PROBABILITY AND STATISTICS			
Course Code	1BMATCV301	Scheme	2025
Type of Course	Applied Science Course (ASC)	Semester	III
Teaching Hours/Week (L: T: P)	70 (3:2:0)	CIE Marks	50
Total Hours of Pedagogy per semester CI (L /T):LI(P):SL&TW:	120 (42:28:0:50)	SEE Marks	50
Credits	4	Total Marks	100
Examination type (SEE)	Theory	Exam Hours	03

Course outcome (Course Skill Set):

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

CO1: Understand and explain basic statistical concepts, descriptive measures, and data visualization.

CO2: Apply probability rules, random variables, and common probability distributions to engineering problems.

CO3: Use sampling distributions, estimation, and hypothesis testing to draw statistical inferences.

CO4: Interpret statistical results, discuss assumptions and limitations, and relate them to engineering practice.

CO5: Analyze relationships between variables using correlation and regression models.

Module-1

DESCRIPTIVE STATISTICS: Role of statistics in engineering; types of data, scales of measurement, collection and presentation of data. Frequency distribution, histograms, bar diagrams, pie charts, and box plots. Measures of central tendency: mean, median, and mode for grouped and ungrouped data. Measures of dispersion: range, variance, standard deviation, and coefficient of variation. Concept of skewness and kurtosis.

(RBT Levels: LI, L2 and L3) **Number of Hours: 14**

Module-2

PROBABILITY AND RANDOM VARIABLES

Review on sample space, events, axioms of probability, conditional probability, independence of events, total probability theorem, and Bayes theorem.

Random variables, discrete and continuous types, probability mass function, probability density function, cumulative distribution function. Expectation and variance. Joint distributions for two discrete variables.

(RBT Levels: LI, L2 and L3) **Number of Hours: 14**

Module-3

PROBABILITY DISTRIBUTIONS

Discrete distributions: Binomial, Geometric, and Poisson - definitions, mean, and variance.

Continuous distributions: Uniform, exponential, and normal - definitions, mean, and variance and related problems.

(RBT Levels: LI, L2 and L3) **Number of Hours: 14**

Module-4

SAMPLING AND ESTIMATION

Sampling concepts: population, sample, parameter, statistic, random sampling, bias, and standard error. Sampling distributions and central limit theorem. Point estimation and interval estimation. Confidence intervals for mean and proportion.

Hypothesis testing: null and alternative hypotheses, type I and type II errors, one-tailed and two-tailed tests.

Basic tests for mean and proportion for large sample; student's t-distribution, chi-square test for goodness of fit.

(RBT Levels: LI, L2 and L3) **Number of Hours: 14**

Module-5: **CORRELATION, REGRESSION**

Statistics: Principles of least squares, Curve fitting by the method of least squares in the form: $y = a + bx$, $y = a + bx + cx^2$, $y = ax^b$ and $y = ae^{bx}$. Correlation, Coefficient of correlation, Lines of regression, Angle between regression lines, rank correlation. Introduction to multiple regression.

(RBT Levels: LI, L2 and L3) **Number of Hours: 14**

Suggested Learning Resources Textbooks:

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand Publishing.
2. V.K. Rohatgi and A.K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, Wiley.
3. S. Ross, A First Course in Probability, Pearson India.
4. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.

Reference Books:

1. M.R. Spiegel, J. Schiller, and R.A. Srinivasan, Schaum's Outline of Probability and Statistics, McGraw Hill.
2. A.M. Mood, F.A. Graybill, and D.C. Boes, Introduction to the Theory of Statistics, McGraw Hill.
3. S. C. Gupta, Statistical Methods, S. Chand Publishing.
4. R. Ramakrishnan, Statistics for Engineers and Scientists, Tata McGraw Hill.

Web links and e-Resources:

NPTEL (National Programme on Technology Enhanced Learning) - Probability and Statistics courses for Engineers: https://nptel.ac.in/.

SWAYAM learning modules on statistics and data analysis.

Coursera(Empower employability with online learning for universities) Understanding statistics requires building foundational skills in descriptive statistics: https://www.coursera.org/

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching-learning process and facilitate the achievement of course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to learn groups to improve their creative and analytical skills.
6. Show short-related video lectures in the following ways:
    - As an introduction to new topics (pre-lecture activity).
    - As a revision of topics (post-lecture activity).
    - As additional examples (post-lecture activity).
    - As an additional material of challenging topics (pre-and post-lecture activity).
    - As a model solution of some exercises (post-lecture activity).

