Columns features to help you manipulate and standardize your data |
| 5 | Analyzing Data Using Spreadsheets: Fundamentals of analyzing data using a spreadsheet, and learn how to filter and sort data. Learn how to use some of the most useful functions for a data analyst |
| 6 | How to use the VLOOKUP and HLOOKUP reference functions. In addition, learn how to create pivot tables in Excel, and use several pivot table features |
| 7 | Final Project: In this final module, you will be introduced to a hands-on lab where you will complete a graded assignment for cleaning and preparing data, and then analyzing data using an Excel spreadsheet. |
| 8 | Submission of report for final assessment |

**Course outcomes (Course Skill Set):**

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

- Prepare the data sets and perform the analysis.
- Analyse and perform repetitive calculations using several functions
- Design and apply solutions to verify the data sets

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- https://www.coursera.org/learn/excel-basics-data-analysis-ibm
- Any online platform with the above course content like YouTube videos and NPTEL courses

| Smart Urban Infrastructure | | Semester | 3 |
|---|---|---|---|
| Course Code | BCV358B | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 1:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 15 | Total Marks | 100 |
| Credits | 01 | Exam Hours | 1 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Knowing about Urban Infrastructure Systems & their Management
- Knowing about Smart Cities Key Concepts
- Understand the Transport and Energy Smart Urban Infrastructure and Services
- Developing Feasibility Studies for Smart City Services
- Understand the Global Context of Smart Cities

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. You Tube videos and online study material
2. PPT.
3. Assignments and quiz to explore more on smart cities

**Module-1**

Introduction to Smart Urban Infrastructures and Smart Cities: Introduction to smart city, Basic concept of developing smart city, Global standards to create smart city. Different conceptual approaches to Smart Cities and discussing the pros and cons of each approach.

Smart urban Infrastructure: List of infrastructure facilities, advantages and disadvantages.

**Module-2**

Smart Urban Energy Systems: Introduction to Smart Energy Systems, Government policy and technology. Energy sector to explore some of the most important managerial considerations in the transition phase and operation of Smart Urban Energy Systems.

**Module-3**

Smart Transportation Technologies: Introduction to smart transportation system, Mode of transport systems for smart city, data collection to arrive at best transport facility. Significant opportunities and threads for legacy urban transportation systems. Managerial considerations to facilitate the transition phase, and operation of Smart Urban Transportation Systems

**Module-4**

Towards Smart Cities: Important factors in the transition phase of legacy cities to Smart cities and their managerial implications.

**Module-5**

Towards Smart Cities: Management of Smart Cities calls for different approaches from conventional urban management approaches. The role of city government in the network of actors who play an important role in management of Smart Cities.

**Course outcome (Course Skill Set)**

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

1. Understand the concept of smart city
2. Play the role of a civil engineer in providing smart infrastructure
3. Design efficient energy system for smart city
4. Analyse and design efficient transport system

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examinations (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Books**


1. Infrastructure for Smart Cities, Dr. R P Rathaliya, Shree Hari Publications, 2021
2. Building Smart Cities, ISBN-13 978-1032340128, by Carol L. Stimmel, 2022
3. Smart Cities for Sustainable Development, Ram Kumar Mishra, Ch Lakshmi Kumari, Sandeep Chachra, P.S. Janaki Krishna, Springer, ISBN-13 978-9811674099, 2022


**Web links and Video Lectures (e-Resources):**

- https://www.coursera.org/learn/smart-cities

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

-

| Problem Solving with PYTHON | | Semester | 3 |
|---|---|---|---|
| Course Code | BCV358C | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 0:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 15 | Total Marks | 100 |
| Credits | 01 | Exam Hours | 1 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To understand why Python is a useful scripting language for developers.
- To read and write simple Python programs
- To learn how to identify Python object types.
- To learn how to write functions and pass arguments in Python.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Black board and PPT.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

**Module-1**

Introduction to Python: Installing Python and Python packages, Managing virtual environments with venv module Introduction to NumPy arrays:Array creation, indexing, data types, broadcasting, copies and views, universal functions, I/O with NumPy

**Module-2**

Introduction to NumPy and SciPy:NumPy subpackages– linalg, fft, random, polynomials, SciPy subpackages– linalg, fftpack, integrate, interpolate, optimize Introduction to Matplotlib: Plotting 2D graphs with Matplotlib, annotations, legend, saving plots to file, bar and pie charts, line plots.

**Module-3**

Linear algebra using NumPy and SciPy:Solving linear simultaneous equations using NumPy and SciPy using numpy.linalg and scipy.linalg – solve, inverse, determinant, least square solution, Linear algebra using NumPy and SciPy (continued): Decomposition using lu and cholesky. Solving eigenvalue problems using NumPy and SciPy:Using numpy.linalg and scipy.linalg – eig, eigvals.

**Module-4**

Solving initial value problems for ODE systems using scipy.integrate subpackage – solve_ivp, RK45, LSODA. Numerical integration of functions using SciPy:Using scipy.integratesubpackage– Definite integral using Gaussian quadrature – quad and quadrature Numerical integration of fixed samples using scipy.integratesubpackage– Trapezoidal rule trapezoid, Simpson's 1/3 rule using Simpson, Romberg integration romb.

**Module-5**

Determining roots of equations using SciPyusing scipy.optimizesubpackage– Bisection method bisect, Brent's method brentq, Newton-Raphson method newton. Symbolic computing using SymPy and solving civil engineering problems using SymPy: Introduction, defining symbols, derivatives, integrals, limits, expression evaluation, expression simplification, solving equations, solving differential equations.

**Course outcome (Course Skill Set)**

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

1. Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. Demonstrate proficiency in handling Strings and File Systems.
3. Represent compound data using Python lists, tuples, Strings, dictionaries.
4. Read and write data from/to files in Python Programs

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
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**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examinations (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Books**

1. R. Nageswara Rao, "Core Python Programming", dreamtech
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson

3. 3. Python Programming , Reema theraja, OXFORD publication

**Web links and Video Lectures (e-Resources):**

- NumPy documentation at https://numpy.org/doc/
- SciPy documentation at https://docs.scipy.org/doc/scipy/
- Matplotlib documentation at https://matplotlib.org/stable/users/index
- SymPy documentation at https://docs.sympy.org/latest/index.html.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving: Demonstration of projects developed using python language

| Personality Development for Civil Engineers | | Semester | 3 |
|---|---|---|---|
| Course Code | BCV358D | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 1:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 15 | Total Marks | 100 |
| Credits | 01 | Exam Hours | 1 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To offer placement focused guidance across interview best practices, formal communication, and business etiquette
- To give learners a comprehensive understanding of job skills and knowledge that are essential for adapting to changes in workplace

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. .

**Module-1**

**LSRW and Personality Development:** Importance of LSRW Skills: Art of listening- Listening comprehension – Art of Speaking – Art of Reading – Reading comprehension – Art of Writing – email writing Personality Development: Emotional Intelligence – Self Awareness – Self Management – Personal SWOT – Manners & Etiquette – Positive Attitude – Confidence building Interpersonal Skills: Active Listening – Motivation – Flexibility – Patience – Dependability – Adaptability – Interpersonal & Intrapersonal skills – Body Language

**Module-2**

**NVC, Presentation and Teamwork:** Non – Verbal Communication: Body language – Gestures – Postures – Eye contact – Hand Shake – First impression – Proxemics – Facial Expressions Presentation Skills: 4P's of Presentation – Communicating with Credibility – Audience analysis and Building Rapport – Usage of Figures, diagrams & Charts – Presenting with Confidence – Body Language in Presentation Teamwork: What is a Team - Stages of a Team – Benefits of Team work & Collaboration – Group vs Team – Types of Teams – Roles of the Team

**Module-3**

**Etiquette and Management:** Critical Thinking & Problem Solving: Core Skills – Uses & Importance of Critical Thinking – Principles of Critical Thinking – Facts about Problem Solving – Skills to use in Problem Solving - Problem Solving Process – Barriers to Problem Solving Time Management: Managing your time – Time wasters – Analyzing your Strengths and weakness – Goal Setting – Why Goal Setting is important - SMART Goals – Types of Goals Business Etiquette: Types of Etiquette – Importance of Etiquette – Meeting Etiquette – Office Etiquette – Phone and email Etiquette – Work Place Etiquette

**Module-4**

**Leadership:** Leadership Skills: What makes an effective Leader – Relationship Building – Leader vs Boss – Decision Making Skills – Innovation & Motivation – Dependability Business Writing – How to improve your Business writing skills – Importance of Business writing – how to write effectively – 5C's of Business writing – 4 types of Business writing Conflict Management: Strategies of Conflict Management – Best practices for Conflict Resolution –

Stress Management – Learn to say No – Importance of Conflict Management at Work Place

**Module-5**

**V GD, Creativity and Psychometry:** Group Discussion: Types of GD – Attitude & being Proactive – Time management & how to stick to it – Importance of Listening - Do's & Don'ts Creativity & Innovation: What is Creativity – What is Innovation – Difference between Creativity & Innovation – Categories and misconception of Creativity Psychometric Analysis: What is Psychometric Analysis – Cognitive Skills – Importance of Personality Tests – Personality Profiling

**Course outcome (Course Skill Set)**

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

1. Use English as a medium of communication in interviews and in any professional working environment proficiently
2. Develop necessary skills to Answer common interview questions, express confidence in body language and present with clarity

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examinations (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Books**


1. Personality Development And Soft Skills, Barun K Mitra, 2nd edition, Oxford University Press, 2016
2. Power of Positive thinking, Norman Vincent Peale, ISBN-13 978-0091906382, RHUK, 2016
3. Magic of thinking Big, David J Schwartz, ISBN-13 978-1785040474, Vermilion, 2016


**Web links and Video Lectures (e-Resources):**

- NPTEL videos.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Select a topic and write an essay
- Conduct group discussion

| Analysis of Structures | | Semester | IV |
|---|---|---|---|
| Course Code | **BCV401** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 03 | SEE Marks | 50 |
| Total Hours of Pedagogy | 3:0:0:0 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory/practical/Viva-Voce /Term-work/Others | | |

**Course Learning objectives**: This course will enable students to

- Understand the Different Forms of Structural Systems.
- Determine the Strain Energy and Slope and Deflection of Beams, Trusses and Frames.
- Analyse arches and cable structures.
- Analyse different types of beams and frames using slope deflection method.
- Analyse different types of beams and frames using moment distribution method.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Arrange field visits to give brief information about the water and wastewater treatment plant.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinkingand enhance the knowledge of treatment processes.
5. Adopt Problem Based Learning (PBL), which fosters students, Analytical skills, develop thinking skills suchas the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Seminars, surprise tests and Quizzes may be arranged for students in respective subjects to develop skills

**Module-1**

**Introduction and Analysis of Plane Trusses:** Structural forms, Conditions of equilibrium, Compatibility conditions, Degree of freedom, Linear and nonlinear analysis, Static and kinematic indeterminacies of structural systems, Types of trusses, Assumptions in analysis, Analysis of determinate trusses by method of joints and method of sections. L1,L2,L3

**Module-2**

**DEFLECTION OF BEAMS: Moment area method:** Derivation, Mohr's theorems, sign convention; Application of moment area method to determinate prismatic beams, beams of varying cross section; Use of moment diagram by parts.

**Strain Energy:** Principle of virtual displacements, Principle of virtual forces, Strain energy and complimentary energy, Strain energy due to axial force, bending, shear and torsion (No numerical). Castigliano's theorems, application of Castigliano's theorems to calculate deflection of beams, trusses and frames (No numerical on unit load method).

**Module-3**

**Arches and Cable Structures:** Three hinged parabolic arches with supports at the same and different levels. Determination of normal thrust, radial shear and bending moment. Analysis of cables under point loads and UDL. Length of cables for supports at same and at different levels- Stiffening trusses for suspension cables. L1,L2,L3

**Module-4**

**Slope Deflection Method:** Introduction, sign convention, development of slope deflection equation; Analysis of continuous beams including settlement of supports; Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy up to 3 L1,L2,L3,L4

**Module-5**

**Moment Distribution Method:** Introduction, Definition of terms, Development of method, Analysis of continuous beams with support yielding, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy up to 3 L1,L2,L3,L4

**Course outcome (Course Skill Set)**

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

1. identify the different forms of structural systems and analyse the trusses.
2. Evaluate the slope and deflections in beams, frames and trusses by using moment area method and energy principle.
3. Analyse and determine the stress resultants inarches and cables.
4. Analyse the indeterminate structures and construct BMD AND SFD using slope deflection methods.
5. Analyse the indeterminate structures and construct BMD AND SFD using Moment Distribution Method.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**


1. Reddy, C.S., Basic Structural Analysis, 3 rd. ed., Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2011.
2. Hibbeler, R.C., Structural Analysis, 9 th edition., Pearson publications., New Delhi, 2012.
3. Thandavamoorthy, T.S., Structural Analysis, 6 th edition., Oxford University press., New Delhi,2015.
4. L S Negi and R S Jangid, "Structural Analysis", Tata McGraw-Hill Publishing Company Ltd.
5. D S Prakash Rao, "Structural Analysis: A Unified Approach", Universities Press 4
6. K.U. Muthu and H. Narendra, "Indeterminate Structural Analysis", IK International Publishing Pvt. Ltd.
7. Gupta S P, G S Pundit and R Gupta, "Theory of Structures", Vol II, Tata McGraw Hill Publications company Ltd.
8. V N Vazirani and M M Ratwani, "Analysis of Structures", Vol. 2, Khanna Publishers
9. Wang C K, "Intermediate Structural Analysis", McGraw Hill, International Students Edition. S. Rajashekhara and G. Sankarasubramanian, "Computational Structural Mechanics", PHI Learning Pvt. Ltd.,
10. S S Bhavikatti, structural analysis, vikas publishing house pvt.ltd., new Delhi
11. S Ramamrutham and R Narayanan,Theory of structures , Dhanpat Rai Publishing Company.

| Web links and Video Lectures (e-Resources): |
|---|
| • https://nptel.ac.in/courses/105105166<br>• https://nptel.ac.in/courses/105105166<br>• https://nptel.ac.in/courses/105105166<br>• https://nptel.ac.in/courses/105105109<br>• https://nptel.ac.in/courses/105105109<br>• https://nptel.ac.in/courses/105105109 |
| **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**<br>• Seminars /Quiz (to assist in GATE preparations)<br>• Demonstrations in using Softwares<br>• Self-Study on simple topics<br>• Simple problems solving by Etabs/Staad pro. |

**CO & PSO - PO Mapping (Individual Teacher has to fill)**

| Mapping of Course Outcomes and Program specific outcomes to Program Outcomes | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | | **Program Specific Outcomes** | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
| **CO1** | | | | | | | | | | | | | | | | |
| **CO2** | | | | | | | | | | | | | | | | |
| **CO3** | | | | | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | | | | | |
| **CO5** | | | | | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | | | | | |
| **Average** | | | | | | | | | | | | | | | | |

**Level 0: Not Mapped, 1: Low Mapped, 2: Moderately Mapped 3: Highly Mapped**

**Note**: Depending on the Assessment tool used, higher order POs Can be identified by the concerned course instructor.

| FLUID MECHANICS AND HYDRAULICS | | Semester | IV |
|---|---|---|---|
| Course Code | **BCV402** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | 3 |
| Examination nature (SEE) | Theory/Practical | | |

**Course Learning objectives**: This course will enable students to

- Understand the Fundamentals of properties of fluids, fluid pressure measurement and hydrostatic law
- Learn the Principles of kinematics, hydrodynamics and its applications
- Study the Flow measurements and design of pipes
- Understand the design of open channels and energy concepts
- Understand the Working principles of hydraulic turbines and pumps

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Arrange field visits to give brief information about the water and wastewater treatment plant.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinkingand enhance the knowledge of treatment processes.
5. Adopt Problem Based Learning (PBL), which fosters students, Analytical skills, develop thinking skills suchas the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Seminars, surprise tests and Quizzes may be arranged for students in respective subjects to develop skills.

**MODULE-1**

Fluids and their properties – compressibility, surface tension, capillarity, Pascal's law, hydrostatic law, fluid pressure measurement using simple and differential manometers, Total pressure and center of pressure on vertical and inclined plane surfaces. **L2,L3**

**MODULE-2**

Kinematics- Types of flow, continuity equation in Cartesian coordinates, velocity potential, stream function, flow nets, Dynamics-Euler's equation of motion, Bernoulli's equation, Application- Venturimeter, Orifice meter, Pitot tube. **L2,L4**

**MODULE-3**

Classification of orifice and mouthpiece, hydraulic coefficients, discharge over rectangular, triangular and Cipoletti notch, Flow through pipes- major and minor losses, pipes in series and parallel, equivalent pipe, concept of water hammer and surge tanks. **L2,L4**

**MODULE-4**

Open channel hydraulics- classification of flow, Most economical channel sections-rectangular, triangular, trapezoidal, circular, Uniform flow, specific energy-rectangular channels, on-uniform flow, hydraulic jump-equation and applications, GVF equation-types. **L2,L4**

**MODULE-5**

Momentum equation, impact of jet on stationary and moving curved vanes Turbines-types, Pelton wheel-working proportions, velocity triangles Francis turbine- working proportions, velocity triangles Centrifugal pumps-work done, efficiency, multi-stage pumps. **L2,L4**

**PRACTICAL COMPONENT OF IPCC** *(May cover all / major modules)*

| Sl.NO | Experiments | |
|---|---|---|
| 1 | Verification of Bernoulli's equation | L1,L2 |
| 2 | Calibration of Venturimeter/Orifice meter | L1,L2 |
| 3 | Determination of hydraulic coefficients of small vertical orifice | L1,L2 |
| 4 | Calibration of triangular notch | L1,L2 |
| 5 | Determination of Cd for Cipoletti notch | L1,L2 |
| 6 | Determination of major losses in pipes | L1,L2 |
| 7 | Determination of Cd for ogee/broad crested weir | L1,L2 |
| 8 | Determination of efficiency of jet on flat and curved vanes | L1,L2 |
| 9 | Determination of Cd of Venturiflume | L1,L2 |
| 10 | Demo of determination of efficiency of centrifugal pump | **L1,L2** |
| 11 | Demo of determination of efficiency of Francis/Kaplan turbine | **L1,L2** |
| 12 | Demo of determination of efficiency of Pelton wheel | **L1,L2** |

**Course outcomes (Course Skill Set):**

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

- Explain the fundamental properties of fluids and solve problems on fluid pressure and hydrostatics.
- Apply the principles of kinematics and dynamics of fluid flow to solve problems on velocity and pressure.
- Compute the discharge through pipes, notches and weirs.
- Design the turbines and open channels of different sections and to estimate the energy loss in hydraulic jump.
- Able to interpret the experimental results of discharge, efficiency based on the test conducted in the laboratory.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Books:**

**Text Books:**


1. P.N. Modi and S.M. Seth-Hydraulics and Fluid Mechanics, including Hydraulic machines, standard Book House, New Delhi
2. K Subramanya- Fluid Mechanics and Hydraulic Machines, Tata McGraw-Hill, New Delhi
3. R.K. Bansal- A text book of Fluid Mechanics and Hydraulic Machines- Laxmi Publications, New Delhi
4. Victor L. Streeter, Benjamin Wyile E and Keith W. Bedford- Fluid Mechanics, Tata McGraw Hill publishing Co Ltd, New Delhi
5. J.F. Douglas. M. Gastric, John Warfield, Lynne Jack – Fluid Mechanics, Pearson, Fifth edition.
6. K. Subramanya- Fluid Mechanics and Hydraulic Machines, Problems and Solutions, Tata McGrawhill, New Delhi.
7. S K SOM and G.Bis was – " introduction to Fluid Mechanics and Fluid Machines, Tata Mcg raw Hill, New Delhi.


**Web links and Video Lectures (e-Resources):**

- **YouTube Videos**

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:**

- **Visit to hydro- electric power plant**
- **Visit to sites to visualise the flow measuring devices, viz., weirs, spillways, etc.**

## CO & PSO - PO Mapping (Individual Teacher has to fill)

| Mapping of Course Outcomes and Program specific outcomes to Program Outcomes | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | | **Program Specific Outcomes** | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
| **CO1** | | | | | | | | | | | | | | | | |
| **CO2** | | | | | | | | | | | | | | | | |
| **CO3** | | | | | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | | | | | |
| **CO5** | | | | | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | | | | | |
| **Average** | | | | | | | | | | | | | | | | |

**Level 0: Not Mapped, 1: Low Mapped, 2: Moderately Mapped 3: Highly Mapped**

**Note**: Depending on the Assessment tool used, higher order POs Can be identified by the concerned course instructor.

| TRANSPORTATION ENGINEERING | | Semester | |
|---|---|---|---|
| Course Code | **BCV403** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | |
| Examination nature (SEE) | Theory | | |

**Course Learning objectives:** This course will enable students to

- Gain knowledge of different modes of transportation systems and to learn the introductory concepts on Highway Engineering.
- Get insight to different highway materials and pavement design elements of a highway network.
- Realize the significance of road safety by incorporating the concepts of Traffic Engineering.
- Understand to different aspects of geometric elements of railway system and evaluate the material quantity required for track laying
- Gain knowledge about various components of an Airport and its runway design.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Arrange field visits to give brief information about the water and wastewater treatment plant.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinkingand enhance the knowledge of treatment processes.
5. Adopt Problem Based Learning (PBL), which fosters students, Analytical skills, develop thinking skills suchas the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Seminars, surprise tests and Quizzes may be arranged for students in respective subjects to develop skills

## MODULE-1

TRANSPORTATION ENGINEERING: Introduction, Different Modes of Transportation, M R Jayakar Committee recommendations, Road Classifications and Road Patterns.

Highway Alignment: Factors affecting highway alignment, Engineering surveys for alignment-conventional and modern methods.

Highway Geometric Design: Factors affecting geometric design of roads, Cross Sectional Elements, Sight distances, Horizontal alignment- Transition curve, superelevation, Extrawidening, Vertical alignment–gradients, summit and valley curves***. (No derivations)***

***Problems on Sight distance, Super elevation, extra widening of curves, Length of transition curve, Length of summit and valley curve. (L1, L2)***

**MODULE-2**

HIGHWAY MATERIALS AND PAVEMENTS: Desirable properties of aggregates, soil subgrade & Bitumen, Application of bituminous emulsion, Desirable properties of Bituminous Mixes

Pavement Design: Factors Controlling design of highway pavements, Pavement types, component parts of pavements and their functions; types of joints used in rigid pavement. Critical stresses in flexible and rigid pavement.

Highway Drainage: Significance and requirements, Surface drainage system and design-Examples, sub surface drainage system, Types of cross drainage structures their choice and location.