Assessment Structure:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.

The CIE Theory component consists of average of TWO IA tests for 25 marks and Continuous Comprehensive Assessments (CCA) for 25 marks.

To qualify and become eligible to appear for SEE, in the **CIE**, a student must score at least **40% of 50 marks**, i.e., **20 marks**.

To pass the **SEE**, a student must score at least **35% of 50 marks**, i.e., **18 marks**.

Notwithstanding the above, a student is considered to have **passed the course,** provided the combined total of **CIE and SEE is at least 40 out of 100 marks**.

Continuous Comprehensive Assessments (CCA):

CCA will be conducted with a total of 25 marks. It is recommended to include a maximum of two learning activities aimed at enhancing the holistic development of students. These activities should align with course objectives and promote higher-order thinking and application-based learning.

Learning Activity-1: Tutorial: Practicing problems (Two objective type assessments for 7.5 marks each (Total 15 marks).

Lab activity: Execute the following lab exercises with the aid of any modern technological tool (Matlab/ Mathematica/ Scilab/ Python/ Maxima, etc).

Seminars: The students have to present applications of mathematics related to syllabus as a group maximum of four members.

Case study: Analyze engineering data using descriptive statistics by collecting a relevant dataset, performing descriptive statistical analysis, fitting probability distributions, evaluating a reliability-based problem, preparing a brief report with probability plots, return-period and risk analysis, and developing a digital workbook (Excel/R/Python/MATLAB) implementing descriptive statistics, distribution fitting, regression, confidence intervals, and basic reliability metrics.

Students' activities for TW/SL under NCrF: Samples only

As per National credit formwork (NCrF) students must spend 120 hours of study for 4 credit courses, which include Course instructions (CI-70 hour) and Teamwork/ Self learning (TW/Sl-50 hours). Hence, students must complete minimum of two activities as part of NCrF. These learning activities shall be considered as CCA components of CIE. The evaluation activities will be done using set of rubrics developed for each activity. The following sample activities are listed below. The course coordinator can also give their own TW/SL activities as per the course outcomes.

Term Work (TW) and Self Learning (SL) components in Number of Hours per semester

Term work (includes seminars, micro projects, industrial visits, any other student activities etc.)

Sl. No.	Term Work (TW) Activity	Number of Hours / Semester
1.	**Analysis of engineering data using descriptive statistics.**: Collect or obtain a dataset of specific programme and perform descriptive statistics, fit distributions, and pose at least one reliability-style question with a short report.	25
2.	**Mini Project**: Prepare concise case studies on extreme events or demand patterns (e.g., flood peaks, daily traffic), using probability plots, return-period calculations and risk statements with a short seminar.	25
3.	**Programming & Tools Workbook:** Develop a digital workbook in Excel/R-programming/Python/MATLAB implementing core course computations: descriptive stats, distribution fitting, regression, confidence intervals and simple reliability metrics.	25

Rubrics for Learning Activity (Based on the nature of learning activity, design the rubrics for each activity):

1. Sample Rubrics - Mini-Project

Criterion	Exemplary (3)	Proficient (2)	Basic (1)	Weight
Problem definition & data	Clear, relevant civil-engineering questions; data source and limitations documented.	Mostly clear; minor gaps in context or data description.	Vague questions or poorly documented data.	10%
Data processing & descriptive statistics	Correct cleaning, visualization, and computation of key measures; patterns clearly highlighted.	Mostly correct; minor computational errors.	Significant errors, missing key measures or plots.	25%
Probabilistic modeling (distributions, inference)	Appropriate distributions and tests used; assumptions stated; results interpreted in context.	Reasonable choice of models; some assumptions implicit; interpretation mostly sound.	Inappropriate or poorly justified models; limited interpretation.	30%
Civil engineering insight / risk framing	Clear link to design/assessment decisions, safety and uncertainty; limitations discussed.	Some discussion of implications; limited treatment of limitations.	Minimal civil engineering interpretation on beyond numbers.	20%
Report & communication	Well-structured report, clear figures/tables, reproducible calculations; effective	Acceptable structure; some clarity issues; presentation adequate.	Disorganized or incomplete report; weak presentation.	15%