***Problems on design of Longitudinal drain. (L2, L3)***

**MODULE-3**

TRAFFIC ENGINEERING: Objectives and scope of Traffic Engineering. Traffic Characteristics: Road user characteristics, vehicular characteristics – static and dynamic characteristics, Reaction time of driver and PIEV theory, Types of traffic engineering studies-volume, spot speed, speed and delay, parking, accident, origin & destination, objectives of studies and data collection, method of study, analysis. PCU concept, factors affecting and PCU at different locations and applications. Traffic signs, Signal design by IRC method; Types of intersections.

***Problems on Spot speed studies, Speed and delay studies, accident studies, Signal design by IRC method. (L2, L3)***

**MODULE-4**

RAILWAY ENGINEERING: Permanent way and its requirements, Gauges and types, Typical cross sections single and double-line BG track, Coning of wheels and tilting of rails, Rails-Functions-requirements, types and defects of rails. Sleepers and Ballast: Functions, requirements, Track fitting and fasteners, Calculation of quantity of materials required for laying a track, Points & crossings, Railway Station and Yards. Metro train & high speed train- Design factors considered.

***Problem on Quantity calculation for laying railway track. Super-elevation (L1, L2)***

**MODULE-5**

AIRPORT ENGINEERING: Layout of an airport with component parts and functions, Site selection for airport, Aircraft characteristics affecting the design and planning of airport, Airport classification, Runway orientation using wind rose with examples.

RUNWAY-Basic runway length-Corrections and examples, Runway geometrics, Taxiway-Factors affecting the layout - geometrics of taxiway-Comparison between Runway and Highway, Design of exit taxiway with examples.

***Problems on Runway orientation, Basic Runway length, Exit taxiway design. (L2, L3)***

**PRACTICAL COMPONENT OF IPCC** *(May cover all / major modules)*

| Sl. NO | Experiments (8-10 Lab slots) |
|---|---|
| 1 | Tests on Aggregates<br>a. Crushing Strength Test b. Los Angeles abrasion test c. Impact test<br>d. Shape tests (combined index and angularity number) **(L1, L2)** |
| 2 | Tests on Bituminous Materials<br>a. Penetration test b. Ductility test c. Softening point test d. Specific gravity test e. Viscosity test by tar viscometer f. Flash and fire point test **(L1, L2)** |
| 3 | Tests on Soil<br>a. Wet sieve analysis b. CBR Test on soil **(L1, L2)** |
| 4 | Design of flexible pavement as per IRC 37-2018 **(L2, L4)** |
| 5 | Design of Rigid pavement as per IRC 58-2015 **(L3, L4)** |
| 6 | Bituminous Mix Design by Marshall Method (Demonstration only) **(L1, L2)** |
| 7 | Traffic Engineering studies **(L3, L4)** |

**Course outcomes (Course Skill Set):**

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

1. Explain the basic principles of geometric design in the context of transportation engineering and planning.
2. Select the appropriate pavement materials for construction and design the pavement as per standard practices.
3. Conduct traffic studies and analyse traffic data for practical applications.
4. Identify the Components parts of Railway Track and design the suitable runway for an Airport.
5. Able to interpret the experimental results of highway materials based on laboratory tests and design the pavement as per IRC guidelines.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Books**


1. S K Khanna and C E G Justo, "Highway Engineering", Nem Chand Bros, Roorkee.
2. L R Kadiyali, "Highway Engineering", Khanna Publishers, New Delhi.
3. "A Text Book of Railway Engineering" by S C Saxena and S P Arora
4. "Airport Engineering" by S C Rangwala
5. "Airport Planning and Design" by Khanna Arora and Jain, Nem Chand Bros, Roorke.
6. "Roads, Railways, Bridges, Tunnels and Harbour Dock Engineering by B L Gupta, Amit Gupta.
7. S K Khanna, C E G Justo and A Veeraragavan, "Highway Materials Testing Laboratory Manual", Nem Chand Bros, Roorkee.

**Web links and Video Lectures (e-Resources):**

1. https://nptel.ac.in/courses/105101087
2. https://onlinemanuals.txdot.gov/txdotmanuals/rdw/horizontal_alignment.htm#BGBHGEGC
3. www.civil.iitb.ac.in/tvm/1111_nptel/567_Grade/plain/plain.html
4. https://www.pavementinteractive.org/
5. https://www.eng.auburn.edu/research/centers/ncat/research/other-publications.html
6. https://nptel.ac.in/courses/105/106/105106203/
7. https://nptel.ac.in/courses/105/101/105101008
8. https://nptel.ac.in/courses/105/104/105104098
9. https://www.classcentral.com/course/edx-intro-to-traffic-flow-modeling-and-intelligenttransport-systems-12728
10. https://www.aai.aero/
11. https://www.faa.gov/
12. https://www.icao.int

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to a road construction project

**CO & PSO - PO Mapping (Individual Teacher has to fill)**

| Mapping of Course Outcomes and Program specific outcomes to Program Outcomes | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course outcomes** | **Program outcomes** | | | | | | | | | | | | **Program Specific Outcomes** | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
| **CO1** | | | | | | | | | | | | | | | | |
| **CO2** | | | | | | | | | | | | | | | | |
| **CO3** | | | | | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | | | | | |
| **CO5** | | | | | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | | | | | |
| **Average** | | | | | | | | | | | | | | | | |

**Level 0: Not Mapped, 1: Low Mapped, 2: Moderately Mapped 3: Highly Mapped**

**Note**: Depending on the Assessment tool used, higher order POs Can be identified by the concerned course instructor.

| BUILDING MATERIALS TESTING LABORATORY | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCVL404** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Total Marks | 100 |
| | | Exam Hours | 02 |
| Examination type (SEE) | **Practical** | | |

**Course objectives:**

- Ability to apply knowledge of mathematics and engineering in calculating the mechanical propertiesofstructuralmaterials.
- Abilitytofunctiononmulti-disciplinaryteamsintheareaofmaterialstesting.
- Abilitytousethetechniques,skillsandmodernengineeringtoolsnecessaryforengineering.
- Understandingofprofessionalandethicalresponsibilityintheareasofmaterialtesting.
- Abilitytocommunicateeffectivelythemechanicalpropertiesofmaterials..

| Sl.NO | Experiments |
|---|---|
| 1 | Tests on Bricks, Tiles, Cement Concrete blocks (Weight &Dimensionality, Water Absorption, Strength)**(L1, L2, L3, L4)** |
| 2 | Tests on Fine aggregates - Sieve Analysis, Moisture content, Specific gravity, Bulk density, Bulking and Silt Content **(L1, L2, L3, L4)** |
| 3 | Tests on Coarse aggregates- Sieve Analysis, Water absorption, Moisture content, specific gravity and Bulk density**(L1, L2, L3, L4)** |
| 4 | Compression test on mild steel, cast iron and wood.**(L1, L2, L3, L4)** |
| 5 | Tension test on mild steel and HYSD bars **(L2, L3, L4)** |
| 6 | Torsion test on mild steel circular sections. **(L1, L2, L3, L4)** |
| 7 | Bending Test on Wood Under two-point loading. **(L1, L2, L3, L4)** |
| 8 | Shear Test on Mild steel- single and double shear. **(L1, L2, L3, L4)** |
| 9 | Impact test on Mild Steel (Charpy&Izod). **(L1, L2, L3, L4)** |
| 10 | Hardness tests on ferrous and non-ferrous metals- Brinell's, Rockwell and Vicker's. **(L1, L2, L3, L4)** |
| 11 | Demonstration of Strain gauges and Strain indicators. **(L1, L2, L3, L4)** |

**NOTE:AlltesttobecarriedoutasperrelevantlatestBISCodes**

**Course outcomes (Course Skill Set):**

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

- Analyze the physical characteristics, and behavior of common building materials.
- Reproducethebasicknowledgeofmathematicsandengineeringinfindingthestrengthintension,compression,shear andtorsion for steel
- Evaluatetheimpactof engineeringsolutionsonthesocietyand also willbeawareof contemporaryissuesregardingfailureofstructuresduetounsuitablematerials.
- Recognize the importance of ethical conduct, integrity, and accuracy in materials testing and

reporting..

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are**50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement

evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**


- Davis, Troxell and Hawk, "Testing of Engineering Materials", International Student Edition – McGraw Hill Book Co. New Delhi.
- M L Gambhir and Neha Jamwal, "Building and construction materials-Testing and quality control", McGraw Hill education (India)Pvt. Ltd.,2014.
- Fenner, "Mechanical Testing of Materials", George Newnes Ltd. London.
- Holes K A, "Experimental Strength of Materials", English Universities Press Ltd. London.
- Suryanarayana A K, "Testing of Metallic Materials", Prentice Hall of India Pvt. Ltd. New Delhi.
- Kukreja C B, Kishore K. and Ravi Chawla "Material Testing Laboratory Manual", Standard Publishers & Distributors1996.
- Relevant latest IS Codes.


**CO & PSO - PO Mapping (Individual Teacher has to fill)**

**Mapping of Course Outcomes and Program specific outcomes to Program Outcomes**

| Course outcomes | Program outcomes | | | | | | | | | | | | Program Specific Outcomes | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
| **CO1** | | | | | | | | | | | | | | | | |
| **CO2** | | | | | | | | | | | | | | | | |
| **CO3** | | | | | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | | | | | |
| **CO5** | | | | | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | | | | | |
| **Average** | | | | | | | | | | | | | | | | |

**Level 0: Not Mapped, 1: Low Mapped, 2: Moderately Mapped 3: Highly Mapped**

**Note**: Depending on the Assessment tool used, higher order POs Can be identified by the concerned course instructor.

| Finance for Professionals | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCV405A** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To give learners an overview of finance and develop their finance sense

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

Economics: Introduction to economics, Economic policies, Role of monetary policy in managing the economy

**Module-2**

Finance Vocabulary and Financial Statements: Unique role of finance, Unique role of finance example, Accounting, finance & auditing, Capital vs. revenue, Capital vs. revenue example, Sources & uses of funds, Sources & uses of funds example, Revenue recognition principles, Double entry bookkeeping, Illustration of double entry book keeping, Understanding profit & loss, Understanding profit & loss example, Profit and profitability, Profit and profitability example 1, Profit and profitability example 2

**Module-3**

Financial Statement and Risk Analysis: Finance metrics & financial statement analysis, Finance metrics & financial statement analysis example, understanding liquidity, understanding liquidity example, Funds flow analysis, Example of funds flow analysis, Cash flow analysis, Example of cash flow analysis, Introduction to risk management, understanding risk management example, Management of risk, understanding risk management measurement example, Understanding risk management products example, Holistic look at risk management.

**Module-4**

Time Value of Money: Time value of money, understanding time value of money, understanding financial functions, Applications of time value of money, Capital structure, Capital structure example, Cost of capital, Cost of capital example, Capital budgeting, Understanding capital budgeting - example

**Module-5**

Personal Finance: Financial Instrument, Approaches to investing, Ratios for investment, Portfolio management principles, Example of portfolio, forming a portfolio, Forming a portfolio example

**Course outcome (Course Skill Set)**

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

1. Understand how their work and effort contribute to organizational financial performance
2. Comprehend financial acumen and tools to optimize outcomes

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Financial Management: Theory & Practice | 11th Edition by Prasanna Chandra
2. International Financial Reporting Standards (Bangalore Univ)

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Case study to understand the project finance concept

| Construction Equipment, Plants and Machinery | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCV405B** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To provide insight on the different functions and operations of different equipment and techniques during construction
- To impart knowledge on the various maintenance and safety to be considered during construction
- To acquire knowledge on the life cycle of a construction equipment
- To adopt mechanization in the Construction industry

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

Basics and Hydraulics of Construction Equipment: Introduction to Construction Equipment- Functions, Operations of Construction EquipmentIntroduction to Four & Two Stroke Engine and their components- Introduction and Components to Automobiles. Introduction to Principles of Hydraulic- Calculation of Pressure, Force & Flow- Components of a Hydraulic System- Basic layout of Hydraulic SystemApplications of Hydraulics- Strand Jack Operation

**Module-2**

Concreting, Earth Moving, Road Making and Quarry/Mining Equipment: Operations of a Batching Plant - Introduction and Components of Concrete Pump & Placer- Concrete Pipeline- Laying and Cleaning- Bulldozer- Classification and Components- Classification, Components and Attachments of Excavator- Backhoe Loader- Classification & components- Introduction and classification to Hot mix Plant Process of Asphalt Paver-PQC Paver- Classification & Components- Motor Grader Classification & Components- Horizontal Movement Vehicles- Quarry/Mining

**Module-3**

Equipment Life Cycle Management: Life Cycle of an Equipment- Equipment Performance Parameters - Introduction to Maintenance- Types of Maintenance- Maintenance Practices

**Module-4**

Tunnelling Equipment / Piling Equipment: Introduction to Tunnel Boring Machines- Details and Operation of a Hard-Rock TBM Details of Earth Pressure Balance (EPB) TBM- Details and operation of Slurry TBM & Components- Hydraulic Grabs- Piling Rig

**Module-5**

Mechanization and Digitalization in Construction and Safety in Construction Equipment: Importance of Digital Analytics- Digital Solution in Construction Projects- Importance of Mechanization – Railway Track Construction- Rebar Processing Machine- Operation of

Mechanized Equipment- Introduction to 3D Concrete Printer- Importance of Safety- Various PPE & Purpose- Safety of Men & Machines at Work- Safety During Construction Activities Safety with Tools & Tackles

**Course outcome (Course Skill Set)**

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

1. Evaluate equipment and techniques required during construction
2. Understand the operation of a batching plant.
3. Analyse the equipment life cycle management.
4. Comprehend mechanization and digitalisation in construction

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**


1. Velumani. P, "Construction Techniques and Practices", SIA Publishers & Distributers Pvt Ltd, 2020.
2. Dr. Manoranjan Samal, "Advanced Construction Techniques and Equipment" S.K. Kataria & Sons
3. S.C.Sharma, "Construction Equipment and management" E-Book .2019


**Web links and Video Lectures (e-Resources):**

| |
|---|
| • E-learning content on L&T EduTech Platform. |
| **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**<br>• Visit to construction site to understand construction equipments |

| Concreting Techniques and Practices | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCV405C** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To present the basics of concrete and different materials used in it.
- To impart knowledge on materials used in concrete, relevant Indian standard codes, and practical aspects on concreting activities at projects.
- To explain the importance of making good quality concrete to build durable structures.
- To introduce the Design of concrete mixes from the Industrial experiences at Sites and optimization of higher grades of Concrete.
- To learn the best practices in concrete construction from industry's decades of experiences, thumb rules, mitigation of concreting issues at Sites

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

Introduction to concrete, overview of materials- cement, low carbon cement, coarse aggregate and fine aggregate, and mineral admixture:- fly ash, GGBS, micro silica / silica fume, metakaolin / rice husk ash, composite cement and ultrafine materials, lab test - fineness of fly ash, recycled aggregate

**Module-2**

Water and chemical admixture: source, requirements, limits and testing Blending of aggregate -: Blending of fine and coarse aggregate, gradation for optimization and practical aspects.

**Module-3**

Mix design - Volumetric mix design, mix design by absolute volume method, worked out practical examples based on industries experience at project sites over several decades, higher grades of concrete, high performance concrete, test on concrete: workability of concrete, flexural and compressive strength tests.

**Module-4**

Production of concrete-: batching plant, calibration, mixing and transportation of concrete handling of concrete at construction, ready-mix concrete, pumping, placing of concrete with boom placers, levelling, vibration and compaction, cold joints, finishing and curing and protection of concrete

**Module-5**

Special types of concrete: self-compacting concrete, mass concrete, dry lean concrete, geopolymer concrete, pavement quality concrete, fiber reinforced concrete, composite concrete, lightweight concrete, ferrocement, shotcreteing, guniting, grouting, challenges faced at sites: plastic shrinkage cracks, plastic settlement, honey comb, bug holes, cover to concrete, do's and

don’ts in concrete construction, site shoot, introduction on 3D printing.

**Course outcome (Course Skill Set)**

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

1. Evaluate the properties of concrete by conducting test on cement, aggregate and concrete (with & without admixtures) for using the data for Mix design procedures
2. Understand to Select and proportionate different materials used in a concrete mix including admixtures
3. Design a concrete mix as per requirement of construction project
4. Apply the best practices in concrete construction from industry’s requirement, thumb rules, mitigation of concreting issues at Sites.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Concrete Technology by M. S. Shetty, S Chand, New Delhi-110055.
2. Concrete Technology by M. L. Gambhir, Tata McGraw-Hill.
3. IS 456, IS 269, IS 516, IS 1786, IS 1893, IS 12269, IS 9103, IS 8112

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to construction site to understand concreting process

| Watershed Management | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCV405D** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | **Theory/practical/Viva-Voce /Term-work/Others** | | |

**Course objectives:**

- To understand Watershed Hydrology
- To estimate water demand and learn, water conservation methods
- To understand application of Remote Sensing and GIS in watershed management
- Sustainable measures for watershed management

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Power point Presentation, video
- Video tube, NPTEL materials
- Quiz/Assignments/Open book test to develop skills
- Encourage collaborative learning in the class with site visits related to subject and impart practical knowledge

**Module-1**

**Principles of Watershed Management:** Basics concepts, hydrology and water availability, surface water, ground water, conjunctive use, human influences in the water resources system.

**Module-2**

**Water resources systems:** Integrated water resources system, river basins-morphometric analysis of watersheds for watershed management, watershed management practices in arid and semi-arid regions, watershed management through wells, management of water supply, short term and long-term strategic planning.

**Module-3**

**Conservation of Water:** Perspective on recycle and reuse, wastewater reclamation, social aspects of watershed management and community participation, private sector participation, institutional issues, socio-economy, integrated development, water legislation and implementations, case studies.

**Water Harvesting:** Rainwater management, conservation, storage and effective utilization of rainwater, structures for rainwater harvesting, roof catchments system, check dams, aquifer storage.

**Module-4**

**Sustainable Watershed Approach:** Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, soil erosion and conservation.

**Module-5**

**Applications of RS and GIS in Watershed management:** Role of decision support system in watershed management, watershed characteristics of coastal regions, coastal aquifer tor management, uniqueness of coastal water resources.

**Course outcome (Course Skill Set)**

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

- Discuss surface and ground water resources system and, human influences.
- Integrate water resources system in arid and semi-arid regions and explain watershed aquifer for management.
- Analyse water resources related issues for conservation and synthesize augmentation of water resources.
- Design integrated watershed management system.
- Apply modern tools in watershed management.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Note: Subject to be taught by Geologist with qualification M. Sc Geology/MPhil/ Ph. D in Geology or Faculty of Civil Engineering**

**Suggested Learning Resources:**

**Books**


1. Singh Vir, Raj., "Watershed Planning and Management", Yash Publishing House, Bikaner.3rd Revised Edition, 2016.
2. Murthy, J. V. S., "Watershed Management in India", New Age Publishers, New Delhi. 2nd Edition, 2017.
3. "Decision Support System for Integrated Watershed Management", Colorad State University. 2012.
4. Tideman, E. M., "Watershed Management", Omega Scientific Publishers, New Delhi. 2003

| **Web links and Video Lectures (e-Resources):** |
| --- |
| • https://www.youtube.com/watch?v=wkPu4LwRKro<br>• https://youtu.be/wkPu4LwRKro<br>• https://youtu.be/wkPu4LwRKro<br>• https://youtu.be/wkPu4LwRKro |
| **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**<br>• Seminars/Quiz (To assist in GATE Preparations)<br>• Self-Study on simple topics<br>• Discussion of case studies<br>• Field visits to construction sites |

| Building Information Modelling In Civil Engineering - Basic | | Semester | 4 |
|---|---|---|---|
| Course Code | BCVL456A | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 15 | Total Marks | 100 |
| Credits | 01 | Exam Hours | 2 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- Understand the concept of Building Information Modelling
- Create the workflow followed in industry during creation of BIM 3D model which includes
- Building the discipline-based model and create the federated models

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.

| Exercise |
|---|
| 1. Introduction Building Information Modelling |
| 2. Revit Projects: Project Templates, Revit File Types Working with Revit Elements and Families Exploring the User Interface Starting a Project |
| 3. Setting Up Levels and Grids (Datum Planes) Setting up Levels & Modifying Creating Grids |
| 4. Modelling Walls Creating Walls Modify wall types |
| 5. Working with Doors and Windows Loading Door and Window Types from the Library Creating Additional Door and Window Sizes |
| 6. Using Editing Tools & Working with Views: Using Editing Commands Setting the view display Visibility Graphics, Duplicate Views Elevations & Sections , Adding Callout Views Creating and Modifying 3D Views |
| 7. Modelling Floors Creating and Modifying Floors |
| 8. Modelling Stairs, Railings, and Ramps Creating & Modifying Stairs Working with Railings Sketching Custom Stairs Creating Ramps |
| 9. Modelling Roofs Creating Roofs by Footprint Using Join & unjoin roof |

**Course outcome (Course Skill Set)**

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

1. Prepare, read and interpret the drawings in a professional set up.
2. Know the procedures of submission of drawings and Develop working and submission drawings for building.
3. Plan of residential or public building as per the given requirements with details

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are**50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedules mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the

examiners jointly.

- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

1. The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

**Books**

1. ISO 19650 - Building Information Modelling (BIM)
2. BIM Handbook – Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Create a plan of residential building and practice BIM tools

| GIS with Quantum GIS | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCV456B** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 15 | Total Marks | 100 |
| Credits | 01 | Exam Hours | 1 |
| Examination type (SEE) | Theory (MCQ) | | |

**Course objectives:**

- Learning the open source QGIS software for Civil Engineering applications
- Understand raster and vector data
- Creation of base map and thematic maps for specific application

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Demonstration of open source software for GIS
2. YouTube videos to learn GIS software
3. Power Point presentations.

**Module-1**

QGIS Introduction: Definition of GIS and its use. Introduction to a free and open source desktop geographic information system software. Types of data (vector and raster formats), web services, useful commands and utilities for geo-processing, extending its capabilities to digital satellite image processing and analysis

**Module-2**

INTRODUCTION IN QGIS About QGIS Characteristics of QGIS Start using QGIS. QGIS TOOLS QGIS Configuration, General tools, Working with projections QGIS Browser. WORKING WITH RASTER DATA Introduction, Display raster data, Raster calculator, Working with images, Practical exercises: Working with raster data and operations with images

**Module-3**

QGIS PLUGINS Additional modules of QGIS or "plugins" Description of Plugins incorporated in QGIS Operations through "plugins" Practical exercises: Different QGIS "plugins" and their applications: GDAL library tool, georeferencing, coordinate capture, format converter.

**Module-4**

CREATE MAPS AND RELATED PRODUCTS: Creation tools, Graphic elements, Atlases generation, and Graphic output creations. Practical exercises: Map creation with QGIS.

**Module-5**

RELATIONAL DATABASE MANAGEMENT SYSTEMS AND SPATIAL DATA. Database design, Database connections, Table joins Spatial joins, generate new statistics and new data using table and spatial data information. Practical exercises: Creation of thematic maps like population data of taluk, Watershed map with drainage and water bodies, Highway with other 2 road intersection details

**Course outcome (Course Skill Set)**

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

1. Use open source software for civil engineering applications
2. Various tools in QGIS software
3. Create thematic layers with attribute data
4. Generate maps for decision making

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examinations (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

**Suggested Learning Resources:**

**Books**


1. Geographic Information System-An Introduction, Tor Bernharadsen, 2009, 3rd Edition, Wiley India Pvt. Ltd. New Delhi, ISBN - 9788126511389.
2. Principles of Remote sensing and Image Interpretation, Lillesand and Kiefer, 2011, 6th Edition, John Wiley Publishers, New Delhi, ISBN – 8126532238.


**Web links and Video Lectures (e-Resources):**

- YouTube videos
- https://docs.qgis.org/3.16/pdf/en/QGIS-3.16-DesktopUserGuide-en.pdf for QGIS manual
- NPTEL Lectures.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Prepare the thematic maps using google earth images for various applications

| Electronic Waste Management - Issues and Challenges | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCV456C** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 0:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 15 | Total Marks | 100 |
| Credits | 01 | Exam Hours | 1 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To provide students with a comprehensive understanding of e-waste and its impact on the environment.
- To familiarize students with the generation, composition, and hazardous components of e-waste.
- To highlight the health and environmental risks associated with improper e-waste management.
- To introduce students to various methods of e-waste collection, recycling, and disposal.
- To develop an understanding of the relevant policies and regulations governing e-waste management in India.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials

| **Module-1** |
|---|
| Introduction to E-Waste Management, Overview of e-waste and its impact on the environment, |
| **Module-2** |
| E-Waste Generation and Composition, Types of e-waste and their components |
| **Module-3** |
| E-Waste Hazards and Environmental Impacts, Health and environmental risks associated with e-waste |
| **Module-4** |
| E-Waste Collection and Recycling, Methods of e-waste collection, recycling, and disposal |
| **Module-5** |
| E-Waste Management Policies and Regulations, Relevant laws, policies, and regulations in India |

**Course outcome (Course Skill Set)**

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

1. Explain the concept of e-waste and its significance in the context of environmental sustainability.
2. Identify and classify different types of e-waste and describe their components.
3. Recognize the potential health and environmental hazards associated with improper e-waste management.
4. Evaluate and apply appropriate methods for the collection, recycling, and disposal of e-waste.
5. Demonstrate knowledge of the existing policies, regulations, and frameworks for e-waste management in India

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examinations (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

**Suggested Learning Resources:**

**Books**


1. "E-Waste Management: From Waste to Resource" by R. K. Rathore and H. N. Chanakya, TERI Press, 2019
2. "E-Waste in India: An Emerging Crisis" by Sangeeta Sharma, Cambridge Scholars Publishing, 2019
3. "E-Waste Management: Research, Technology, and Applications", Majeti Narasimha Vara Prasad, CRC Press, 2016
4. "Electronic Waste Management and Treatment Technology" by Rezaul Begg, R. M. Sarcar, and R. V. R. Singh, Springer, 2018
5. "E-Waste Management: From Waste to Resource" by Florin-Constantin Mihai, Academic Press, 2018


**Web links and Video Lectures (e-Resources):**

- NPTEL video Lectures.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to an E-waste management industry

| Technical Writing Skills | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCV456D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 1:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 15 | Total Marks | 100 |
| Credits | 01 | Exam Hours | 1 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Achieve better Technical writing and Presentation skills for employment.
- Develop adequate knowledge of paragraph writing and precise writing techniques
- Write business proposals and reports.
- Write conference papers and prepare gist of published papers.
- Develop efficiency in drafting social media posts and blogs.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Power point Presentation, video
3. Practice sessions.

**Module-1**

**Technical Report Writing:** Introduction to Technical writing process, Understanding of writing process, Introduction to various Technical Report writing.

**Module-2**

**Art of condensation and Paragraph Writing:** Introduction and importance, Types and principles of condensation. Importance of paragraph writing, Features and its construction styles.

**Module-3**

**Business Report Writing:** Introduction, Definition and Salient features of Business reports. Significance and types of report writing. (Formal and Informal). Resume building and Types of resumes. (samples of resumes)

**Module-4**

**Technical Articles and Proposals:** Nature and significance, Types of technical Articles Journal articles and conference papers. Elements of technical articles .Introduction to technical proposal writing, Purpose, importance, structure and types of technical proposals.

**Module-5**

**Social media posts and Blog Writing:** Ethics and practices of social media posts, Principles and fundamentals, Guiding principles for composition of articles, some common pitfalls. Maintaining common etiquette. Blogs and Blog writings strategies.

**Course outcome (Course Skill Set)**

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

1. Effectively communicate in technical matters.
2. Practice preparation of gist, abstract and notes from a technical article.
3. Prepare a business proposals and reports.
4. Write and respond in social media and write blogs.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examinations (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

**Suggested Learning Resources:**

**Books**


1. Sanjay Kumar and Pushpalata, 'Communication Skills', Oxford University Press. 2018.
2. M. Ashraf Rizvi, 'Effective Technical Communication', McGraw Hill, 2018.
3. Gajendra Singh Chauhan and et.al. 'Technical Communication', Cengage Publication, 2018.
4. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practice, Oxford University Press, 2018.


**Web links and Video Lectures (e-Resources):**

- https://developers.google.com/tech-writing/announcements
- https://www.classcentral.com/course/technical-writing-7117.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstrations of Videos
- Group Discussion
- Practice sessions
- Presentation on any social issues
- Quizzes

| Geotechnical Engineering | | Semester | 5 |
|---|---|---|---|
| Course Code | **BCV502** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | 03 |
| Examination nature (SEE) | Theory | | |

**Course objectives:**

- Appreciate basic concepts of soil mechanics as an integral part in civil engineering.
- Comprehend basic engineering and mechanical properties of different types of soil.
- Become broadly familiar with geotechnical engineering requirements, such as, flow of water through soil medium and compaction characteristics.
- Model and measure strength & settlement characteristics and bearing capacity of soils.

**Teaching-Learning Process (General Instructions)**

1. **Use of Black Board, PPT and modern learning tools for teaching**
2. **Performing laboratory experiments to assess the desired properties of soil**

**MODULE-1**

**INDEX PROPERTIES AND IS CLASSIFICATION**

**Index Properties:** Phase Diagram, definitions, and their interrelationships. Determination of Index properties, Types of soil structures and Clay Minerals, IS soil classification of Soil.

**MODULE-2**

**SOIL WATER-EFFECTIVE STRESS ANALYSIS**

**Soil Water**: Permeability, Darcy's law-assumption and validity, coefficient of permeability and its determination (only laboratory method), permeability of stratified soils. Capillary phenomenon, Flow net characteristics and applications

**Effective Stress Analysis:** Effective stress concept-total stress, effective stress and Neutral stress.

**MODULE-3**

**COMPACTION AND CONSOLIDATION**

**Compaction:** Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control

Mass-spring analogy, Terzaghi's one dimensional consolidation theory (No derivation). Consolidation characteristics of soil (Cc, av, mv and Cv). Laboratory one dimensional consolidation test, Pre-consolidation pressure and its determination by Casagrande's method.

**MODULE-4**

**SHEAR STRENGTH**

Concept of shear strength, Mohr–Coulomb Failure Criterion, Modified Mohr–Coulomb Criterion Total and effective shear strength parameters, Measurement of shear strength parameters - Direct shear test, unconfined compression test, triaxial compression test and field Vane shear test, Factors affecting shear strength of soils.

**MODULE-5**

**BEARING CAPACITY AND SETTLEMENT**

**Bearing Capacity:** Types of foundations, Determination of bearing capacity by Terzaghi's and BIS methods (IS: 6403), Modes of shear failure, Factors affecting Bearing capacity of soil. Effect of water table and load eccentricity on bearing capacity of soil, Field methods of determining bearing capacity of soil (SPT and plate load test).

**Settlement:** Types of settlements and importance, Computation of immediate and consolidation settlement, permissible differential and total settlements (IS 8009 Part 1).

**PRACTICAL COMPONENT OF IPCC**

| Sl. No | Experiments |
|---|---|
| 1 | Water content determination by oven drying, Rapid moisture meter method |
| 2 | Grain size analysis (Sieve analysis of soil) |
| 3 | In-situ density tests i) Core-cutter method ii) Sand replacement method |
| 4 | Consistency limits i) Liquid limit test (by Casagrande's and cone penetration method) & ii) Plastic limit test |
| 5 | Co-efficient of permeability test i) Constant head test ii). Variable head test |
| 6 | Standard compaction test (light compaction only) |
| 7 | Direct shear test |
| 8 | Unconfined compression test & Laboratory vane shear test |
| 9 | Triaxial test (unconsolidated undrained test only) |
| 10 | Demonstration of Standard penetration test & Boring equipment |
| 11 | Demonstration of Proctors Needle |
| 12 | Demonstration of Vane shear test |

**Course outcomes (Course Skill Set):**

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

- Comprehend the fundamentals of Soil mechanics and identify and classify the soil
- Apply the knowledge to determine MDD and OMC and compute consolidation properties and shear parameters of soil and compute the settlement and bearing capacity of soil
- Apply the knowledge to determine shear parameters of soil and compute the settlement and bearing capacity of soil
- Carry out experiments to assess the index properties of soil and determine Compaction, Permeability and Shear Strength characteristics of soil.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and

for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will**

**have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Text Books**

1. Gopal Ranjan and Rao A.S.R., Basic and Applied Soil Mechanics, New Age International (P) Ltd., New Delhi. 2016
2. Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering, UBS Publishers and Distributors, New Delhi. 2018
3. Braja, M. Das, Geotechnical Engineering; Thomson Business Information India (P) Ltd., India. 2015
4. Punmia B C, Soil Mechanics and Foundation Engineering, Laxmi Publications co., New Delhi. 2017
5. Soil Testing for Engineers by S. Mittal and J.P. Shukla 2020

**Reference Books**

1. T.W. Lambe and R.V. Whitman, Soil Mechanics-, John Wiley & Sons. 1991
2. Donald P Coduto, Geotechnical Engineering- Phi Learning Private Limited, New Delhi. 2010
3. Shashi K. Gulathi & Manoj Datta, Geotechnical Engineering-Tata McGraw Hill Publications. 2010
4. Bowles J E, Foundation analysis and design, McGraw- Hill Publications 5th edition 2001
5. Malcolm D Bolton, “A Guide to soil mechanics”, Universities Press., 2003
6. Manual of Soil Laboratory Testing- Head K.H., (1986)- Vol. I, II, III, Princeton Press, London 2006

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Students may be teamed in to teams of four and given the task of determining the SBC of soil at any site shown. They will be required to conduct all relevant tests and use the knowledge gained to assess SBC of soil. This will address PO6, PO9, PO10 and PO12. If EXCEL is used for calculation of bearing capacity, PO5 also will be addressed.

| Concrete Technology | | Semester | 5 |
|---|---|---|---|
| Course Code | BCV503 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | 3hrs |
| Examination nature (SEE) | Theory/practical/Viva-Voce /Term-work/Others | | |

**Course objectives:**

- To recognize material characterization of ingredients of concrete and its influence on properties of concrete
- To study the properties of fresh concrete and hardened concrete
- Proportion ingredients of Concrete to arrive at most desirable mechanical properties of Concrete.
- Ascertain various types of special concrete with their properties.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.
6. Encourage collaborative learning, site visits related to subject and impart practical knowledge.

**MODULE-1**

**Concrete Ingredients**

Cement manufacturing process, chemical composition and their importance, hydration of cement, types of cement. Testing of cement, steps to reduce carbon footprint.

Fine aggregate: Functions, requirement, Alternatives to River sand, M-sand introduction, and manufacturing. Coarse aggregate: Importance of size, shape and texture. Grading and blending of aggregate. Testing on aggregate, requirement. Recycled aggregates Water – qualities of water.

Chemical admixtures – plasticizers, accelerators, retarders, and air entraining agents. Mineral admixtures – Pozzolanic and cementitious materials, Fly ash, GGBS, silica fumes, Metakaolin and rice husk ash.

**MODULE-2**

**Fresh Concrete**

Factors affecting workability. Measurement of workability–slump, Compaction factor and Vee-Bee Consistometer tests, flow tests. Segregation and bleeding. Process of manufacturing of concrete- Batching, Mixing, Transporting, Placing and Compaction. Curing – Methods of curing – Water curing, membrane curing, steam curing, accelerated curing, self- curing. Good and Bad practices of making and using fresh concrete and Effect of heat of hydration during mass concreting at project sites.

**MODULE-3**

**Hardened Concrete**

Factors influencing strength, W/C ratio, gel/space ratio, Maturity concept, testing of hardened concrete, Creep – factors affecting creep. Shrinkage of concrete – plastic shrinking and drying shrinkage, Factors affecting shrinkage. Definition and significance of durability. Internal and external factors influencing durability, Mechanisms- Sulphate attack – chloride attack, carbonation, freezing and thawing. Corrosion, Durability requirements as per IS-456, In situ testing of concrete- Penetration and pull-out test, rebound hammer test, ultrasonic pulse velocity, core extraction – Principal, applications and limitations.

**MODULE-4**

**Concrete Mix Design**

Principles of concrete mix design, Parameters and factors influencing mix design, Concept of Mix Design with and without admixtures, variables in proportioning and Exposure conditions, Selection criteria of ingredients used for mix design, Procedure of mix proportioning. Numerical Examples of Mix Proportioning using IS-10262:2019.

**MODULE-5**

**Special Concretes**

RMC-manufacture and requirement as per QCI-RMCPCS, properties, advantages, and disadvantages. Self-Compacting concrete- concept, materials, tests, properties, application and typical mix Fiber reinforced concrete - types of fibres, properties, application of FRC. Light weight concrete-material properties and types. Typical light weight concrete mix proportion and applications, materials, requirements, mix proportion and properties of Geo polymer Concrete, High Strength Concrete and High-Performance Concrete.

**PRACTICAL COMPONENT OF IPCC**

| Sl.NO | Experiments |
|---|---|
| 1 | Testing of cement: Consistency, fineness, setting time, |
| 2 | Specific Gravity, Soundness and strength of cement |
| 3 | Testing of fine aggregate: Specific Gravity, sieve analysis and zoning, bulking of fine |
| 4 | aggregate, bulk density, silt content. |
| 5 | Testing of coarse aggregate: Specific Gravity, sieve analysis, bulk density, flakiness index, |
| 6 | elongation index, water absorption & moisture content, soundness of aggregate. |
| 7 | Concrete Mix design by IS code method as per 10262- 2019 & 456-2000, DOE method. |
| 8 | Demonstration of Testing of concrete cube of specified strength |
| 9 | Demonstration of Testing of concrete beam for pure bending |

**Course outcomes (Course Skill Set):**

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

Relate material characteristics and their influence on microstructure of concrete.

Distinguish concrete behaviour based on its fresh and hardened properties.

Illustrate proportioning of different types of concrete mixes for required fresh and hardened properties using professional codes.

Select a suitable type of concrete based on specific application.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25**

**marks**.

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Books**

Neville A.M. "Properties of Concrete"-4th Ed., Longman.

M.S. Shetty, Concrete Technology - Theory and Practice Published by S. Chand and Company, New Delhi.

Kumar Mehta. P and Paulo J.M. Monteiro "Concrete-Microstructure, Property and Materials", 4th Edition, McGraw Hill Education, 2014

A.R. Santha Kumar, "Concrete Technology", Oxford Un iversity Press, New Delhi (NewEdition).

**Web links and Video Lectures (e-Resources):**

Cement https://nptel.ac.in/courses/105102012/1
Aggregates https://nptel.ac.in/courses/105102012/6
Mineral admixtureshttps://nptel.ac.in/courses/105102012/11
Chemical admixtures https://nptel.ac.in/courses/105102012/9
https://nptel.ac.in/courses/105102012/10
Concrete mix design https://nptel.ac.in/courses/105102012/14

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|---|
| Concrete production & fresh concrete https://nptel.ac.in/courses/105102012/19<br>Engineering properties of concretehttps://nptel.ac.in/courses/105102012/23<br>Dimensional stability & durability https://nptel.ac.in/courses/105102012/27<br>Durability of concrete https://nptel.ac.in/courses/105102012/31<br>Special concretes https://nptel.ac.in/courses/105102012/36 |
| **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**<br>● Seminars/Quizz(To assist in GATE Preparations<br>● Demonstrations in Lab<br>● Self Study on simple topics<br>● Simple problems solving using Excel<br>● Virtual Lab Experiments |

| Environmental Engineering Lab | | Semester | 5 |
|---|---|---|---|
| Course Code | BCV504 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 2 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- To learn different methods of water & waste water quality
- To conduct experiments to determine the concentrations of water and waste water
- To determine the degree and type of treatment
- To understand the environmental significance and application in environmental engineering practice.

| Sl.NO | Experiments |
|---|---|
| 1 | Preparation chemical solutions required for analysis and sampling methodologies |
| 2 | Determination of pH, Conductivity, TDS and Turbidity. |
| 3 | Determination of Acidity and Alkalinity |
| 4 | Determination of Calcium, Magnesium and Total Hardness. |
| 5 | Determination of Dissolved Oxygen |
| 6 | Determination of BOD. |
| 7 | Determination of Chlorides |
| 8 | Determination of percentage of % of available chlorine in bleaching powder sample, Determination of Residual Chlorine and chlorine demand. |
| 9 | Determination of Solids in Sewage: i) Total Solids, ii) Suspended Solids, iii) Dissolved Solids, iv) Volatile Solids, Fixed Solids v) Settleable Solids. |
| 10 | Determination of optimum coagulant dosage using Jar test apparatus. |
| 11 | Determination Nitrates and Iron by spectrophotometer |
| | **Demonstration Experiments ( For CIE )** |
| 12 | Determination of COD (Demonstration) |
| 13 | Air Quality Monitoring (Demonstration) |
| 14 | Determination of Sound by Sound level meter at different locations (Demonstration) |

**Course outcomes (Course Skill Set):**
At the end of the course the student will be able to:

- Acquire capability to conduct experiments and estimate the concentration of different parameters.
- Compare the result with standards and discuss based on the purpose of analysis.
- Determine type of treatment, degree of treatment for water and waste water.
- Identify the parameter to be analysed for the student project work in environmental stream.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before

the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- IS codes-3025 series
- Standard method for examination of water and waste water, APHA, 20th edition
- Clair Sawyer and Perry McCarty and Gene Parkin, "Chemistry for Environmental Engineering and Science", McGraw-Hill Series in Civil and Environmental Engineering.

| Numerical methods in civil engineering | | Semester | 5 |
|---|---|---|---|
| Course Code | **BCV515A** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3;0;0;0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40Hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To learn various numerical techniques.
- To solve Numerical differentiation and integration problems.
- Apply numerical techniques to solve civil engineering problems.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

Historical development of Numerical techniques, role in investigations, research and design in the field of civil engineering development of algorithm/ flow charts for following methods for the solution of linear simultaneous equation- Gaussian elimination method, Gauss-Jordan matrix inversion method, Gauss-Siedel method and Factorization method.

**Module-2**

Development of algorithm for Bisection method.

Newton-Raphson method and its applications for solution of nonlinear algebraic and transcendental equations from problems in hydraulics, irrigation engineering, structural engineering and environmental engineering.

**Module-3**

**Numerical differentiation and integration**

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Two-point and three-point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules. Trapezoidal rule, Simpson's one-third and their application for computation of area of BMD drawn for statically determinate beams.

**Module-4**

New Marks method for computation of slopes and deflections in statically determinate beams.

Development of algorithm and application of solution of ordinary differential equation to civil engineering problems by Euler's method, Runge Kutta $4^{th}$ order method

**Module-5**

Introduction, expression of derivatives by finite difference: backward differences, forward differences, and central differences. Application of finite difference method for analysis of statically determinate beams, statically indeterminate beams, Buckling of columns, Beams on elastic foundation.

**Course outcome (Course Skill Set)**

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

1. To learn various numerical techniques.
2. To solve Numerical differentiation and integration problems.
3. Apply numerical techniques to solve civil engineering problems.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**


1. Grewal. B.S. and Grewal. J.S., "Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi
2. Gerald. C. F., and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi.
3. Chapra. S.C. and Canale. R. P., "Numerical Methods for Engineers, Tata McGraw Hill, New Delhi.
4. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi.
5. Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of India Private, New Delhi.


**Web links and Video Lectures (e-Resources):**

- https://nptel.ac.in/courses/111107105
- https://www.coursera.org/learn/numerical-methods-engineers
- https://cosmolearning.org/courses/numerical-methods-and-programing/video-lectures/.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- solving civil engineering problems

| OCCUPATIONAL SAFETY AND HEALTH MONITORING | | Semester | 5 |
|---|---|---|---|
| Course Code | **BC515B** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3;0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40Hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To Identify hazards in the workplace that pose a danger or threat to their safety or health.
- To Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
- To analysis a potential safety or health hazard
- To Discuss role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.
- To Identify decisions required to maintain protection of the environment, workplace as well as personal health and safety.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Encourage collaborative (Group Learning) Learning in the class.
3. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
4. Seminars and Quizzes may be arranged for students in respective subjects to develop skills.

**Module-1**

**Occupational Hazard and Control Principles:**

Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation.

**Module-2**

**Ergonomics at Work Place:**

Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis – Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations.

**Module-3**

**Fire Prevention and Protection:**

Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers.

Electrical Safety, Product Safety: Technical Requirements of Product safety.

**Module-4**

**Health Considerations at Work Place:**

Types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability.

**Module-5**

**Occupational Health and Safety Considerations:**

Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants, and construction sites. Policies, roles and responsibilities of workers, managers and supervisors.

**Course outcome (Course Skill Set)**

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

1. Identify hazards in the workplace that pose a danger or threat to their safety or health.
2. Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
3. Present a coherent analysis of a potential safety or health hazard
4. Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.
5. Identify the decisions required to maintain protection of the environment, workplace as well as personal health and safety.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Goetsch D. L.,(1999), "Occupational Safety and Health for Technologists, Engineers and Managers", Prentice Hall.
2. Heinrich H.W.,(2007),"Industrial Accident Prevention-A Scientific Approach",McGraw-Hill Book Company National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991),
3. "Industrial Safety and Pollution Control Handbook.
4. Colling D.A.,(1990),"Industrial Safety Management and Technology", Prentice Hall,New Delhi.
5. Della D.E., and Giustina, (1996), "Safety and Environmental Management", Van Nostrand Reinhold International Thomson Publishing Inc.

**Web links and Video Lectures (e-Resources):**

- https://www.cdc.gov/niosh/index.htm
- https://nptel.ac.in/courses/114106017
- https://youtu.be/8nbOI-0U9Co
- https://youtu.be/Be9inw8xlw8
- https://youtu.be/n7oUOUCIblg
- https://youtu.be/gzgNLvHTrfY
- https://www.slideshare.net/engkhanmsh/introduction-to-osha-50289682

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- http://nptel.ac.in
- https://swayam.gov.in

| SOLID WASTE MANAGEMENT | | Semester | 5 |
|---|---|---|---|
| Course Code | **BCV515C** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 Hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To facilitate the learners to understand fundamentals of key elements in solid waste management and governance.
- To impart knowledge to arrive strategies for waste management and selection of technologies for processing, treatment, and disposal.
- To examine and plan designs for material recovery facility, micro composting units, incinerators, biodigesters, and landfills

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Arrange visits to nearby solid waste disposal sites
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Seminars and Quizzes may be arranged for students in respective subjects to develop skills.

**Module-1**

**Introduction to Solid waste management**

Definition, Classification, need and Global perspective of solid waste management. Policies and legislative frameworks, Government initiatives on Solid waste management. Integrated solid waste management and concept of 3R's, Role of stakeholders.

**Module-2**

**Waste generation and characterization**

Factors affecting waste generation and methods to estimate the quantity of waste generated. Physical, chemical, and biological methods of waste characterization.

**Module-3**

**Storage, collection, and Transportation of waste**

Methods of storage, Storage container types and materials, onsite processing. Methods of collection and collection vehicles, Analysis, and design of Hauled and Stationary container systems with case studies. Transfer stations – feasibility and economic analysis.

**Module-4**

**Waste processing and Disposal**

Waste processing facilities- MRFs Landfills – Selection of liners, Design, Closure and Leachate management, Composting, Waste to Energy concepts – Incineration, Biogas recovery and Refuse derived fuels RDFs**.**

**Module-5**

**Special Waste and Smart Solid Waste Management**

Definition, Classification, Effects, treatment, disposal, Legislation and case studies of Hazardous waste, Construction and demolition waste, Electronic waste, Plastic, Biomedical waste and Radioactive waste. Life cycle assessment of solid waste management, Automation and IOT in storage, collection and treatment of

solid waste. Case studies.

**Course outcome (Course Skill Set)**

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

1. Articulate the elements of solid waste management and categorize the waste based on physical, chemical, and biological characteristics.
2. Design a waste collection system for onsite collection, storage and demonstrate waste transfer and transport operations.
3. Evaluate and develop waste processing and treatment methods for solid and hazardous waste with sustainable practices.
4. Select appropriate disposal methods such as landfills, waste to energy plants and its handling in an efficient way.
5. Develop reduce, reuse, and recycling methods for special waste and prepare smart solutions for solid waste management.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Handbook of Solid Waste Management by Frank Kreith, George Tchobanoglous 1994
2. Management of Municipal Solid waste by T.V. Ramachandra 2009
3. Hazardous Waste management by Michael D LaGrega, Philip. L. Buckingham, Jeffery C. Evans 2001
4. Manuals and best practices in solid waste management by Swachh Bharat Mission

(https://swachhbharatmission.gov.in/sbmcms/technical-notes.htm)

**Web links and Video Lectures (e-Resources):**

- Introduction to solid waste https://www.youtube.com/watch?v=k0ktJRoRcOA
- Solid waste management https://www.youtube.com/watch?v=sMeUGwpvLtk
- Municipal Solid Waste Management (Civil Engineering) https://www.digimat.in/nptel/courses/video/105103205/L01.html
- Primary collection SWM https://www.digimat.in/nptel/courses/video/105103205/L09.html
- Solid waste types, methods, challenges and solutions https://www.youtube.com/watch?v=T_pIJiZ8JYI
- Types and sources of SWM https://www.digimat.in/nptel/courses/video/105103205/L03.html.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- http://nptel.ac.in
- https://swayam.gov.in
- https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham

| REMOTE SENSING AND GIS | | Semester | 5 |
|---|---|---|---|
| Course Code | **BCV515D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0;0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40Hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Understand concept of using photographic data to determine relative positions of points.
- Study the methods of collection of land data using Terrestrial and Aerial camera.
- Analyse the data gathered from various sensors and interpret for various applications.
- Apply the principles of RS, GIS and GPS in various scopes of Civil Engineering

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. NPTEL courses on remote sensing and GIS has to be referred to students
2. online resources for remote sensing data to be made available in the lab
3. Open source software QGIS should be made available in the lab
4. YouTube videos
5. PowerPoint presentations.

**Module-1**

**Remote Sensing-**

Definition, types of remote sensing, components of remote sensing, electromagnetic spectrum, Black body, Atmospheric windows, energy interaction with earth surface features. Spectral reflectance curve. Platforms and sensors. Sensor resolutions. Types of satellites Indian and other remote sensing satellites (IRS, IKONS and Landsat). Principle of visual interpretation - key elements.

**Module-2**

**Photogrammetry:**

Introduction types of Photogrammetry, Advantages Photogrammetry, Introduction to digital Photogrammetry. Aerial Photogrammetry: Advantages over ground survey methods- geometry of vertical photographs, scales of vertical photograph. Ground coordination relief displacement, scale ground coordinates – flight planning.

**Module-3**

**Geographic Information System-**

Introduction, Functions and advantages, sources of data for GIS. Database – Types, advantages and disadvantages. Data Analysis.-overlay operations, network analysis, spatial analysis. Outputs and map generation. GPS- components and working principles.

**Module-4**

**Applications of GIS, Remote Sensing and GPS: (1)**

Water Resources engineering and management- prioritization of river basins, water perspective zones and its mapping, Highway and transportation -highway alignment, Optimization of routes, accident analysis, Environmental Engineering- Geostatistical analysis of water quality, rainfall.

**Module-5**

**Applications of GIS, Remote Sensing and GPS: (2)**

Urban Planning & Management, urban sprawl, Change detection studies, forests and urban area, agriculture, Disaster Management. Layouts: Dead end, Radial, Grid iron, Circular system.

**Course outcome (Course Skill Set)**

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

1. Understand and remember the principle of Remote Sensing (RS) and Geographical Information Systems (GIS) data acquisition and its applications.
2. Apply RS and GIS technologies in various fields of engineering and social needs
3. Analyse and evaluate the information obtained by applying RS and GIS technologies.
4. Create a feasible solution in the different fields of application of RS and GIS

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Geographic Information System-An Introduction, Tor Bernharadsen, 2009, 3rd Edition, Wiley India Pvt. Ltd. New Delhi, ISBN - 9788126511389.
2. Principles of Remote sensing and Image Interpretation, Lillesand and Kiefer, 2011, 6th Edition,
3. John Wiley Publishers, New Delhi, ISBN – 8126532238.
4. Higher Surveying, Chandra A.M, 2015, 3rd Edition, New age international (P) Ltd, ISBN: 8122438121
5. Remote Sensing, Robert A. Schowengerdt, 2009, 3rd Edition, Elsevier India Pvt Ltd, New Delhi.
6. Remote Sensing and GIS, Bhatta B, 2011, Oxford University Press, New Delhi, ISBN - 0198072392

**Web links and Video Lectures (e-Resources):**

- NPTEL lecture videos.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Delineating the boundary for a watershed using SOI topomap as reference in GIS software
- Delineating the national highway and study the different components
- Delineating different features on land surface and create land use/land cover map using topomap and google earth image of specific region

| Design of RCC Structures | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCV601** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | 3 |
| Examination nature (SEE) | Theory/practical | | |

**Course objectives:**

- Identify, formulate and solve engineering problems of RC elements subjected to different kinds of loading.
- Follow a procedural knowledge in designing various structural RC elements.
- Impart the usage of codes for strength, serviceability and durability.
- Acquire knowledge in analysis and design of RC elements.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos , NPTEL materials
4. Quiz/Assignments/Open book test to develop skills
5. Adopt problem based learning (PBL) to develop analytical and thinking skills
6. Encourage collaborative learning, site visits related to subject and impart practical knowledge..

**MODULE-1**

Introduction to working stress and limit State Design: Introduction to working stress method, Difference between Working stress and Limit State Method of design. Philosophy and principle of limit state design with assumptions. Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section. Limiting deflection, short term deflection, long term deflection, Calculation of deflection of singly reinforced beam only.

**MODULE-2**

**Limit State Analysis of Beams:** Analysis of singly reinforced, doubly reinforced and flanged beams for flexure and shear.

**MODULE-3**

**Limit State Design of Beams:**

Design of singly reinforced beams with check for shear, check for development length and other checks. Design of doubly reinforced beams and flanged sections without checks.

**MODULE-4**

Limit State Design of Slabs and Stairs: Introduction to one way and two way slabs, Design of Cantilever, simply supported and one way continuous slab. Design of two way slabs for different boundary conditions. Design of dog legged and open well staircases

**MODULE-5**

Limit State Deign of Columns and Footings: Analysis and design of short axially loaded RC column. Design of columns with uniaxial and biaxial moments, Design concepts of the footings. Design of Rectangular and square column footings with axial load.

**PRACTICAL COMPONENT OF IPCC** *(May cover all / major modules)*

| Sl.NO | Experiments |
|---|---|
| 1 | Calculation of deflection of singly reinforced beam using Excel |
| 2 | Design of a simply supported RCC singly reinforced beam using Excel and draw the reinforcement details |
| 3 | Design of a simply supported RCC doubly reinforced beam using Excel and draw the reinforcement details |
| 4 | Design of singly reinforced beams with check for shear, check for development length and other checks using Excel. |
| 5 | Design of a cantilever beam using Excel and draw the reinforcement |
| 6 | Design a simply supported RCC one way slab with intermediate support and draw the reinforcement details |
| 7 | Design a two-way slab for the given data and prepare Bar bending schedule |
| 8 | Design a short axially loaded RC column using Excel |
| 9 | Design the reinforcement for RCC square column with isolated square footing |
| 10 | Design the reinforcement for RCC circular column with isolated square footing |
| 11 | Creation of models related to RC Structural elements. (Demonstration) |
| 12 | |

**Course outcomes (Course Skill Set):**

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

- Understand the design philosophy and principles.
- Solve problems of RC elements subjected to flexure, shear and torsion.
- Demonstrate the procedure in designs of RC structural elements such as slabs, columns and footings.
- Owns professional and ethical responsibility.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the

theory component of IPCC (that is for **25 marks)**.

- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Books**

1. Unnikrishnan Pillai and Devdas Menon, " Reinforced Concrete Design" , McGraw Hill, New Delhi
2. N Subramanian, " Design of Concrete Structures" , Oxford university Press
3. H J Shah, "Reinforced Concrete Vol. 1 (Elementary Reinforced Concrete)" , Charotar Publishing House Pvt. Ltd.

Reference Books:

1. P C Varghese, "Limit State design of reinforced concrete", PHI, New Delhi.
2. W H Mosley, R Husle, J H Bungey, "Reinforced Concrete Design", MacMillan Education, Palgrave publishers.
3. Kong and Evans, "Reinforced and Pre-Stressed Concrete", Springer Publications.
4. A W Beeby and Narayan R S, "Introduction to Design for Civil Engineers", CRC Press.
5. Robert Park and Thomas Paulay, "Reinforced Concrete Structures", John Wiley & Sons, Inc.

**Web links and Video Lectures (e-Resources):**

**https://nptel.ac.in/courses/105105105**

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Students to prepare the models showing the reinforcement details in singly reinforced, doubly reinforced beams, Columns, Staircases and footings.

| Irrigation Engineering and Hydraulic Structures | | Semester | VI |
|---|---|---|---|
| Course Code | **BCV602** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 50 | Total Marks | 100 |
| Credits | 04 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Analyse and design gravity dams.
- Find the cross-section of earth dam and estimate the seepage loss.
- Design spillways and aprons for diversion works.
- Design CD works and chose appropriate canal regulation works.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

Irrigation: Definition. Benefits and ill effects of irrigation. System of irrigation: surface and ground water, flow irrigation, lift irrigation, Bandhara irrigation. Water Requirements of Crops: Duty, delta and base period, relationship between them, factors affecting duty of water crops and crop seasons in India, irrigation efficiency, frequency of irrigation.

**Module-2**

Canals: Types of canals. Alignment of canals. Definition of gross command area, cultural command area, intensity of irrigation, time factor, crop factor. Unlined and lined canals. Standard sections. Design of canals by Lacey's and Kennedy's method. Reservoirs: Definition, investigation for reservoir site, storage zones determination of storage capacity using mass curves, economical height of dam.

**Module-3**

**Gravity dams:**

Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile, and practical profile of a gravity dam, limiting height of a low gravity dam, Factors of Safety – Stability Analysis, Foundation for a Gravity Dam, drainage and inspection galleries.

**Module-4**

**Earth dams:**

Types of Earth dams, causes of failure of earth dam, criteria for safe design of earth dam, seepage through earth dam-graphical method, measures for control of seepage. Spillways: types of spillways, Design principles of Ogee spillways – Spillway gates. Energy Dissipaters and Stilling Basins Significance of Jump Height Curve and Tail Water Rating Curve – USBR and Indian types of Stilling Basins.

**Module-5**

**Diversion Head works:**

Types of Diversion head works- weirs and barrages, layout of diversion head work – components. Causes and failure of Weirs and Barrages on permeable foundations, -Silt Ejectors and Silt Excluders, Weirs on Permeable Foundations – Creep Theories – Bligh's, Lane's and Khosla's theories, Determination of uplift pressure-Various Correction Factors – Design principles of weirs on permeable foundations using Creep theories – exit gradient, U/s and D/s Sheet Piles – Launching Apron.

**Course outcome (Course Skill Set)**

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

1. Know types of water retaining structures for multiple purposes and its key parameters considered for planning and designing
2. Understand details in any Irrigation System and its requirements
3. Analyse and Design of a irrigation system components

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Irrigation Engineering and Hydraulic structures by Santhosh kumar Garg, Khanna Publishers.
2. Irrigation engineering by K. R. Arora Standard Publishers.
3. Irrigation and water power engineering by Punmia & Lal, Laxmi publications Pvt. Ltd., New Delhi
4. Theory and Design of Hydraulic structures by Varshney, Gupta & Gupta
5. Irrigation Engineering by R.K. Sharma and T.K. Sharma, S. Chand Publishers 2015.
6. Irrigation Theory and Practice by A. M. Micheal Vikas Publishing House 2015.
7. Irrigation and water resources engineering by G.L. Asawa, New Age International Publishers.

**Web links and Video Lectures (e-Resources):**

- NPTEL Videos.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Site visit to a dam site and observe all the facility

| DESIGN OF BRIDGES | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCV613A** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0;0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40Hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Introduce students to various aspects of Bridge structures, its components.
- Understand the hydraulic design concepts of Bridges, various IRC loading standards.
- Design small span bridges like culverts, slab decks, and T-beam decks and post tensioned
- slabs.
- Understand various types of bearings, analysis of substructures, and foundations.
- Understand super structure construction methods and practices.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and Talk teaching.
2. Use of ICT (Video) material to show real world pictures of bridges and their construction.

**Module-1**

**Introduction and Conceptual Design of Bridges**

Introduction, components of a bridge and their functions, Site investigations prior to bridge construction, classification of bridges, IRC loading standards, IRC A, AA, and 70 R. Hydraulic design of bridges, natural and artificial water ways, afflux, Economical span, problems.

**Module-2**

Pipe culverts. Hydraulic design and structural design, IRC standards. Design problems.

Design of Box culverts, general procedure of design for all the conditions of culvert , reinforcement details, Design example ( students should be given to design the culvert for any one condition of loading)

**Module-3**

**Design of Deck slab (Limit state method):**

Introduction, Design of deck slab. Effective dispersion of wheel load along the span and effective width concept, Arrangement of wheel loads of IRC A for obtaining maximum bending moment and shear force. Design example, Arrangement of IRC class AA obtaining maximum bending moment and shear force. Design example. Arrangement of IRC 70R loading for obtaining maximum bending moment and shear force. Design example.

**Module-4**

**Introduction to T-beam bridges:**

Code provisions, typical arrangement of longitudinal and cross girders, Pigeaud's method, design of interior panel (for IRC class AA & 70R), methods for finding load distribution among longitudinal girders ( Courbon's, Hednry Jaguer's method), general steps of design ( only design concepts).

**Module-5**

**Bridge substructures, abutments and Piers:**

Types of abutments and piers, stability analysis of piers and abutments, base pressure distribution. Bridge bearings, types and their suitability.

**Course outcome (Course Skill Set)**

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

1. Select the type of the bridge based on the site investigation inputs and be able to compute design discharge, linear water way , economic span and depth of scour (L2 & L3)
2. Design pipe culverts.
3. Design deck slabs for critical loads (L3 & L4)
4. Analyse the stability of bridge piers and abutments. (L3 & L4)
5. Recommend suitable bearings for the given type of bridge and support condition

## Assessment Details (both CIE and SEE)

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**Continuous Internal Evaluation:**

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- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

### Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. D. Johmson Victor, Essentials of Bridge Engineering, 6 th edition, Oxford IBH publications, New Delhi, 2019 ,ISBN:978-81-204-1717-5
2. T.R.Jagadeesh & M A Jayaram, Design of Bridge Structures, 3 rd edition, PHI, New Delhi, 2020, ISBN:978-81-203-3385-29
3. Krishna Raju N, Design of Bridges, Oxford-IBH publishing, 5 th edition, New Delhi
4. Rajagopalan, Bridge Super Structures, Narosa Publishing House, 2013, ISBN :817-31-964-78
5. IRC : 112- 2020: Code of Practice for Concrete Bridges, July 2020, New Delhi

| **Web links and Video Lectures (e-Resources):** |
| --- |
| • https://www.youtube.com/watch?v=hc9Vj_wuQlg<br>• https://www.youtube.com/watch?v=XFRqwmpR7JE<br>• https://www.youtube.com/watch?v=2Dw4vbpPx54<br>• https://www.youtube.com/watch?v=Hfq9cqZFOkc<br>• https://www.youtube.com/watch?v=Hfq9cqZFOkc<br>• https://www.youtube.com/watch?v=unys9j1qxw4. |
| **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**<br>• Students in groups (not more than two)need to garner data pertaining to a short span bridge/ box culvert and perform the redesign of the bridge and submit the report. |

| DESIGN OF FORMWORK AND SCAFFOLDING | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCV613B** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To select the appropriate formwork system
- To design the formwork system
- To compute the bill of quantity for the formwork system
- To incorporate safer design and construction aspects including assembling and dismantling to prevent formwork failures
- To comprehend plan, layout and detailed drawing for formwork systems

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

**Introduction to Formwork**

Classification, benefits, objectives, areas of competitiveness, selection of Formwork, formwork materials, accessories and consumables, application of Tools. Formwork for Foundation, Wall, Columns, Slab and Beam. Conventional drawings. Vertical Application of Conventional Foundation Formwork, Formwork components,

Components, assembly and de-shuttering of formwork System, Flex System, Heavy Duty Tower System, safety of work, Formwork for stairs, Load Bearing Tower.

**Module-2**

**Planning and Design of formwork**

Formwork planning and monitoring, basics of formwork design, design assumptions and design methods. Design of wall formwork, slab formwork and checks. Formwork drawing Concept and Preparation Guidelines, BOQ Calculation and Checklist.

**Module-3**

**Formwork cost estimation and optimization**

Schedule of formwork, Mobilization distribution, BOQ, Quantity Calculation, Cost optimization

**Module-4**

**Modular and Special formwork, scaffolding**

Modular and Special formwork: Advantages and Limitations, Shuttering and de-shuttering, applications, Aluminium formwork - Drawings & Components, Activities, High rise construction, Table lifting system.

Scaffolding: Modular scaffold Installation sequence, Tie and material specification, Ladder safety, Loading Classification, application, Components of L&T Modular Scaffolding system, Access scaffold Do's and Don'ts. Innovation and Global practices.

**Module-5**

Formwork building and erection, Formwork Failures

Formwork assembly for Wall & Column Panels, Equipment and Layout, Plant and Machinery, Formwork erection and safety, Inspection and Corrections, Plant and Machinery, Code and Contractual Requirements.

Formwork Failures: Causes, design deficiency, safety in formwork, prevention of formwork failures.

**Course outcome (Course Skill Set)**

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

1. Analyse the project, and decide appropriate formwork materials and suitable formwork system
2. Design formwork systems as per Industrial requirement
3. Estimate the bill of quantity and optimize the formwork cost
4. Prepare the layout and detailed drawing for the formwork system

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Jha, K.N., Formwork for Concrete Structures, First Edition, McGraw Hill. 2012
2. Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGraw-Hill, 1996.
3. IS 14687 -Guidelines for falsework for concrete structures
4. Concrete pressure on formwork (R108D) - CIRIA
5. IS 456: Plain and Reinforced Concrete - Code of Practice

**Web links and Video Lectures (e-Resources):**

- NPTEL and YouTube Videos.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to construction sites to understand form work

| APPLIED GEOTECHNICAL ENGINEERING | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCV613C** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0;0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40Hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Appreciate basic concepts of soil mechanics applied in the design of foundations
- Learn concepts of Geotechnical investigations required for civil engineering projects emphasizing in situ investigations
- Conceptually learn various theories related to bearing capacity of soil and their application in the design of shallow foundations and estimation of load carrying capacity of pile foundation
- Estimate internal stresses in the soil mass and application of this knowledge in proportioning of shallow and deep foundation fulfilling settlement criteria
- Study about assessing stability of slopes and earth pressure on rigid retaining structures.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. PPT
3. You Tube video lectures
4. Open book test to understand the concepts.

**Module-1**

**Soil Exploration:**

Introduction, Objectives and Importance, Stages and Methods of exploration- Test pits, Borings, stabilization of boreholes, Sampling techniques, Undisturbed, disturbed and representative samples, sample disturbance and Bore hole log.

**Module-2**

**Drainage and Dewatering:**

Drainage and Dewatering methods, estimation of depth of GWT (Hvorslev's method)

Flownets: Importance, properties and applications, Phreatic Lines, Seepage in earth dams (with and without

**Module-3**

**Lateral Earth Pressure:**

Active, Passive and earth pressure at rest, Rankine's theory for cohesionless and cohesive soils, Factors influencing lateral earth pressure, Geotechnical design of gravity and cantilever retaining walls.

**Module-4**

**Stability of Slopes:**

Assumptions, infinite and finite slopes, factor of safety, Swedish slip circle method for C and C-ø (Method of slices) soils, Fellineous method for critical slip circle, use of Taylor's stability charts. Causes for slope instability, Methods of stabilisation of slopes

**Module-5**

**Stresses in Soil:**

Geodesic stress and Stress due to structures, Boussinesq's Stress distribution in ground for point load, line load and uniformly distributed loads, Newmark's Chart, Contact Pressure, Pressure bulbs. Types of settlements and importance, Computation of immediate and consolidation settlement, permissible differential and total settlements (IS 8009 part 1).

**Course outcome (Course Skill Set)**

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

1. Ability to plan and execute geotechnical site investigation program for different civil engineering projects
2. Understanding of stress distribution and resulting settlement beneath the loaded footings on sand and clayey soils
3. Ability to estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures
4. Ability to determine settlement in footing.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering,UBS PublishersandDistribu tors, NewDelhi.
2. K.R.Arora, Soil Mechanics and Foundation Engineering, Standard Publisher Distributors, NewDelhi.
3. PC Varghese, Foundation Engineering, PHI India Learning Private Limited, NewDelhi.
4. Punmia BC, Soil Mechanics and Foundation Engineering (2017), 16th edition, LaxmiPublicationsco., New Delhi.

**Web links and Video Lectures (e-Resources):**

- Online study material
- NPTEL video lectures..

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Site visit to understand the practical difficulty in construction of earth retaining strucures
- Assignment to students on design of an earth retaining structures

| DESIGN AND CONSTRUCTION OF HIGHWAY PAVEMENTS | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCV613D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3;0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40Hrs | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To impart a fundamental understanding to the basics of highway geometric design features
- To introduce the evaluation of pavement material characteristics to identify their suitability for construction
- To study the principles and design of flexible and rigid pavements according to IRC specifications
- To skill up for executing pavement construction with quality control and assurance along with Plants and Machinery selection

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

**Introduction and Subgrade Materials:** Overview of highway - Classification of roads, Pavement Layers – Components and Functions, Highway alignment and Survey, road development in India, Components and
Geometric Standards of Highway Design

**Pavement subgrade material:** Soils, Soil Characteristic Evaluation, desirable properties, tests (Virtual) - Liquid Limit, Plastic limit, Shrinkage Limit, Grain size analysis - Wet sieve and Hydrometer analysis, Water Content, Specific gravity, Free swell index, Relative density, Heavy compaction, California Bearing Ratio.

**Module-2**

**Pavement Materials**

**Stone aggregates:** Desirable properties, tests (Virtual) - Sieve analysis, Specific gravity, Water absorption, Bulk density, Wet Sieve analysis, Aggregate crushing value, Aggregate impact value, Combined Flakiness and Elongation index, Aggregate abrasion value, Soundness of aggregate, Characteristic evaluation

**Bituminous binders:** Desirable properties, tests (Virtual) - Specific gravity, Penetration, Softening Point, Ductility, Elastic recovery, Flash point, Separation, Loss on heating, Matter soluble in trichloro ethylene, Absolute, Kinematic and Rotational Viscosity, Aging of Bitumen, Characteristic evaluation.

**Bituminous paving mix:** Desirable properties, tests (Virtual) - Stripping value of coarse aggregate, Stone polishing value of coarse aggregate, Maximum specific gravity of bituminous mix, Marshall stability & flow, Binder content, Bulk specific gravity and density, Indirect tensile strength, Resilient Modulus (indirect tension test), Resistance of compacted asphalt mixtures to moisture-induced damage, Characteristic evaluation

**Cement:** Desirable properties, tests (Virtual) - Consistency, Initial Setting Time, Final Setting Time, Mortar Cube compressive strength, Fineness of cement, Specific gravity of cement, Soundness of cement, Characteristic evaluation

**Concrete:** Desirable properties, requirements, tests (Virtual) - Workability, Compressive Strength, Flexural strength, Characteristic evaluation

| Module-3 |
| --- |
| **Principles and Design of Pavements**<br>**Flexible Pavement:** Introduction, composition, factors governing design, design of flexible pavements as per IRC; Bituminous mix design (Marshall method), IIT Pave Software; Case study - Design Problem<br>**Rigid pavement:** Introduction, composition, factors governing design, DLC and PQC mix design; design of concrete pavements as per IRC; Joints; Case study – Design Problem |
| **Module-4** |
| **Plants and Machinery:** Introduction; Asphalt Hot Mix Plant, Concrete Batching Plant, Wet Mix Macadam Plant, Earthmoving and Excavation Equipment, Paving Equipment, Slipform Paver, Paver Milling and Road Marking Equipment; Factors affecting output of Plant & Equipment; Initiatives to improve quality<br>**Construction Planning:** Concept of Highways, Planning; Schedules in Planning; Monitoring; Software in Planning |
| **Module-5** |
| **Subgrade and Base Layer:** Construction Practices and Quality Control; Granular Sub-base Construction Activities; Cement Treated Sub-base Construction Activities<br>**Flexible Layers**: Wet Mix Macadam; Construction Practices of Wet Mix Macadam; Hot Mix Asphalt; Construction Practices of Hot Mix Asphalt Layer, Quality Control of Flexible Layers<br>**Rigid Layers:** Dry Lean Concrete; Construction Practices of Dry Lean Concrete; Pavement Quality Concrete; Construction Practices of Pavement Quality Concrete, Quality Control of Rigid Layers<br>**Pavement Evaluation:** Introduction, Pavement Condition Survey, Pavement Evaluation Functional and Structural, Distresses - Flexible and Rigid Pavement, Overlay Design of Flexible Pavement. |
| **Course outcome (Course Skill Set)**<br>At the end of the course, the student will be able to :<br>1. Develop an understanding of the fundamentals of pavement layer behaviour.<br>2. Comprehend the material specifications by interpreting the relationship between material properties and pavement behaviour.<br>3. Conduct different tests on road construction materials to evaluate their characteristics<br>4. Carry out the design of flexible and rigid pavements<br>5. Acquire skilful knowledge of pavement construction practices, plant and machinery selection and quality control |

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Partha Chakraborty, "Principles of Transportation Engineering", PHI Learning,
3. Principles and Practices of Highway Engineering by Kadiyali L.R and Dr.Lal N.B., Khanna Publishers, New Delhi, 2003
4. Relevant IRC and IS Codes of Practices, MoRTH Specification

**Web links and Video Lectures (e-Resources):**

- NPTEL and YouTube Videos.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to road construction site

| GEOGRAPHIC INFORMATION SYSTEM | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCV654B** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0;0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data structures and input, management and output processes.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. PPT
3. You Tube video lectures
4. Open book test to understand the concepts..

**Module-1**

**Fundamentals of GIS:**

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions– History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

**Module-2**

**Spatial Data Models**;

Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.

**Module-3**

**Data Input and Topology:**

Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input –Digitiser – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration

**Module-4**

**Data Quality and Standards:**

Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure.

**Module-5**

**Data Management and Output:**

Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion -
Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GISdistributed GIS.

**Course outcome (Course Skill Set)**

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

1. Have basic idea about the fundamentals of GIS.
2. Understand the types of data models.
3. Get knowledge about data input and topology.
4. Gain knowledge on data quality and standards.
5. Understand data management functions and data output

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.
3. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

**Web links and Video Lectures (e-Resources):**

- NPTEL VIDEOS.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to KSRSAC and ISRO

| Integrated Waste Management for a Smart City | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCV654C** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0;0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 6 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To introduce the fundamentals of Solid Waste Management
- To provide details of Sustainable Cities
- Understand the Sustainable Development Goals.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. PPT
3. You Tube video lectures
4. Open book test to understand the concepts..

**Module-1**

**Introduction to Solid Waste Management**

Municipal Solid Waste Characteristics and Quantities generation rates and waste composition; Integrated waste management issues, collection, recovery, reuse, recycling, energy-from-waste, and landfilling;

**Module-2**

**Biological treatment of the organic waste fraction** ;

Direct land application, composting, and anaerobic digestion.

MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program

**Module-3**

**Biochemical Processes and Composting**

Energy Recovery from Municipal Solid Waste.

Current Issues in Solid Waste Management and Review of MSW Management Status in First List of 20 Smart Cities in the Country

**Module-4**

**Construction and Demolition (C&D) Waste**

Management - Overview

C&D Waste – Regulation, Beneficial Reuse of C&D Waste Materials

**Module-5**

**Electronic Waste (E-Waste)**

Management – Issues and Status in India and Globally, E-Waste Management Rules 2016 and Management Challenges.

**Course outcome (Course Skill Set)**

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

1. Understand basic idea about Sustainable Development.
2. Get knowledge about Sustainable Cities.
3. Gain knowledge on Saving Biodiversity.
4. Understand Sustainable Development Goals.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. William A Worrell and P. Aarne Veslind Solid Waste Engineering, 2nd Edition (SI Edition) Cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3)
2. George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Integrated Solid Waste management, Tata McGraw Hill
3. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization(CPHEEO), India
4. MSW Management Rules 2016, Govt. of India, available online at CPCB website.
5. Electronic Waste Management Rules 2016, Govt. of India, CPCB website.

**Web links and Video Lectures (e-Resources):**

- NPTEL VIDEOS.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to landfill and waste management site

| SUSTAINABLE DEVELOPMENT GOALS | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCV654D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0;0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To introduce the fundamentals and components of Sustainable Development
- To provide details of Sustainable Cities
- Understand the Sustainable Development Goals.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. PPT
3. You Tube video lectures
4. Open book test to understand the concepts..

**Module-1**

**Sustainable Development:**

Introduction to Sustainable Development

Economic Growth and Progress, Continuing Poverty, Environmental Threats, Business as Usual Versus Sustainable Development

**Module-2**

**Sustainable Cities:**

The Patterns of Urbanization Around the World, development of Sustainable city, Smart Infrastructure, Urban Resilience, Planning for Sustainable Development.

**Module-3**

**Curbing Climate Change**

The Basic Science of Climate Change, Consequences, Mitigation, Adaptation, Mitigation Policies:

**Module-4**

**Saving Biodiversity:**

Concept of Biodiversity, Biodiversity Under Threat, Oceans and Fisheries, Deforestation International Dynamics.

**Module-5**

**Sustainable Development Goals**

Introduction to Sustainable Development Goals, Goal-Based Development, Financing for Sustainable Development, Principles of Good Governance, Feasibility of Sustainable Development.

**Course outcome (Course Skill Set)**

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

1. Understand basic idea about Sustainable Development.
2. Get knowledge about Sustainable Cities.
3. Gain knowledge on Saving Biodiversity.
4. Understand Sustainable Development Goals.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Ram Kumar Mishra, Ch Lakshmi Kumari, Sandeep Chachra, P.S. Janaki Krishna "Smart Cities for Sustainable Development" Springer, 2022 Edition
2. The Sustainable Development Goals Report 2020 Kindle Edition, Department of Economic and Social Affairs
3. 'The Sustainable Development Goals" Hardcover – December 4, 2018 United Nations.

**Web links and Video Lectures (e-Resources):**

- NPTEL VIDEOS.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to Industry to understand sustainability goals adopted

| Software Application Lab | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCVL606** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 100 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- Use industry standard software in a professional set up.
- Understand the elements of finite element modelling, specification of loads and boundary condition, performing analysis and interpretation of results for final design.
- Develop customized automation tools..

| Sl.NO | Experiments |
|---|---|
| 1 | Analysis of plane trusses, continuous beams using software |
| 2 | Analysis of portal frames using software |
| 3 | Understanding basic features of Project management software. Constructing Project: create WBS, Activities, and tasks and Computation Time using Excel spread sheet and transferring the same to Project management software. |
| 4 | Identification of Predecessor and Successor activities with constrain. Constructing Network diagram (AON Diagram) and analyzing for Critical path, |
| 5 | Critical activities and Other non-Critical paths, Project duration, Floats. Study on various View options available |
| 6 | Basic understanding about Resource Creation and allocation g. Understanding about Splitting the activity, Linking multiple activity, assigning Constrains, Merging Multiple projects, Creating Baseline Project |
| 7 | GIS applications using open source software: To create shape files for point, line and polygon features with a map as reference. To create decision maps for specific purpose. |
| 8 | Computation of earthwork, Design of horizontal curve by offset method, Design of super elevation Using Excel |
| | **Demonstration Experiments ( For CIE )** |
| 9 | Creating structural model and analysis of high rise structures |
| 10 | Creating a model of building and the effect of earth quake |
| 11 | Create a model of large span roof and analyse |
| 12 | Crate a plan and set of structural drawings for a multi-storied building |

**Course outcomes (Course Skill Set):**

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

- Use software for analysis and design of structural elements.
- Design using excel spread sheet
- Modelling of structural elements of buildings

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- Training manuals and User manuals and Relevant course reference books

| Structural Health Monitoring Using Sensors | | Semester | 6 |
|---|---|---|---|
| Course Code | BCV657B | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 1:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 15 | Total Marks | 100 |
| Credits | 01 | Exam Hours | 1 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To provide an understanding of the principles of SHM and its importance in the field of civil engineering.
- To familiarize students with different types of sensors used in SHM and their principles of operation
- To teach students how to design and implement a sensor-based monitoring system for a civil engineering structure.
- To provide students with the knowledge of data acquisition, processing, and analysis techniques for SHM.
- To demonstrate the application of SHM in the assessment of civil engineering structures

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Blackboard teaching
- Power point Presentation
- Videos, NPTEL materials
- Quiz/Assignments/Open book test to develop skills.

**Module-1**

**Introduction on SHM:** Introduction to Structural Health Monitoring, Definition and importance of SHM in civil engineering, History and evolution of SHM,SHM system components and their functions.

**Module-2**

**Types of Sensors for Structural Health Monitoring:** Overview of different types of sensors, Principles of operation and selection of sensors for different structures, Advantages and disadvantages of different sensors, SHM using Optical Fibres and other sensors

**Module-3**

**Structural Health Monitoring and Smart Materials:** Structural Health Monitoring versus Non Destructive Evaluation, Health Monitoring and Demolition Techniques, Long term health monitoring techniques, Understanding Piezoelectric materials

**Module-4**

**Design of Sensor-based Monitoring System:** System design considerations, Sensor placement and installation, System calibration and validation

**Module-5**

**Applications of Structural Health Monitoring:** Monitoring of buildings, bridges, and dams, Case studies of SHM applications in civil engineering, Future trends and challenges in SHM.

**Course outcome (Course Skill Set)**

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

1. Understand the concept of structural health monitoring and various methods applied for monitoring of structures and structural safety
2. Analyze the sensor systems in structural health monitoring.
3. Design and implement a sensor-based monitoring system for a civil engineering structure.
4. Apply the application of SHM in the assessment of engineering structures

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Books**

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, "Structural Health Monitoring", John Wiley and Sons, 2006
2. Douglas E Adams, "Health Monitoring of Structural Materials and Components", John Wiley and Sons, 2000
3. E-resources 1. E-learning content on L&T EduTech Platform

**Web links and Video Lectures (e-Resources):**

- L&T EduTech Lecture Videos.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Site visit to understand the structural health monitoring systems

| DATA ANALYTICS FOR CIVIL ENGINEERS | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCV657C** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 1;0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 20Hrs | Total Marks | 100 |
| Credits | 01 | Exam Hours | 1 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Get an overall view of data analysis based on CRISP-DM process model.
- Study data quality assessment and visualization techniques for data involving two attributes and for higher dimensional data.
- Understand principles of modelling by going through various data modelling techniques.
- Get a detailed account of data preparation phase.
- Study statistical concepts related to data analysis.
- Enable students to independently perform data analytic procedures on data pertaining to civil engineering using Excel and R.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and Talk teaching.
2. Collection of data from allied fields of civil engineering and selecting appropriate data analytic method.
3. Use of ICT material to show graphical simulations related to dimension reduction, scattering, parallel plots , star diagrams, Radar plots etc....

**Module-1**

**Introduction to Data Analytics:** Data and knowledge, criteria to assess the knowledge, descriptive statistics of the data, inferential statistics, exploratory data analysis, knowledge discovery in data bases, data analysis processes, SEMMA, CRISP-DM, methods, tasks and tools.

**Module-2**

**Understanding the Data** : Attribute understanding, kinds of attributes (nominal, interval, ratio types). Characteristics of one dimensional data, location measures, dispersion measures, and shape measures. Characteristic measures of multidimensional data, data quality, visual analytics of one dimensional data, density plots, box plots, scatter plots. Correlation and covariance. Methods for multidimensional data ( just briefing). ***Analysis of data pertaining to civil engineering.***

**Module-3**

**Principles of Data Modelling** : The four steps of modeling, model classes, black-box models, fitting criteria and score functions, error functions for classification problems, measure of interestingness, closed form algorithm for model fitting. Types of errors. Model validation (briefing on methods). ***Modelling on the data specific to civil engineering***.

**Module-4**

**Data Preparation** : Selection of data, feature selection, selecting top ranked subset of data, cross product, wrapper approach, and correlation based filter. Cleaning data, improving data quality, dealing with missing values, construct data, providing operability, assuring impartiality and maximize efficiency. Complex data types. Implementation of methods on data specific to civil engineering.

**Module-5**

**Finding patterns in data**: Clustering – methods. Hierarchical clustering. Dissimilarity measures, Minkowisci, Euclidian, Manhattan, Chebyshev, and cosine. Deviation measures. Association rules. Brief introduction to self organizing maps. Implementation of methods on data specific to civil engineering.

**Course outcome (Course Skill Set)**

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

1. Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each methods and tasks involved. Apply CRISP-DM data analysis processes to civil engineering related data in decision making.
2. Apply appropriate data visualization techniques and perform correlation analysis on the real world data pertaining to allied areas of civil engineering.
3. Develop appropriate model for the data using the suitable algorithm and validate the so developed model using appropriate validation technique.
4. Decide on appropriate method/ technique for data preparation and provide operability by assuring impartiality and integrity to the given real world data drawn from various sub domains of civil engineering.
5. Perform similarity analysis using similarity metrics and to implement simple clustering techniques of the given data set in one and multiple dimensions.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examinations (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.
4. **The duration of the examinations shall be defined by the concerned board of studies**

**Suggested Learning Resources:**

**Books**

1. Michel R. Berthold, Christian Borgelt, Frank Hoopner, Guide to Intelligent Data Analysis, Springer- Verlag

Publications, ISBN 978-1-84882-259-7, DOI 10.1007/978-1-84882-260-3, London , 2010
2. Charles M.Zudd, Garry H.Mcchelland, Carry S.Ryan, Data Analysis: A Model Comparison Approach, Routledge Publication, NY, 2009.
3. Allan Agresty, An Introduction to Categorical Data Analysis, 2nd Edition, Wiley Publication.

**Web links and Video Lectures (e-Resources):**

- https://www.kdnuggets.com
- www.kaggle.com
- www.datameer.com.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Students in groups ( not more than two)need to garner data pertaining to civil engineering from resources ( Internet, standard Journal papers, experimental data....) apply all the methods learnt during the course, implement the methods using Excel and prepare a small report.

| Quality Control and Quality Assurance | | Semester | 6 |
|---|---|---|---|
| Course Code | BCV657B | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 1:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 15 | Total Marks | 100 |
| Credits | 01 | Exam Hours | 1 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Appreciate the concept of Quality
- Articulate the Implication of Quality in construction
- Implement QA & QC Programs
- Realise the importance of QMS in Civil Engineering.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Power point Presentation, video
3. Site Visit
4. Industry interaction.

**Module-1**

**Overview of Quality:** Quality History, Quality Definition, Quality Inspection, Quality Control, Quality Assurance, Quality Engineering, Quality Management, Quality Gurus: Philip B. Crosby, W. Edwards Deming etc, PDCA Cycle, Costs associated with Quality, Reasons for Poor Quality

**Module-2**

Quality Management: Management Practices: TQM, Vision and Quality policy, Quality Function Deployment, Bench marking and performance evaluation, ISO 9000 Quality Management System, ISO 14000 Environmental Management System

**Module-3**

**Statistical Quality Control:** Importance of SQC in construction, Statistical parameters: sampling, population and sampling, measure of variability, measure of central tendency, Recommendations of IS 456:2000 on sampling, testing and acceptance criteria for concrete.

**Module-4**

**QA and QC in Construction:** Errors in concrete construction; Frequency of material testing and reporting of basic construction materials (cement, sand, coarse aggregate, bricks, steel), Norms for accepting and rejecting criteria of basic construction materials as per relevant IS codes.

**Module-5**

**On-Site Quality:** Achieving quality at different stages of construction: Conceptual Design, Preliminary Design, Detailed Design, Construction, Testing, Commissioning, and Handover. Quality assessment of concrete through NDT: rebound hammer and USPV tests and guidelines for accepting and rejecting.

**Course outcome (Course Skill Set)**

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

1. Realize the importance of quality in construction
2. Apply SQC techniques in different aspects of construction
3. Implement QMS programs at different levels of construction

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examinations (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Books**

1. Juran J M and Gryna F M, Quality Planning and Analysis
2. Hutchins G, John L Ashford, The Management of Quality in Construction
3. Mohamed A. El-Reedy, "Concrete and Steel Construction, Quality Control and Assurance", CRC Press, Taylor and Francis Group
4. M. S. Shetty, Concrete Technology, S Chand Publications
5. Relevant IS Codes

**Web links and Video Lectures (e-Resources):**

- Online study material
- You Tube videos.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstrations of Videos
- Industrial visit – preparation of checklists for different activities in construction
- Collection of typical reports on testing of basic construction materials

| Design of Steel Structural Elements | | Semester | 7 |
|---|---|---|---|
| Course Code | **BCV701** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | 3 |
| Examination nature (SEE) | Theory/practical | | |

**Course objectives:**

1. Understand the behaviour of structural elements in steel structures and well versed with Steel design principles according to the guidelines of IS: 800-2007.
2. Apply their knowledge of Structural mechanics to analyse and design the steel structures.
3. Design the steel structural elements of different forms and connections under different stresses.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and Talk
2. Use Power point presentation
3. Visit an Industrial Building Construction site.

**MODULE-1**

**Introduction:** Advantages and Disadvantages of Steel Structures, Limit state method Limit State of Strength, Structural Stability, Serviceability Limit states, Failure Criteria of steel, Design Consideration, Loading and load combinations, IS code provisions, Specification and Section classification.

**Plastic Behavior of Structural Steel:** Introduction, Plastic theory, Plastic Hinge Concept, Plastic collapse load, load factor, Shape factor, Theorem of plastic collapse, Methods of Plastic analysis.

**MODULE-2**

**Bolted Connections:** Introduction, Types of Bolts, Behavior of bolted joints, Design of High Strength friction Grip (HSFG) bolts, Design of Simple bolted Connections (Lap and Butt joints) and bracket connections both types

**MODULE-3**

**Welded Connections:** Introduction, Types and properties of welds, Effective areas of welds, Weld Defects, Simple welded joints for truss member and Bracket connections both types. Advantages and Disadvantages of Bolted and Welded Connections.

**MODULE-4**

**Design of Tension Members:** Introduction, Types of Tension members, Slenderness ratio, Modes of Failure, Factors affecting the strength of tension members, Design of Tension members with Lug angles.

**Design of Column Bases:** Design of Simple Slab Base and Gusseted Base.

**MODULE-5**

**Design of Compression Members:** Introduction, Failure modes, Behavior of compression members, Sections used for compression members, Effective length of compression members, Design of compression members and built up Compression members, Design of Laced and Battened Systems.

**PRACTICAL COMPONENT OF IPCC** *(May cover all / major modules)*

| Sl.NO | Experiments |
|---|---|
| 1 | Design a Bolted Connections using M S Excel |
| 2 | Design a welded Connections using M S Excel |
| 3 | Design of Tension members using M S Excel |
| 4 | Design of Compression Members using MS Excel |
| 5 | Design of Simple Slab Base using M S excel |
| 6 | Design of Gusseted Base using M S Excel |
| 7 | Draw the following using AutoCAD.<br>Column bases and Gusseted bases with bolted and welded connections. |
| 8 | Draw the following using AutoCAD.<br>Roof Truss – Welded and Bolted |
| 9 | Draw the following using AutoCAD.<br>Connections – Beam to beam, Beam to Column by Bolted and Welded Connections. |
| 10 | Draw the following using AutoCAD.<br>Built-up Columns with lacings and battens. |
| 11 | Drawing of Gantry Girder for the given data using AutoCAD. |
| 12 | Drawing of Welded Plate girder for the given data using Auto CAD. |

**Course outcomes (Course Skill Set):**

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

1. Explain: the engineering properties and the behaviour of steel structural elements according to the guidelines. L - 2
2. Analyse and design: Structural connection of Steel Elements. L-4 & L-5
3. Analyse and design: the steel structural elements of different forms under different stresses. L-4 & L-5

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous

evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.

- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Books**

1. N Subramanian, "Design of Steel Structures", Oxford University Press, New Delhi, India.
2. S K Duggal, "Limit State Design of Steel Structures" McGraw Hill Publications Chennai.

**Web links and Video Lectures (e-Resources):**

https://nptel.ac.in/courses/105105162

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:**

Develop a Models of the following connections:

1. Lap Joint, But Joint (bolted and welded)
2. Angle connected to Gusset plate
3. Plate Connected to gusset plate
4. Beam to beam connections
5. Beam to Column Connection
6. Built up Column with lacings and Battens.

| ESTIMATION AND CONTRACT MANAGEMENT | | Semester | VII |
|---|---|---|---|
| Course Code | BCV702 | CIEMarks | 50 |
| TeachingHours/Week(L:T:P:S) | 3:2:0:0 | SEEMarks | 50 |
| TotalHoursofPedagogy | 40hoursTheory | TotalMarks | 100 |
| Credits | 04 | ExamHours | 03 |
| Examinationnature(SEE) | Theory | | |

**Course Learning Objectives:** This course will enable students to;

- Estimate the quantities of work, develop the bill of quantities and arrive at the Cost of civil engineeringProject
- Understand and apply the concept of Valuation for Properties
- Understand, Apply and Create the Tender and Contract document.

**Teaching-Learning Process(General Instructions)**

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching/power point presentation
2. Regular review of the students by asking questions based on topics covered in the class

**MODULE-1**

**Quantity Estimation for Building:** study of various drawing attached with estimates, important terms, units of measurements, abstract, Types of estimates. Estimation of building by Short wall and long wall method - centreline method.

Estimate of R.C.C structures including Slab, beam, column, footings.

**MODULE-2**

Estimate of Steel truss, manhole and septic tanks and slab culvert.

**Quantity Estimation for Roads:** Computation of volume of earthwork fully in banking, cutting, partly cuttingand partly Filling by mid-section, trapezoidal and Prismoidal Methods.

**MODULE-3**

**Specification for Civil Engineering Works:** Objective of writing specifications essentials in specifications, general and detail specifications of different items of works in buildings and roads.

**Analysis of Rates :** Factors Affecting Cost of Civil Works , Concept of Direct Cost , Indirect Cost and Project Cost

Rate analysis and preparation of bills, Data analysis of rates for various items of Works, Sub-structure components, Rate analysis for R.C.C. slabs, columns and beams.

**MODULE-4**

. **Contract Management-Tender and its Process:** Invitation to tender, Prequalification, administrative approval& Technical sanction. Bid submission and Evaluation process. Contract Formulation: Letter of intent, Award of contract, letter of acceptance and notice to proceed. Features / elements of standard Tender document (source: PWD / CPWD / International Competitive Bidding – NHAI / NHEPC / NPC).

Law of Contract as per Indian Contract act 1872, Types of Contract, Joint venture.

**Contract Forms:** FIDIC contract Forms, CPWD, NHAI, NTPC, NHEPC

**MODULE-5**

**Contract Management-Post award :**Basic understanding on definitions, Performance security, Mobilization and equipment advances, Secured Advance, Suspension of work, Time limit for completion, Liquidated damages and bonus, measurement and payment, additions and alterations or variations and deviations, breach ofcontract, Escalation, settlement of account or final payment, claims, Delay's and Compensation, **Disputes & itsresolution mechanism,** Contract management and administration.

**Valuation:** Definitions of terms used in valuation process, Purpose of valuation, Cost, Estimate, Value and its relationship, Capitalized value. Freehold and lease hold and easement, Sinking fund, depreciation–methods of estimating depreciation, Outgoings, Process and methods of valuation: Rent fixation, valuation for mortgage, valuation of land.

**Course outcomes:** After studying this course, students will be able to:

1. Taking out quantities and work out the cost and preparation of abstract for the estimated cost for variouscivil engineering works.
2. Prepare detailed and abstract estimates for various road works, structural works and water supply andsanitary works.
3. Prepare the specifications and analyze the rates for various items of work.
4. Assess contract and tender documents for various construction works.
5. Prepare valuation reports of buildings..

**AssessmentDetails(bothCIEandSEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall bedeemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE(Continuous InternalEvaluation)andSEE (SemesterEndExamination)taken together.

**CIE(maximummarks50)**

- 50 marks for CIE are split into **30marks** for three Internal Assessment Tests and 2**0marks** for other assessment methods mentioned in 22OB4.2.
- The first test at the end of 30-35% coverage of the syllabus, the second test after covering 65-70%of the syllabus and the third test for 95-100% coverage of syllabus
- The student must secure 40% of 50marks to qualify in the CIE

**SEE (Max 100 Marks scaled downed to 50 Marks)**

Theory SEE will be conducted by University as per the scheduled timetable, with common questionpapersfor thecourse (**duration03hours**)

1. The question paper will have ten questions. Each question is set for 20marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3sub-questions), **should have a mix of topics** under that module.
3. The students must answer 5 full questions, selecting one full question from each module. Marks scored by the student shall be proportionally scaled down to 50Marks

**Suggested Learning Resources:**

**Recommended Reading**:


1. Datta B.N., "Estimating and costing", UBSPD Publishing House, New Delhi.
2. B.S. Patil, "Civil Engineering Contracts and Estimates", Universities Press.
3. M. Chakraborthi; "Estimation, Costing and Specifications", Laxmi Publications.
4. MORTH Specification for Roads and Bridge Works – IRC New Delhi
5. Kohli D.D and Kohli R.C, "Estimating and Costing", 12 th Edition, S.Chand Publishers, 2014.
6. Vazirani V.N and Chandola S.P, "Estimating and costing", Khanna Publishers, 2015.
7. Rangwala, C. "Estimating, Costing and Valuation", Charotar Publishing House Pvt. Ltd., 2015.
8. Duncan Cartlidge , "Quantity Surveyor's Pocket Book", Routledge Publishers, 2012.
9. Martin Brook, "Estimating and Tendering for Construction Work", A Butterworth-Heinemann publishers, 2008.
10. Robert L Peurifoy , Garold D. Oberlender , " Estimating Construction Costs" – 5ed , Tata McGraw-Hill , New Delhi.
11. David Pratt, "Fundamentals of Construction Estimating" – 3ed, Edition.
12. PWD Data Book, CPWD Schedule of Rates (SoR). and NH SoR – Karnataka FIDIC Contract forms.
13. B.S. Ramaswamy "Contracts and their Management" 3ed, Lexis Nexis(a division of Reed Elsevier IndiaPvt Ltd).


**WeblinksandVideoLectures(e-Resources):**

https://youtu.be/ofkpm4lhJcg
https://youtu.be/GGikveOcaJw

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Conduction of technical seminars on recent research activities
- Group Discussion

- Site visits

| Prestressed Concrete | | Semester | 7 |
|---|---|---|---|
| Course Code | **BCV703** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 04 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To explain the necessity of prestressed concrete
- To understand the principles and methods of design according to IS 1343 and IRC 112
- To estimate losses due to prestressing
- To design pre-stressed concrete pipes, tanks, beams or I-girder for bridge, one-way and two-way slabs
- To illustrate the concept of special bridge like cable stayed bridges and balanced cantilever bridges

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

**Introduction to pre-stressed concrete structures:** Concepts of Prestressing- Historical development of prestressing-Design Codes for PreStressed Structures- Advantages & Limitations of Pre-stressed Concrete Material - Need for High Strength Concrete- High Tension Steel- Types of Prestressing Steel

**Module-2**

**Losses of Prestressing and Prestressing Systems:** Losses– Immediate losses due to Friction and wobble, Elastic shortening Anchorage Slip - Time dependent losses due to Creep, Shrinkage and Relaxation losses - Introduction to Pre-stressing systems – Pre -Tensioning Devices – Post -Tensioning Devices - Anchorage Devices - Mechanical pre-stressing - Chemical Pre-stressing - Electrical Pre-stressing

**Module-3**

**Principle and Methods of design:** Combined Load Approach - Internal Couple Approach - Load Balancing Approach - Steel Stress in Bonded and Un-bonded tendons – Flexure and Shear – Crack and Deflection - Design as per IS 1343 - Design of Anchorage zone – End block- Cable Profiling for different beams - Mechanism of Transfer of Prestress in Pre-Tensioning System and Post Tensioned system

**Module-4**

**Applications of Pre-stressing:** Circular Prestressing – Introduction - Types and Design of Prestressed Concrete Pipes Pre-stressing in Buildings – Beams – One-way Slabs – Two-way Slabs – Flat slabs Structures – Tanks, Poles & Piles - Partial Prestress - behavior, advantages and disadvantagesRemember the concepts of Prestressing

**Module-5**

**Pre-stressing in Bridges:** Composite Construction – Introduction - Analysis-IRC 112 Codal provisions for ULS and SLS – Design of a I-girder with cast in situ slab -Viaducts – Balanced cantilever bridges – Railway sleepers

**Course outcome (Course Skill Set)**

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

1. Remember the concepts of Prestressing
2. Understand the concept of pre-tensioning and posttensioning
3. Carry out the Analysis and Design of composite I girder
4. Perform the design of anchorage zones, composite pipes, sleepers and tanks

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Prestressed Concrete Structure by T.Y. Lin, Ned H. Burns
2. Prestressed Concrete by N. Krishna Raju
3. Prestressed Concrete by G.S.Pandit and S.P.Gupta
4. IRC 112 and IS 1343 codes

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to Site to understand prestressing

**VII Semester**

| INTELLIGENT TRANSPORTATION SYSTEMS | | | |
|---|---|---|---|
| Course Code | BCV714A | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | (3:0:0:0) | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination nature (SEE) | Theory | | |

**Course objectives:**

**This course will enable students**

- To learn the fundamentals of ITS.
- To study the ITS functional areas
- To have an overview of ITS implementation in developing countries

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching/PowerPoint presentations (if needed)
2. Regular review of students by asking questions based on topics covered in the class.

**Module-1 Introduction to Intelligent Transport System**

Introduction to Intelligent Transportation Systems (ITS) -Definition – Role and Responsibilities – Advanced Traveller Information System – Fleet Oriented ITS Services – Electronic Toll Collection – Critical issues – Security – Safety

**Module-2 ITS Architecture and Hardware**

Architecture – ITS Architecture Framework – Hardware Sensors – Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection

**Module-3 Advanced Transport Management System**

Video Detection – Virtual Loop - Cameras - ANPR – IR Lighting – Integrated Traffic Management – Control Centre – Junction Management Strategies- ATMS – Advanced Traveler Information Systems (ATIS)- Route Guidance – Issues - Historical – Current – Predictive Guidance – Data Collection – Analysis – Dynamic Traffic Assignment (DTA) – Components – Algorithm.

**Module-4 Advanced Traveller and Information System**

Travel Information – Pre Trip and Enroute Methods- Basic ATIS Concepts – Smart Route System – Data Collection – Process – Dissemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities

**Module-5 Case Studies**

Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

**Course outcome (Course Skill Set)**

On completion of the course the students should be able to

- Understand the sensor and communication technologies.
- Apply the various ITS methodologies
- Define the significance of ITS under Indian conditions

**Assessment Details (both CIE and SEE)**

**CIE for the theory component of the PEC (maximum marks 50)**

**CIE for the practical component of the PEC**

**SEE for PEC**

**Suggested Learning Resources:**

**Books**


1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill, 1992.
3. Turban E.,"Decision Support and Export Systems Management Support Systems", Maxwell Macmillan, 1998.
4. Sitausu S. Mittra, "Decision Support Systems – Tools and Techniques", John Wiley, New York, 1986.
5. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems – Theory and Application", Springer Verlog, New York, 1987
6. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.


**Web links and Video Lectures (e-Resources):**

- https://nptel.ac.in/courses/105107210
- https://www.civil.iitb.ac.in/tvm/nptel/591_ITS_1/web/web.html

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Seminars/Quiz (To assist in GATE Preparations)
- Self-Study on simple topics
- Simple problems solving using Excel
- Discussion of case studies
- Virtual Lab experiments

| Earthquake Resistant structures | | Semester | VII |
|---|---|---|---|
| Course Code | | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory | Total Marks | 100 |
| Credits | 03 | Exam Hours | |
| Examination nature (SEE) | Theory/practical/Viva-Voce /Term-work/Others | | |

**Course objectives: The Course will enable students**

- Fundamentals of structural dynamics
- Fundamentals of engineering seismology
- Irregularities in building which are detrimental to its earthquake performance
- Different methods of computation seismic lateral forces for framed and masonry structures
- Earthquake resistant design requirements for RCC and Masonry structures and Relevant clauses of IS codes of practice pertinent to earthquake resistant design of structures

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Black board teaching/power point presentation
2. Regular review of the students by asking questions based on topics covered in the class

**MODULE-1**

**Introduction to structural dynamics:** Basic Definitions, Concept of degrees of freedom, D'Alembert's principle, principle of virtual displacement and energy principles, Types of Vibrations, Damping and its types, Analytical Model of dynamic system, Free vibration of damped and undamped system having single degree of freedom. Concept of equivalent spring, Numerical problems on determining natural period, natural frequency, mass, stiffness, amplitude, and acceleration for undamped free vibration systems.

**MODULE-2**

**Engineering Seismology:** Terminologies (Focus, Focal depth, Epicenter, etc.); Causes of Earthquakes; Theory of plate tectonics; Types and characteristics faults; Classification of Earthquakes; Types and characteristics of seismic waves; Magnitude and intensity of earthquakes; local site effects; Earthquake ground motion characteristics: Amplitude, frequency and duration; Seismic zoning map of India, Earthquake measuring instruments-Seismoscope, Seismograph and accelerograph.

**MODULE-3**

Seismic Performance of Buildings and Over View of IS-1893 (Part-1): Types of damages to building observed during past earthquakes; Plan irregularities; mass irregularity; stiffness irregularity; Concept of soft and weak storey; Torsional irregularity and its consequences; configuration problems; continuous load path; Architectural aspects of earthquake resistant buildings; Lateral load resistant systems. Seismic design philosophy; Structural modeling; Code based seismic design methods.

**MODULE-4**

**Determination of Design Lateral Forces:** Equivalent lateral force procedure and dynamic analysis procedure. Step by step procedures for seismic analysis of RC buildings using Equivalent static lateral force method and response spectrum methods (maximum of 4 storeys and without infill walls). Numerical problems.

**MODULE-5**

**Ductility considerations:** Factor affecting ductility, ductile detailing of flexural members, columns and frame members as per IS13920. Design of Ductile Reinforced Concrete Beams, Seismic Design of Ductile Reinforced Concrete column

**Earthquake Resistant Design of Masonry Buildings:** Performance of Unreinforced, Reinforced, Infill Masonry Walls, Box Action, Lintel and sill Bands, elastic properties of structural masonry, lateral load analysis, Recommendations for Improving performance of Masonry Buildings during earthquakes; Retrofitting of Masonry buildings.

**PRACTICAL COMPONENT OF IPCC***(May cover all / major modules)*

| Sl.NO | Experiments |
|---|---|
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**Course outcomes (Course Skill Set):**

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

- To formulate the solution for damped and undamped SDOF systems.
- To describe basic principles of engineering seismology
- To describe various irregularities and their limits for earthquake resistant structure as per Indian standard code books.
- Analyze the structure for seismic forces using Equivalent static lateral force method and response spectrum method
- To perform ductile Design of RC members and to describe behavior of masonry under seismic loads.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other

assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Books**


1. Pankaj Agarwal and Manish Shrikande, "Earthquake resistant design of structures", PHI India.
2. S.K. Duggal, "Earthquake Resistant Design of Structures", Oxford University Press
3. Anil K. Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Pearson
4. Education, Inc.
5. T. K. Datta, "Seismic Analysis of Structures", John Wiley & Sons (Asia) Ltd.
6. David Dowrick, "Earthquake resistant design and risk reduction", John Wiley and Sons Ltd.
7. C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan & Vipul V. Mehta, "Some Concepts in Earthquake
8. Behaviour of Buildings", Published by Gujarat State Disaster Management Authority, Government of Gujarat.

**9.** IS-13920 – 2016, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, BIS, New Delhi.

**10.** IS-1893 – 2016, Indian Standard Criteria for Earthquake Resistant Design of Structures, Part-1, BIS, New Delhi.

**11.** IS- 4326 – 2013, Earthquake Resistant Design and Construction of Buildings, BIS, New Delhi.

**12.** IS-13828 – 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings, BIS, New Delhi.

**13.** IS-3935 – 1993, Repair and Seismic Strengthening of Buildings-Guidelines, BIS, New Delhi.

**Web links and Video Lectures (e-Resources):**

1. https://www.steel-insdag.org/assets/frontend/trmpdf/Chapter41.pdf
2. https://www.steel-insdag.org/assets/frontend/trmpdf/Chapter6.pdf
3. https://www.steel-insdag.org/assets/frontend/trmpdf/Chapter42.pdf
4. https://nptel.ac.in/courses/105105162

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

| Design And Execution of Pile Foundations | | Semester | 7 |
|---|---|---|---|
| Course Code | **BCV714D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Introduce the concept of Piling works and design requirements for a pile
- Elaborate the construction procedures which are involved in different pile foundations
- Explain the different load test which need to be conducted on the piles.
- Understand the Environmental, Health and Safety standards which need to be in place for the handling of the pile works
- Elaborate on the bill of quantities of various Pile foundations

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

**Introduction to piles, Design and construction of Bored Cast insitu piles and Driven Cast insitu piles:** Overview of Pile foundations, Selection Criteria, Common Design considerations, General Terminologies and Indian standard codes. Materials and Equipment, Construction procedures, workmanship, Vertical and Lateral Capacity calculations, Load tests, Case Studies of Bored cast insitu piles and Driven cast insitu piles

**Module-2**

**Introduction, design and construction of precast driven and under reamed piles:** Materials and Equipment, Construction procedures, workmanship, Vertical and Lateral Capacity calculations, Load tests, Case Studies of precast driven piles, precast driven piles in pre-bored holes and Under reamed piles

**Module-3**

**Grouping and settlement of piles and testing:** Introduction to Grouping and Settlement of piles, Pile Group efficiency and Spacing, Capacity of Pile group, Settlement of Pile group, Case studies Introduction & Types of testing on piles and General requirements for testing, Pile Integrity tests - introduction & Equipment Types of Pile Integrity test, Data Recording & Interpretation of results, Introduction to quality assurance of piles, General requirement

**Module-4**

**Quality control and Special Types of piles:** Quality Control of BCIS, DCIS piles, Quality records and checklists. Materials, Equipment, manufacturing procedure, Design and installation, suitability and application and failure modes of spun piles and helical piles

**Module-5**

**Software and Bill of quantities, Construction challenges:** Introduction to Bill of quantities for Bored cast insitu, Driven Cast insitu, Precast driven and Precast driven piles in pre-bored holes and undreamed piles. Challenges in bored and driven piles, Introduction to types of piling

software, Software demonstrations (e.g., PLAXIS) and step-by-step design techniques for deep foundations. Modelling in Plaxis 2D

**Course outcome (Course Skill Set)**

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

1. Comprehend Basic design concepts, of pile foundations
2. Compute capacity of piles and select suitable type of pile foundation based on soil conditions
3. Apply different construction procedures of pile foundation
4. Design and execute different load testing on piles
5. Compute bill of quantities for pile foundations

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. IS 2911- Indian standard code driven cast insitu, bored cast insitu, Driven precast piles
2. IS 14593-Indian standard code for bored cast insitu piles founded on rocks – Guidelines
3. Michel Tomilson and John Woodward, "Pile design and construction practice", CRC Press

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to a nearby site if available to pile foundation

**VIISemester**

| BUILDING SERVICES-HVAC,ACOUSTICS AND FIRE SAFETY | | | |
|---|---|---|---|
| CourseCode | **BCV755D** | CIEMarks | 50 |
| TeachingHours/Week(L:T:P:S) | 3+0+0 | SEEMarks | 50 |
| TotalHoursofPedagogy | 40 | TotalMarks | 100 |
| Credits | 3 | ExamHours | 3 |

**CourseLearningObjectives:**Thiscoursewillenablestudentsto;

1. TolearnthebasicsofMEPsystems.(Mechanical,Electricalandplumbing)
2. Toexposethelearnerstobuildingacoustics
3. ToimpartknowledgeonHVACandfireprotectionsystemsinbuilding

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk, PPT presentations,
2. You tube videos,
3. visit to nearby sites
4. NDT EQUIPMENTS AWARENESS

**Module-1**

**AdvancedElectricalSystemDesignforBuildings** :Basics of Electrical System, Electrical terminologies, Major Electrical equipment, Buildingpower distribution and its schemes, Fundamentals of Power& distribution transformers, HT,LT, DG Sets, Cables & Wires, UPS and its importance, Introduction of HT, LT switchgearssystems,ImportanceofLightingdesign&differentLightfixturesusedinbuildings–Interior,external, street & offices,RMU, HT consumer, Substation Building in Master plan - SpaceplanningforRMU,HT,DGset,HSDyard,SpaceprovisionforElectricalEquipmentincludingSubstation,Variousequipmentclearancerequirements,HVAC,PHE,FPSservice-electricalloadinputfordesigningelectricalpowerdistribution,Pedestals&ceilingsupportrequirementforallElectricalequipment.

| **Teaching-LearningProcess** | Chalk&Talk,PPTpresentation,Youtubevideos,Nearbysitevisits |
|---|---|

**Module-2**

**ExtraLowVoltageSystemforInfrastructureandBuildingAcoustics:**Introduction & Brief of ELV Systems, Concept of Building Management System (BMS) &Fire Alarm System, Interface with Architecture/ Structure, Access control, CCTV & Publicaddresssystem-Briefandpurpose,BMS-Briefandpurpose,BMSinterfaceswithElectrical,HVAC,Fire&LifeSafetyandPHE,BMSinterfaceswithairportsystems.BasicsofsoundandBuildingacoustics–Acousticdefectsandpreventionofsoundtransmission

| **Teaching-LearningProcess** | Chalk&Talk,PPTpresentation,Youtubevideos,Nearbysitevisits |
|---|---|

**Module-3**

**Heating,Ventilation&Airconditioningsystems** :Basics of HVAC - Psychrometry and its importance - Major Components of Air conditioningSystem-FundamentalconceptsofHeattransfer,Air-conditioningsystem,Ventilationsystem, Pressurization Systems and their importance to Life safety, Chilled water system,Cooling towers and major HVAC equipment, Pumping system in HVAC, Importance ofThermalandAcousticInsulation,IntroductionandbasicsofVariableRefrigerantFlow(VRF)systems,Radiantcooling,Underfloordistribution,Chilledbeams–Spaceplanning-ImportanceofStaticweight/Operatingweightsofmechanicalequipment-Importanceof FloorslabandTerraceroofslabopenings/cut-outs

| **Teaching-LearningProcess** | Chalk&Talk,PPTpresentation,Youtubevideos,Nearbysitevisits |
|---|---|

**Module-4**

**FireProtectionandLifeSafetySystem** :Basics of Fire Protection System - Active Fire protection system - Passive Fire protectionsystem-BasicsofSmokeControlandFireStopSystems-Codes&StandardsandStatutoryCompliance - Fire and its Classes - Hazard Classification based on building occupancy -Means of Egress and its components - Importance of Life Safety - Refuge Area, Fire TowerandFireLift-OccupantLoadandCapacityfactors-FireStoppingMaterials-Compartmentationinabuilding-Smokecontrol&managementinFireZoning–ComponentsofFireCompartments.

| | |
|---|---|
| **Teaching-LearningProcess** | Chalk&Talk,PPTpresentation,Youtubevideos,Nearbysitevisits |

**Plumbingforwatersupplyandsanitarysystem** :ScopeofworksinPublicHealthEngineering-Sanitaryfixturesandtypes-Watersupplyandtreatment - Rain water drainage system - Landscape irrigation features – Water demandcalculationbasedonbuildingoccupancy–Pipingfordifferentplumbingsystemsinbuildings–Pumpselection–Plantroomsizing-Sewagetreatmentprocess-Externalwatersupply,storm drainage & sewerage system - Solid waste management - Interfacing PHE system withArchitectandStructuralengineers.

| | |
|---|---|
| **Teaching-LearningProcess** | Chalk&Talk,PPTpresentation,Youtubevideos,Nearbysitevisits |

**Courseoutcome(CourseSkillSet)**

Attheendofthecoursethestudentwillbeableto:

1. **Understand**ElectricalSystemalongwithsubstationforabuildinginfrastructure
2. **Comprehend**thebasicsofacousticsandELVsystemsinbuilding.
3. **Design**andimplementationofHVACSystem
4. **Implement**FireAlarmSystem(PAS)forbuilding
5. **Understand**theimportanceofwatersupplyandsanitaryplumbingsystemforabuilding

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
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- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

**SuggestedLearningResources:**

**TextBooks**

1. CodeofPracticeforfiresafetyofbuildings(IS1641–IS1646)
2.

**Module-5**

**ReferenceBooks:**

1.
2.

**WeblinksandVideoLectures(e-Resources):**

- . Online study material
- NPTEL video lectures.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Visit to Actual Repair, Retrofitting and Rehabilitation of Structures sites.
- Imparting knowledge of Techniques and materials for retrofitting.
- Mini Projects to explain the concept of Repair, Retrofit and Rehabilitation of structures.

| ROAD SAFETY ENGINEERING | | Semester | 7 |
|---|---|---|---|
| Course Code | **BCV755A** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To provide students with a comprehensive understanding of the principles, strategies, and techniques related to ensuring safety on roadways.
- To equip students with the knowledge and skills necessary to analyse road safety issues
- To design effective road safety measures, and contribute to the improvement of road safety practices.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.

**Module-1**

**Accident Investigations And Risk Management:** Collection Of Accident Data, Assessment Of Road Safety, Methods To Identify And Prioritize Hazardous Locations And Elements, Determine Possible Causes Of Crashes, Crash Reduction Capabilities And Countermeasures, Effectiveness Of Safety Design Features, Accident Reconstruction, Condition And Collision Diagram.

**Module-2**

**Traffic Engineering Studies:** Statistical Methods In Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons- Traffic Management Measures And Their Influence On Accident Prevention.

**Module-3**

**Road Safety In Transport Planning And Geometric Design:** Vehicle And Human Characteristics, Road Design And Safety Elements, Redesigning Junctions, Cross Section Improvements, Traffic Control, Traffic Calming Measures, Road Safety Furniture

**Module-4**

**Role Of Signs And Markings In Safety:** Types Of Signs – Design Specifications – Guidelines For Installation – Role Of Signs In Safety; Types Of Road Markings – Design Specifications – Role Of Road Markings In Safety.

**Module-5**

**Traffic Management Systems For Safety:** Road Safety Audits And Tools For Safety Management Systems, Road Safety Audit Process, Road Safety Improvement Strategies, ITS And Safety.

**Course outcome (Course Skill Set)**

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

1. Analyse road safety data, identify hazardous locations, and assess safety risks on roadways.
2. Evaluate the effectiveness of road safety interventions and conduct post-implementation analysis.
3. Utilize modelling and simulation techniques to predict and assess the impact of road safety measures.
4. Demonstrate knowledge of traffic control devices, traffic management strategies, and their role

in enhancing road safety.

5. Comprehend the legal and policy framework related to road safety engineering and contribute to policy development.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Traffic Engineering And Transportation Planning – L.R. Kadiyali, Khanna Publishers
2. Fundamentals Of Transportation Engineering - C.S.Papacostas, Prentice Hall India.
3. Transportation Engineering – An Introduction, C.Jotin Khisty, B. Kent Lall
4. Fundamentals Of Traffic Engineering, Richardo G Sigua
5. Handbook Of Road Safety Measures, Second Edition, Rune Elvik, Alena Hoye, Truls Vaa, Michael Sorenson
6. Road Safety By NCHRP

**Web links and Video Lectures (e-Resources):**

- NPTEL and YouTube Videos.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to Traffic Police station and traffic monitoring station

| CONSERVATION OF NATURAL RESOURCES | | Semester | 7 |
|---|---|---|---|
| Course Code | BCV755B | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Learn types of land forms, soil conservation and sustainable land use planning.
- Apprehend water resources, types, distribution, planning and conservation. Water pollution and types of uses.
- Know the types of minerals and rocks.
- Know the atmospheric composition of air, pollution and effects on human beings, animals and plants. Air pollution control.
- Apprehend basics of biodiversity and ecosystems.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Power point Presentation
2. Video tube, NPTEL materials
3. Quiz/Assignments/Open book test to develop skills
4. Adopt problem based learning (PBL) to develop analytical and thinking skills
5. Encourage collaborative learning, site visits related to subject and impart practical knowledge.

**Module-1**

Land: Land as a resource, types of lands, conservation of land forms, deforestation, effect of land use changes. Soil health, ecological and economic importance of soil, impact of soil degradation on agriculture and food security, need for soil conservation, sustainable land use planning.

**Module-2**

Water: Global water resources, Indian water resources, Resources system planning. Water use sectors- domestic, industrial, agriculture. Water deficit and water surplus basins in India, equitable distribution, Inter-basin water transfers, Interlinking of rivers – Himalayan component, peninsular component, issues involved. Ground water, its potential in India, conjunctive use, recharge of ground water. Contamination of ground water, sea water ingress, problems and solutions.

**Module-3**

Air: Introduction, composition, sources and classification of air pollutants, National Ambient Air quality standards (NAAQS), Air quality index, effects of air pollution on human health. Economic effects of air pollution. Control of air pollution by equipment, smoke and its control. Ozone depletion –impacts, photochemical changes.

**Module-4**

Biodiversity: Introduction, Flora and Fauna, Importance of biodiversity, Economic values-medicinal plants, drugs, fisheries biogeochemical cycling. Threat to biodiversity, natural & anthropogenic disturbance, habitat loss. Conservation of biodiversity, National parks, wild life sanctuaries, zoological gardens, gene banks, pollen culture, ecological restoration, social forestry. Ecosystem: Definition, Types: forest, grass land, marine, desert, wetlands, estuarine, lotic, lentic. Abiotic & biotic components of ecosystem.

**Module-5**

Global warming: concept, indicators, factor and effects. Global climate change-indicators, health impacts, effect on biodiversity. Introduction to global efforts in conservation of biodiversity. .EIA regulations in India, status of EIA in India, list of projects needing environmental clearance under EIA notifications. Case study of hydro power/ thermal power projects

**Course outcome (Course Skill Set)**

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

1. Apprehend various components of land as a natural resource and land use planning.
2. Know availability and demand for water resources as applied to India.
3. Analyse the components of air as resource and its pollution.
4. Discuss biodiversity & its role in ecosystem functioning.
5. Critically appreciate the environmental concerns of today.

**Assessment Details (both CIE and SEE)**

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**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

1. P.Jaya Rami Reddy, "A Textbook of Hydrology", University Science Press, New Delhi, 2011.
2. Krishnamurthy K.V., "An advanced textbook of Biodiversity- principle & practices." Oxford and IBH publications Co.Pvt ltd, New Delhi. 2004.
3. Odum, E.P., "Fundamentals of Ecology", W.B sounders, Philadelphia, USA, 1971
4. Singh J.S, Singh S.P & Gupta, S.R., "Ecology, environment and resource conservation", Anamaya publications, 2006

**Web links and Video Lectures (e-Resources):**

- NPTEL video lectures and YouTube videos.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to forest department, KSNDMC, KSRSAC to understand Natural resources data and Management

**VII Semester**

# ENERGY EFFICIENCY, ACOUSTICS AND DAYLIGHTING IN BUILDING

| | | | |
|---|---|---|---|
| Course Code | **BCV755C** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3+0+0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning Objectives:** This course will enable students to;

1. To facilitate learners to understand climatology, heat ingress in building and energy
2. To expose the learners to building acoustics, indoor air quality and day lighting.
3. To impart fundamental knowledge on Life cycle assessment and Energy efficiency in buildings.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk, PPT presentations,
2. You tube videos,
3. visit to nearby sites
4. NDT EQUIPMENTS AWARENESS

**Module-1**

**Introduction to Climatology and heat ingress in building:** Basics of climatology, Earth – Sun relationship, Solar angles and sun path diagram, Design of shading systems. Basics of Thermodynamics, Convection/radiation heat transfer, Heat gain through various elements of a building, Thermal comfort models and case studies.

| | |
|---|---|
| **Teaching-LearningProcess** | Chalk & Talk, PPT presentation, Youtube videos, Nearby site visits |

**Module-2**

**Building acoustics, Indoor air quality and Lighting in buildings:** Basics of sound and Building acoustics – Acoustic defects, prevention of sound transmission and acoustic measure for office building. Indoor Air Quality – Effects, control of contaminants and moisture in indoor environment, Integrated approach for IAQ management. Fundamentals of lighting- Day lighting and its metrics – Strategies for day lighting and its control. Artificial lighting – Design and control strategies – Visual comfort enhancement.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk & Talk, PPT presentation, Youtube videos, Nearby site visits |

**Module-3**

**Energy efficient buildings, Water and Waste management in buildings** :Energy efficiency – Energy efficiency in building envelope and energy efficient HVAC and Lighting as per Energy conservation building code (ECBC) 2017, Energy simulation, Energy management system – Renewable energy and Energy Audit. (demand control ventilation) Water Efficiency – Planning and design of water management system, Rain water harvesting, Water efficient design and fixtures, Treatment and reuse and Water efficient landscape system.

Waste management – Types of waste and its treatment methods, Construction and demolition waste management, Waste management in residential, commercial buildings, healthcare facilities.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk & Talk, PPT presentation, Youtube videos, Nearby site visits |

**Module-4**

**Life Cycle Assessment of Buildings and Green project management:** Materials – Green product certifications, features of sustainable building materials and sustainable alternatives for structural, envelope and finishing materials. Low carbon cement, Zero emission bricks and lean construction practices.

Life cycle assessment and its types – Modelling and Analysis, Greenhouse gas emission.

Different phases of Green building project management.

| | |
|---|---|
| **Teaching-Learning Process** | Chalk & Talk, PPT presentation, Youtube videos, Nearby site visits |

**Module-5**

**Energy Efficient rating** :Energy efficiency rating for distribution transformers, diesel generator set, motors, pumps, electrical appliances, lighting fixtures and lifts as per Bureau of Energy Efficiency (BEE). Energy efficiency in HVAC system – Variable Frequency Drive (VFD), Air volume drive. Roof top solar installations and solar water heaters, Heat recovery system in buildings, Building Management System (BMS) – Occupancy sensors and energy efficient lighting controls,Smart Buildings.

| **Teaching-Learning Process** | Chalk & Talk, PPT presentation, Youtube videos, Nearby site visits |
|---|---|

**Course outcome (Course Skill Set)**

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

1. **Comprehend** climatology, shading system and analyze heattransfer mechanism in buildings.
2. **Assess** the design considerations and parameters for lighting, acoustics and indoor air quality.
3. **Develop** solutions for energy efficiency, water efficiency and waste management in buildings.
4. **Calculate** energy savings and CO2 mitigation using web tools such as **ECONIWAS** and **Solar rooftop calculator**.
5. **Adopt** green project management methodology and evaluate building life cycle assessment.
6. **Understand** energy efficiency measures in a building.

Assessment Details (both CIE and SEE)

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- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books**

1. **HarharaIyer G, Green Building Fundamentals, Notion Press**
2. Dr. Adv. HarshulSavla, Green Building: Principles & Practices

**Reference Books:**

1. The Sustainable Habitat Handbook (6 Volume Set), GRIHA Version 2019
2. National Building Code – 2016, Volume 1&2, Bureau of Indian Standards
3. Energy Conservation Building Code – 2017 (with amendments up to 2020), Bureauof Energy Efficiency.

**Web links and Video Lectures (e-Resources):**

- . Online study material
- NPTEL video lectures.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

-

| Precast Members – Systems & Construction | | Semester | 7 |
|---|---|---|---|
| Course Code | **BCV755D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Impart concepts of precast concrete building design
- Comprehend various aspects like selection and planning of structural system and its components, significance, plant and production methods, transportation and erection sequence of precast elements
- Evaluate actual loads, integrating architectural and services requirements, structural modelling & analysis of a precast building
- Design and detailing of precast multi-storeyed building using software.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.
5. Adopt problem-based learning (PBL) to develop analytical and thinking skills.

**Module-1**

**Introduction to Precast and its elements:** tractors, end users) and Limitations, Residential, Commercial & Industrial Applications of precast, Materials used, Code provisions and clauses. **Major elements** (Beam, slab, wall, column, foundation, staircase, roof elements, façade) : Classification, Types and shapes, selection, application, erection, advantages, Infra works - Pipes & drains, duct bank, baggage handling tunnel, culvert and sleeper, facia element, pavement and channel.

**Module-2**

**Precast Structural Systems, Production, Storage, & Logistics:** Structural System: Skeletal System, Portal Frame system, Large Panel system, Cell Block system and hollow block system, Guide lines of selection – Residential & office buildings, Industrial Buildings, Commercial buildings, Structural Stability and Structural Behaviour.

**Plant and Production:** Introduction -Types & Process, Production – Design and shop drawings, check lists, Moulding, Casting and its types, Concreting, Curing, Demoulding and inspection.

**Storage, Delivery, Handling**- introduction and types of equipment, lifting devices, Erection and installation - Horizontal components, vertical components, special elements, Quality Inspection and Tolerance

**Module-3**

**Modelling, Analysis and design of Wall system:** Design Basis Criteria: Geometric parameters and Occupancy, Location and Associated Parameters, Systems and material specifications, analysis tools, Loads and Load Combinations – gravity loads, lateral loads ( seismic and wind)

**ETABS software**, Modelling, Analysis and Design of structural elements for RC Wall system: Design of RC wall, beam, slab & staircase, Design for stripping, stacking, transportation and

erection for all elements

**Module-4**

**Joints Connections for RC Wall system, Modelling, Analysis, Design of the Frame system:** Joints connections for RC wall system – Wall to foundation, wall to wall horizontal connection, wall to wall vertical connection, beam to wall connection, beam to beam connection, slab to wall – progressive collapse, diaphragm action & slab to beam connection, staircase to beam or wall connection.

Modelling, Analysis and design for Frame system and its connections: ETABS Modelling, Analysis and Design for frame system (foundation, column, beam, slab etc.)

**Module-5**

**Prestressed concrete and Preventive Measures and case studies:** Prestressed Concrete, Various types of slab design and its check, Slab to beam connection Preventive Measures – Testing requirements, water tightness, temporary supports, MEP related preventive measures, progressive collapse – introduction and design, common defects and remedies.

Case Studies - Residential Project, Commercial Project

**Course outcome (Course Skill Set)**

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

1. Comprehend the necessity of precast construction
2. Adopt the appropriate mould and method for casting, transportation, and erection.
3. Compute loads (Dead, Superimposed, Live, Wind, Seismic) of various elements & services and select appropriate vertical & lateral load resisting systems for the various loads acting on the building
4. Create and analyze a precast building model using ETABS software
5. Design of precast building including connections, adhering to the code requirements & functional aspects

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. IS 15916, Building Design and Erection Using Prefabricated Concrete
2. IS 13920, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces
3. Precast Concrete Structures Paperback – 12 June 2019 by Kim S. Elliott
4. Precast Concrete Structures – 2018 by Hubert Bachmann and Alfred Steinle Specifications

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Site visit to understand Precast construction

| Deep Excavation and Tunnels | | Semester | 8 |
|---|---|---|---|
| Course Code | **BCV801A** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Introduce various underground structures such as tunnels, caverns, shafts, and stations
- Explain the construction methodology, support systems and challenges in the construction of Tunnels, caverns, shafts, and stations.
- Explain design aspects in the field on geotechnical/rock engineering and tunnelling, Instrumentation, and monitoring of tunnels
- Impart knowledge on the field challenges to the students through introduction of problem statements in each module and to assess the comprehension of course through case studies as project work

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.

**Module-1**

**Introduction to underground constructions and tunnelling:** General Description of Various Tunnels and other underground structures, Components of a tunnel, Stress around an underground opening, Methods of excavations, Subsurface investigation
Surface investigation, Sampling Techniques, Laboratory and in-situ testing of soil and rock, Indian standard codes

**Module-2**

**Construction, challenges and solutions for Caverns, shaft and underground stations:** Factors affecting the choice of method of tunnel construction, Cut and cover method, Bored method, Drill and blast method, Sequential excavation method and shaft method, Norwegian tunnel boring method (NTM), New Austrian tunnel boring method (NATM), Methods of construction of caverns and shafts and underground stations, Challenges and solutions for execution of these methods, Different types of Tunnel boring machines.

**Module-3**

Design methodology, Instrumentation and monitoring for tunnels: Rock mass classification, Geotechnical and geological inputs for design, Empirical, semi empirical and joint set analysis, Numerical 2D modelling and final support recommendations, Need for Instrumentation and monitoring in tunnels, Types of Instruments - Planning and execution

**Module-4**

**Support systems and design software for tunnels:** Need for pre-excavation support system, Fore piling, Bolts and Anchors, Shotcrete, wire meshes, lattice girders and integrated support systems, Different types of retaining structures and their applicability. Secant piles, Sheet piles, contiguous piles and soldier piles and D wall. Requirement of investigation to be carried out for underground structure, Preparation geotechnical interpretation report for design of retaining structure, Numerical analysis to be performed for temporary / permanent retaining system, Introduction to software to be used in embedded retaining system, Case studies.

**Module-5**

**Indian and International Code provisions:** Introduction to interpretation using Rock data, Introduction to Wallap, Introduction to Plaxis Introduction to RS-2, Introduction to CIRIA 143, Wallap and their application Practical application & case studies

**Course outcome (Course Skill Set)**

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

1. Comprehend the different soil investigation techniques, rock mass classifications, components of different underground structures and their functions.
2. Design and apply different construction methodologies for tunnels, Caverns and shafts in different soil and rock conditions
3. Evaluate the suitability of different excavation supports such as sheet piles, soldier piles, diaphragm walls and tunnel support for different soil and rock conditions
4. Create an instrumentation monitoring plan for tunnel construction
5. Comprehend the use of different software tools in deep excavations and apply code provisions for mitigating water ingress and seepage in excavations and tunnels

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. CIRIA -C760 "Guidance on Embedded retaining wall design"
2. David Chapman, Nicole Metje, Alfred Stark " Introduction to Tunnel Construction "2017 , CRC Press

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Site visit to understand deep excavation and tunnelling process

| Advanced Design of RC Structures | | Semester | VII |
|---|---|---|---|
| Course Code | | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination nature (SEE) | Theory | | |

**Course objectives: The Course will enable students**

- To make students to learn principles of Structural Design,
- To design different types of structures and to detail the structures.
- To evaluate performance of the structures

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Black board teaching/power point presentation
2. Regular review of the students by asking questions based on topics covered in the class

**MODULE-1**

- Design of R C slabs by yield line method.
- Design of RCC overhead circular and rectangular water tanks with supporting towers

**MODULE-2**

- Design of grid or coffered floors.
- Design of flat slabs

**MODULE-3**

- Design of R C Chimneys.
- Design of continuous beams with redistribution of Moments

**MODULE-4**

- Design of R C bunkers
- Design of R C silos

**MODULE-5**

**Formwork:** Introduction, Requirements of good formwork, Materials for forms, choice of formwork, loads on formwork, Permissible stresses for timber, Design of formwork, Shuttering for columns, Shuttering for slabs and beams, Erection of Formwork, Action prior to and during concreting, Striking of forms. Recent developments in form work

**Course outcomes (Course Skill Set):**

On completion of this course, students can:

1. Achieve Knowledge of design and development of problem-solving skills
2. Understand the principles of Structural Design.
3. Design and develop analytical skills.
4. Summarize the principles of Structural Design and detailing
5. Understands the structural performance

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE (maximum marks 50)**

- 50 marks for CIE are split into **30 marks** for three Internal Assessment Tests and 2**0 marks** for other assessment methods mentioned in 22OB4.2.
- The first test at the end of 30-35% coverage of the syllabus, the second test after covering 65-70% of the syllabus and the third test for 95-100% coverage of syllabus
- The student must secure 40% of 50 marks to qualify in the CIE

**SEE (Max 100 Marks scaled downed to 50 Marks)**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students must answer 5 full questions, selecting one full question from each module.

Marks scored by the student shall be proportionally scaled down to 50 Marks

**Suggested Learning Resources:**

**Recommended Reading**:


1. Krishna Raju. N., "Advanced Reinforced Concrete Design", CBS Publishers & Distributors
2. Punmia B.C, Ashok Kumar Jain and Arun Kumar Jain, "Comprehensive RCC Design", Laxmi Publications, New Delhi
3. Pillai S. U. and Menon D., "Reinforced Concrete Design", Tata McGraw-Hill,3rd Ed, 1999
4. Relevant IS Code Books
5. Shah.H.J, "Reinforced Concrete", Vol-1 and Vol-2, Charotar, 8th Edition –2009 and 6th Edition – 2012 respectively. 5. Gambhir.M.L, "Design of Reinforced Concrete Structures", PHI Pvt. Ltd, NewDelhi, 2008


**Web links and Video Lectures (e-Resources):**

https://www.youtube.com/watch?v=undsd92MM8w&list=PLbQO4xhI7wEDIYv90NoF7veaJIohpuf0Q

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Conduction of technical seminars on recent research activities
- Group Discussion

**Semester-VIII**

| PROJECT MANAGEMNET AND FINANACE | | | |
|---|---|---|---|
| Course Code: | | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:3:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course objectives:**

- To understand what are the objectives of project management.
- To outline the principles followed in carrying out a project.
- To demonstrate knowledge and understanding of engineering and management principles.
- To function effectively as an individual, and as a member or leader in diverse teams.
- To understand the concepts of finance and accounts carried out in project management.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Power point Presentation, video
3.Group Discussions

**Module-1**

**Project Implementation, Monitoring and Control**

Project representation: Role of project managers ,relevance with objective of organization, preliminary manipulations ,Basic Scheduling concepts :Resource levelling ,Resource allocation ,Setting a base line, Project management information system: Importance of contracts in projects: Team work in Project Management: Formation of Effective terms

| **Teaching-Learning Process** | Chalk and talk method/Power Point Presentation |
|---|---|

**Module-2**

**Project planning and time management**

Purpose, Project scheduling, activity definition, activity sequencing, activity duration estimating, schedule development, schedule control, project management using CPM\PERT- Network basics, Network development, PERT analysis, advantages. Computerized network analysis- features of PM software, capabilities of PM software, multi project analysis,

| **Teaching-Learning Process** | Chalk and talk method/Power Point Presentation |
|---|---|

**Module-3**

**Project Evaluation, Auditing and Other Related Topics in Project Management**

Project Evaluation: Project auditing: Phase of project audit Project closure reports, computers, e-markets in Project Management:

| **Teaching-Learning Process** | Chalk and talk method/Power Point Presentation |
|---|---|

**Module-4**

Project appraisal: Objectives, essentials of a project methodology – Market appraisal – Technical appraisal – Financial appraisal – Socio – economic appraisal – Management appraisal

| **Teaching-Learning Process** | Chalk and talk method/Power Point Presentation |
|---|---|

**Module-5**

**Finance and Accounting**

Source of finance: Term Loans: Capital Structure: Financial Institution Accounting Principles: Preparation and Interpretation of balance sheets, profit and loss statements , Fixed Assets, Current assets, Depreciation methods

:Break even analysis:

| **Teaching-Learning Process** | Chalk and talk method/Power Point Presentation |
|---|---|

**Course outcome (Course Skill Set)**

1. Ability to study the current market trends and choose projects.
2. Ability to prepare project feasibility reports.
3. Ability to implement the project effectively meeting government norms and conditions.
4. Ability to understand the role and responsibility of the Professional Engineer.
5. Be able to assess social, health, safety issues based on the reasoning received from the contextual knowledge.
6. Ability to choose projects which benefit the society and organization

**Suggested Learning Resources:**

**Text Book and Reference**


1. Project Management Institute A Guide to the Project Management Body of Knowledge PMBOK Guide (Sixth Edition), Sept 2017
2. James C.Van Horne, Fundamentals of Financial Management, Person Education 2004.
3. Kuster J., Huber, E., Lippmann, R., Schmid, A., Schneider, E., Witschi, U., Wust, R. Project Management Handbook,2015
4. Khanna, R.B.,Project Management, PHI 2011.
5. Prasanna Chandra, Financial Management, Tata McGraw-Hill,2008.
6. By Carl S. Warren, James M. Reeve, Jonathan Duchac.Financial and Managerial Accounting,2016
7. PaneerSelvam, R., and Senthilkumar, P., Project Management, PHI, 2011.


**Web links and Video Lectures (e-Resources):**

https://www.youtube.com/watch?v=m4KU7Mo1Iqw
https://www.youtube.com/watch?v=2v1GEBfma5k
https://www.youtube.com/watch?v=DL1S6sdr5tA
https://www.youtube.com/watch?v=1mHaBKAamIU

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Quizzes
- Assignment
- Seminars

| Metros and Seaports Engineering | | Semester | 8 |
|---|---|---|---|
| Course Code | **BCV801D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Elaborate on the salient features and types of Transit oriented development and its significance
- Explain the planning, Analysis, design and execution of elevated and underground Metro viaducts, tunnels including monitoring systems and stations
- Explain the design and Analysis of Earth retaining structures used in Metro systems
- Introduce the future trends and technologies in Transportation systems.
- Introduce the salient features of seaports
- Explain the different permanent and enabling structures in seaports

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills

**Module-1**

Introduction to Mass Rapid Transit System (MRTS) and Planning of Metros: Overview of Metro, Transit Oriented Development, Feasibility Study for MRTS Project, Sustainable and Smart Technologies, Recent Advancements & Future Technologies (High Speed Rail Technology, 'Maglev & Ground Effect Trains etc.). Basic Interfacing Principles – Alignment, Urban level planning, constraints and restrictions, Building Information Modelling in Metros, HVAC Systems, Tunnel Ventilation System, Public Health Engineering, Fire Alarm System etc.

**Module-2**

Design, Construction and Quality Control: Introduction to Contracts, Overview of FIDIC standards, Introduction to Quality Systems, Precasting Yard Development, Types of Precast Super Structure, Precast Mould development, Formwork System Overview, introduction to Precast Erection, Superstructure launching Methods, Obligatory Spans, substructure and foundation Construction Methodology, Challenges in Foundation Construction Alignment / Span configuration of elevated structures, Soil condition and type of foundations, Substructure system, Choosing type of Pier based on alignment profile, Rail / Over Head Equipment mast, Station overall layout, Pier arm - spine wing / cantilever and Platform- precast/cast-in-situ system. Erection methods and case studies Overview of Elevated station, Analysis and Design, Spine beam method, Design of station components, Loads and introduction to IRC/IRS Codes, 'Analysis and Design of superstructure, Substructure and foundation, 'Introduction to Modelling Software - STAAD Pro .

**Module-3**

Earth Retaining systems, Underground Metro Stations, Tunnels and monitoring systems: Underground Stations and its configurations, Shoring Systems, supporting systems, Construction Methodology (Bottom Up method/ Top Down method), Tunnelling methods and monitoring systems, Earth retaining structures, Secant pile wall design, Guide walls, Introduction to Loads, Load combinations, Fire resistant criteria and Floatation check, 2D & 3D model generation, SOD restrictions & Element sizing for UG Stations, Design of all the components of UG station.

**Module-4**

Introduction to Seaports: Introduction and evolution of Ports and Harbors, Terminologies, Over view of Marine Structures, Operation and components of Ports, Site investigation and survey, Approach facilities and navigational aids. Design considerations and functional requirements of typical port structures, Breakwater Structures, Berthing structures, Piers, Wharfs, Jetties, Quays, Dolphins, Fenders, Dredging facilities, Shipyard structures (dry dock and floating dock), Shore protection and Reclamation

**Module-5**

Enabling structures: Cofferdams and Dewatering – Case study, Load Out Jetty (LOJ) – Design of retaining structure, Elevated platform and Hydraulic ramp. Casting Yard Planning and Mould Optimisation. Piling Gantry – Layout, Loading. Rock Works – Breakwater construction, Revetment. Floating Stability/Caisson launching – Casting bed, Ballasting. Modular Construction – Modularisation, Erection.

**Course outcome (Course Skill Set)**

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

1. Create the basic layout of elevated and underground metro stations as per laid down codes and regulations
2. Interpret design recommendations and Codes of Practice for Elevated and Underground Metros and select suitable construction practices
3. Design the earth retaining systems for the excavations of underground stations
4. Comprehend the different permanent and enabling structures of seaports and harbors
5. Design Enabling structures of Ports and Harbors

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**


1. Indian Standard code - IS 456, Guidance on embedded retaining wall design CIRIAC760
2. David Chapman, Nicole Metje, Alfred Stark " Introduction to Tunnel Construction "2017 , CRC Press
3. M. Ramachandran ,"Metro Rail Projects in India- A Study in Project Planning "2011, Oxford University Press
4. Srinivasan, R., Harbour, Dock & Tunnel Engineering, Charotar Publishing House
5. Bindra, S.P., A course in Docks and Harbour Engineering, Dhanpat Rai & Sons
6. Port Design - Guidelines and recommendations by C. A. Thoresen, Tapir Publications


**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Site visits

| Energy Conservation in Buildings | | Semester | 8 |
|---|---|---|---|
| Course Code | **BCV802A** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To facilitate learners to understand climatology, heat ingress in building and energy efficiency.
- To expose the learners to comfort in buildings.
- To impart fundamental knowledge on Life cycle assessment and Energy conservation.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.

**Module-1**

Introduction to Climatology and heat ingress in building: Basics of climatology, Earth – Sun relationship, Solar angles and sun path diagram, Design of shading systems. Basics of Thermodynamics, Convection/radiation heat transfer, Heat gain through various elements of a building, Thermal comfort models and case studies.

**Module-2**

Building acoustics, Indoor air quality and Lighting in buildings: Basics of sound and Building acoustics – Acoustic defects, prevention of sound transmission and acoustic measure for office building. Indoor Air Quality – Effects, control of contaminants and moisture in indoor environment, Integrated approach for IAQ management. Fundamentals of lighting- Daylighting and its metrics – Strategies for daylighting and its control. Artificial lighting – Design and control strategies – Visual comfort enhancement.

**Module-3**

Energy efficient buildings, Water and Waste management in buildings: Energy efficiency – Energy efficiency in building envelope and energy efficient HVAC and Lighting as per Energy conservation building code (ECBC) 2017, Energy simulation, Energy management system – Renewable energy and Energy Audit. (demand control ventilation) Water Efficiency – Planning and design of water management system, Rain water harvesting, Water efficient design and fixtures, Treatment and reuse and Water efficient landscape system.

Waste management – Types of waste and its treatment methods, Construction and demolition waste management, Waste management in residential, commercial buildings, healthcare facilities.

**Module-4**

Life Cycle Assessment of Buildings and Green project management: Materials – Green product certifications, features of sustainable building materials and sustainable alternatives for structural, envelope and finishing materials. Low carbon cement, Zero emission bricks and lean construction practices. Life cycle assessment and its types – Modelling and Analysis, Greenhouse gas emission. Different phases of Green building project management.

**Module-5**

Energy conservation: Energy efficiency rating for distribution transformers, diesel generator set, motors, pumps, electrical appliances, lighting fixtures and lifts as per Bureau of Energy Efficiency (BEE). Energy efficiency in HVAC system – Variable Frequency Drive (VFD), Air volume drive. Roof top solar installations and solar water heaters, Heat recovery system in buildings, Building

Management System (BMS) – Occupancy sensors and energy efficient lighting controls, Smart Buildings

**Course outcome (Course Skill Set)**

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

1. Comprehend climatology, shading system and analyze heat transfer mechanism in buildings.
2. Assess the design considerations and parameters for lighting, acoustics and indoor air quality.
3. Develop solutions for energy efficiency, water efficiency and waste management in buildings.
4. Calculate energy savings and CO2 mitigation using web tools such as ECONIWAS and Solar rooftop calculator.
5. Adopt green project management methodology and evaluate building life cycle assessment.
6. Implement energy conservation measures in buildings.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. HarharaIyer G, Green Building Fundamentals, Notion Press
2. Dr. Adv. HarshulSavla, Green Building: Principles & Practices
3. The Sustainable Habitat Handbook (6 Volume Set), GRIHA Version 2019
4. National Building Code – 2016, Volume 1&2, Bureau of Indian Standards
5. Energy Conservation Building Code – 2017 (with amendments up to 2020), Bureau of Energy Efficiency.

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to green buildings

| Occupational Health and Safety | | Semester | 8 |
|---|---|---|---|
| Course Code | **BCV802B** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | |
| Examination type (SEE) | **Theory** | | |

**Course objectives:**

- Gain an historical, economic, and organizational perspective of occupational safety and health
- Investigate current occupational safety and health problems and solutions.
- Identify the forces that influence occupational safety and health.
- Demonstrate the knowledge and skills needed to identify workplace problems and safe work practice

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
- En**courag**e collaborative (Group Learning) Learning in the class.
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Seminars and Quizzes may be arranged for students in respective subjects to develop skills.

**Module-1**

Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation

**Module-2**

Ergonomics at Work Place: Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis , Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations

**Module-3**

Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers. Electrical Safety, Product Safety: Technical Requirements of Product safety.

**Module-4**

Health Considerations at Work Place: types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability

**Module-5**

Occupational Health and Safety Considerations: Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors

**Course outcome (Course Skill Set)**

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

- Identify hazards in the workplace that pose a danger or threat to their safety or health, or that of others.
- Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
- Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the occupational Health and Safety Regulations as well as supported legislation.
- Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.
- Identify the decisions required to maintain protection of the environment, workplace as well as personal health and safety.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**


1. Goetsch D.L., (1999), "Occupational Safety and Heal th for Technologists, Engineers and Managers", Pren tice Hall.
2. Heinrich H.W., (2007), "Industrial Accident Prevent ion - A Scientific Approach", McGraw-Hill Book Company
3. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "Industrial Safety and Poll ution Control Handbook
4. Colling D.A., (1990), "Industrial Safety Management and Technology", Prentice Hall, New Delhi.
5. Della D.E., and Giustina, (1996), "Safety and Environmental Management", Van Nostrand Reinhold International Thomson Publishing Inc.


**Web links and Video Lectures (e-Resources):**

- https://nptel.ac.in/courses/114106017

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- http://nptel.ac.in

| Green Buildings | | Semester | 8 |
|---|---|---|---|
| Course Code | **BCV802C** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Understand the Definition, Concept & Objectives of the terms cost effective construction and green building
- Apply cost effective techniques in construction
- Apply cost effective Technologies and Methods in Construction
- Understand the Problems due to Global Warming
- State the Concept of Green Building 6. Understand Green Buildings

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching/PowerPoint presentations (if needed)
2. Regular review of students by asking questions based on topics covered in the class.

**Module-1**

Introduction to the concept of cost effective construction -Uses of different types of materials and their availability -Stone and Laterite blocks- Burned Bricks- Concrete Blocks- Stabilized Mud Blocks Lime Poszolana Cement- Gypsum Board- Light Weight Beams- Fiber Reinforced Cement Components Fiber Reinforced Polymer Composite- Bamboo- Availability of different materials- Recycling of building materials – Brick- Concrete- Steel- Plastics - Environmental issues related to quarrying of building materials

**Module-2**

Environment friendly and cost effective Building Technologies - Different substitute for wall construction Flemish Bond - Rat Trap Bond – Arches – Panels - Cavity Wall - Ferro Cement and Ferro Concrete constructions – different pre cast members using these materials - Wall and Roof Panels – Beams – columns - Door and Window frames - Water tanks - Septic Tanks - Alternate roofing systems - Filler Slab - Composite Beam and Panel Roof -Pre-engineered and ready to use building elements - wood products - steel and plastic - Contributions of agencies - Costford - Nirmithi Kendra - Habitat

**Module-3**

Global Warming – Definition - Causes and Effects - Contribution of Buildings towards Global Warming - Carbon Footprint – Global Efforts to reduce carbon Emissions Green Buildings – Definition – Features Necessity – Environmental benefit - Economical benefits - Health and Social benefits - Major Energy efficient areas for buildings – Embodied Energy in Materials Green Materials - Comparison of Initial cost of Green V/s Conventional Building - Life cycle cost of Buildings.

**Module-4**

Green Building rating Systems- BREEAM – LEED - GREEN STAR -GRIHA ( Green Rating for Integrated Habitat Assessment) for new buildings – Purpose - Key highlights - Point System with Differential weight age. Green Design – Definition - Principles of sustainable development in Building Design - Characteristics of Sustainable Buildings – Sustainably managed Materials - Integrated Lifecycle design of Materials and Structures (Concepts only)

**Module-5**

Utility of Solar Energy in Buildings Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

Green Composites for Buildings Concepts of Green Composites. Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage

Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

**Course outcome (Course Skill Set)**

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

1. Understand cost effective building materials
2. Choose environment friendly construction procedure
3. Design eco-friendly buildings to reduce global warming
4. Understand the different green rating of buildings
5. Estimate energy saving in construction

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

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1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Harhara Iyer G, Green Building Fundamentals, Notion Press 2. Dr. Adv. Harshul Savla, Green Building: Principles & Practices

**Web links and Video Lectures (e-Resources):**

- https://www.youtube.com/watch?v=THgQF8zHBW8
- https://www.youtube.com/watch?v=DRO_rIkywxQ.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Students have to visit a building which is green rated and prepare a report

| INTEGRATED BUILDING SERVICES | | Semester | 8 |
|---|---|---|---|
| Course Code | **BCV802D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Understand Electrical System along with substation for a building infrastructure
- Learn ELV System and its interface with other allied services
- Design and implement HVAC System
- Learn and implement Fire Alarm System (PAS)
- Understand and implement importance of Public Health Services

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching
2. Power point Presentation
3. Videos, NPTEL materials
4. Quiz/Assignments/Open book test to develop skills.

**Module-1**

Advanced Electrical System Design for Buildings: Basics of Electrical System, Electrical terminologies, Major Electrical equipment, Building power distribution and its schemes, Fundamentals of Power& distribution transformers, HT, LT, DG Sets, Cables & Wires, UPS and its importance, Introduction of HT, LT switchgears systems, Importance of Lighting design & different Light fixtures used in buildings – Interior, external, street & offices, RMU, HT consumer, Substation Building in Master plan - Space planning for RMU,HT, DG set, HSD yard, Space provision for Electrical Equipment including Substation, Various equipment clearance requirements, HVAC, PHE, FPS service-electrical load input for designing electrical power distribution, Pedestals & ceiling support requirement for all Electrical equipment.

**Module-2**

Extra Low Voltage System for Infrastructure: Introduction & Brief of ELV Systems, Concept of Building Management System (BMS) & Fire Alarm System, Interface with Architecture/ Structure, Access control, CCTV & Public address system - Brief and purpose, BMS - Brief and purpose, BMS interfaces with Electrical, HVAC, Fire & Life Safety and PHE, BMS interfaces with airport systems.

**Module-3**

Heating, Ventilation & Air conditioning systems: Basics of HVAC - Psychrometry and its importance - Major Components of Air conditioning System - Fundamental concepts of Heat transfer, Air-conditioning system, Ventilation system, Pressurization Systems and their importance to Life safety, Chilled water system, Cooling towers and major HVAC equipment, Pumping system in HVAC, Importance of Thermal and Acoustic Insulation, Introduction and basics of Variable Refrigerant Flow (VRF) systems, Radiant cooling, Underfloor distribution, Chilled beams – Space planning - Importance of Static weight / Operating weights of mechanical equipment - Importance of Floor slab and Terrace roof slab openings / cut-outs

**Module-4**

Fire Protection and Life Safety System: Basics of Fire Protection System - Active Fire protection system - Passive Fire protection system - Basics of Smoke Control and Fire Stop Systems - Codes & Standards and Statutory Compliance - Fire and its Classes - Hazard Classification based on building occupancy - Means of Egress and its components - Importance of Life Safety - Refuge Area, Fire Tower and Fire Lift - Occupant Load and Capacity factors - Fire Stopping Materials - Compartmentation in a building - Smoke control & management in Fire Zoning - Components of Fire Compartments.

**Module-5**

Public Health Engineering: Scope of works in Public Health Engineering - Sanitary fixtures and types - Water supply and treatment - Rain water drainage system - Landscape irrigation features – Water demand calculation based on building occupancy – Piping for different plumbing systems in buildings – Pump selection – Plant room sizing - Sewage treatment process - External water supply, storm drainage & sewerage system - Solid waste management - Interfacing PHE system with Architect and Structural engineers.

**Course outcome (Course Skill Set)**

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

1. Understand Electrical System along with substation for a building infrastructure
2. Learn ELV System and its interface with other allied services.
3. Design and implement HVAC Systems
4. Learn and implement Fire Alarm System (PAS)
5. Understand and implement importance of Public Health Services

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3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Building Services Integration, P K Barton, Barry G Fryer, David Highfield, ISBN-13 978-0419120308, SPON Press, 1983

**Web links and Video Lectures (e-Resources):**

- E-learning content on L&T EduTech Platform.

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Site visits