FLUID MECHANICS AND HYDRAULIC MACHINERY			
Course Code	**1BCV302**	Scheme	2025
Type of course	Integrated Professional Core Courses (IPCC)	Semester	III
Teaching Hours/Week (L:T:P)	70 (3:0:2)	CIE Marks	50
Total Hours of Pedagogy per Semester CI (L /T): LI(P):TW&SL	120 (42:0:28:50)	SEE Marks	50
Credits	4	Total Marks	100
Type of Examination (IPCC):	Theory- CIE +SEE, and Lab- CIE only.	Exam Hours	03

Course outcome (Course Skill Set):

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

1. CO1 (L2): Explain fluid properties, hydrostatic laws, and pressure measurement techniques.
2. CO2 (L3): Apply kinematics and dynamics principles to analyze fluid flow patterns and energy equations.
3. CO3 (L3): Compute discharges in pipes, notches, weirs, and design pipe networks with losses.
4. CO4 (L4): Design open channels for uniform/non-uniform flows and analyze hydraulic jumps.
5. CO5 (L4): Analyze performance of hydraulic turbines and pumps for hydropower applications.
6. CO6 (L5): Evaluate sustainable hydraulic systems integrating Industry 5.0 digital twins and flood modelling.

Module-1

Fluid Properties & Hydrostatics:

Introduction to fluids, density, specific weight, viscosity (Newton's law), surface tension, capillarity, vapor pressure, compressibility. Hydrostatic law, Pascal's law, pressure measurement (manometers, piezometers, digital gauges). Total pressure and center of pressure on plane/curved surfaces. Buoyancy, metacenter, stability of floating bodies, metacentric height.

CO linkage: CO1. **Number of Hours (CI): 10 hours**:

Module-2

Fluid Kinematics & Dynamics:

Types of flow (steady/unsteady, uniform, laminar/turbulent, rotational/irrotational). Streamlines, pathlines, continuity equation (Cartesian coordinates). Velocity potential, stream function, flow nets. Euler's equation, Bernoulli's theorem (applications: venturimeter, orifice meter, pitot tube). Momentum equation

CO linkage: CO2. **Number of Hours (CI): 8 hours**

Module-3

Flow Measurement & Pipe Flow:

Flow through orifices, mouthpieces, notches (rectangular/trapezoidal), weirs. Flow in pipes: Darcy-Weisbach equation, friction factor (Moody chart), minor losses, pipes in series/parallel, Impact of jet on vanes, water hammer.

CO linkage: CO3. **Number of Hours (CI): 8 hours**

Module-4

Open Channel Flow

Geometrical properties, velocity distribution. Uniform flow: Chezy/Manning equations, most economical sections (rectangular/trapezoidal). Specific energy, critical flow. Non-uniform flow: gradually varied flow (GVF) equations, hydraulic jump.

CO linkage: CO4. **Number of Hours (CI): 8 hours**

Module-5

Hydraulic Turbines & Pumps:

Turbines: Classification, Pelton/Francis/Kaplan (components, velocity triangles, efficiencies). Pumps: Centrifugal/reciprocating (working, characteristics, NPSH, cavitation). Performance curves, selection for civil applications (dams, irrigation).

CO linkage: CO5, CO6. **Number of Hours (CI): 8 hours**

PRACTICAL COMPONENTS OF IPCC
SET OF EXPERIMENTS

Students shall perform practical exercises related to:

1. Verification of Bernoulli's theorem (CO1, CO2)
2. Experimental determination of force exerted by a jet on flat and curved plates (Hemispherical Vane) (CO2)
3. Calibration of venturimeter/orifice meter (CO1, CO3)
4. Determination of friction factor in pipes (CO2, CO3)
5. Calibration of V-notch and rectangular notch (CO3, CO4)
6. Calibration of Ogee weir, Broad-crested weir, and venturiflume (CO3, CO4)
7. Performance testing of Pelton turbine (CO5, CO6)
8. Efficiency of centrifugal pump (CO5, CO6)

Suggested Learning Resources: (Textbook/ Reference Book/ Manuals): Textbooks:

1. Modi & Seth, *Fluid Mechanics*, Standard Book House.
2. Rajput, R. K. – *Fluid Mechanics and Hydraulic Machines*, S. Chand.
3. Bansal, R. K. – *A Textbook of Fluid Mechanics and Hydraulic Machines*, Laxmi Publications.
4. Subramanya, K. – *Flow in Open Channels*, McGraw-Hill

Reference books / Manuals:

1. White, F. M. – *Fluid Mechanics*, McGraw-Hill.
2. Cengel, Y. A. & Cimbala, J. M. – *Fluid Mechanics: Fundamentals and Applications*, McGraw-Hill.
3. Subramanya, K. – *Hydraulic Machines*, McGraw-Hill.

Web links and Video Lectures (e-Resources):

1. NPTEL: Fluid Mechanics for Civil Engineers (https://nptel.ac.in).
2. SWAYAM: Hydraulic Machines.
3. Autodesk/HEC-RAS tutorials for hydraulic modeling.

Teaching-Learning Process (Innovative Delivery Methods):

Suggested Innovative Delivery Methods may include (but are not limited to):

- Flipped Classroom
- Problem-Based Learning (PBL)
- Case-Based Teaching
- Simulation and Virtual Labs
- Partial Delivery of course by Industry expert/ industrial visits
- ICT-Enabled Teaching
- Role Play

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching-learning process and facilitate the achievement of course outcomes.

1. Concept-oriented lectures with frequent physical interpretations and small in-class demonstrations.
2. Problem-solving sessions focused on civil-engineering-type examples (pipes, channels, water-supply and drainage).
3. Flipped-classroom segments for selected topics (e.g., Bernoulli applications, pipe systems, hydraulic jump) using pre-class videos and in-class collaborative problem solving.
4. Mini-projects and open-ended lab tasks that integrate SDG-6, SDG-11, SDG-13, Industry 5.0 (digital tools) and NEP 2020 emphasis on experiential, multidisciplinary learning.

Assessment Structure:

The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying **50% weightage** (i.e., 50 marks each).

The CIE Theory component will be **25 marks** and CIE Practical component will be **25 marks**.

The CIE Theory component consists of IA tests for 25 marks. The CIE Practical component for continuous assessments will be for 15 marks through rubrics and for lab tests will be for 10 marks.

- To qualify and become eligible to appear for SEE, in the **CIE theory component**, a student must score at least **40% of 25 marks**, i.e., **10 marks**.
- To qualify and become eligible to appear for SEE, in the **CIE Practical component**, a student must secure **a minimum of 40% of 25 marks**, i.e., **10 marks**.
- To pass the **SEE**, a student must secure **a minimum of 35% of 50 marks**, i.e., **18 marks**.
- A student is deemed to have **successfully completed the course** if the **combined total of CIE and SEE is at least 40 out of 100 marks**.

CIE Practical component:

The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report using a defined set of rubrics. Each experiment report can be evaluated for 30 marks. The summation of all the experiments marks to be scaled down to 15 marks.

The laboratory test (duration 03 hours) at the end of the last week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 10 marks. For laboratory test, the student is required to conduct one experiment.

Students' activities for TW/SL under NCrF: Samples only: As per National credit farmwork (NCrF) students must spend 120 hours of study for 4 credit courses, which include Course instructions (CI-70 hour) and Teamwork/ Selfe learning (TW/Sl-50 hours). Hence, students must complete minimum of two learning actives as part of NCrF.. The evaluation activities will be done using set of rubrics developed for each activity. The following sample activities are listed below.

Term Work (TW) and Self Learning (SL) components in Number of Hours per semester

Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

Sl. No.	Term Work (TW) Activity	Number of Hours / Semester
1.	**Activity 1 (CO2, CO3, CO6):** Mini-project on campus water-distribution/drainage line – data collection, simple hydraulic analysis, and sustainability recommendations (SDG-6, SDG-11, SDG-13).	25
2.	**Activity 2 (CO3, CO4):** Open-book assignment on pipe and open-channel problems using spreadsheets, including comparison of options for energy loss minimisation.	25
3.	**Activity 3 (CO5, CO6):** Short group task on pump/turbine selection for a given water supply or micro hydro context, considering technical and sustainability criteria (Industry 5.0 perspective).	25

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

Sl. No.	Self-Learning (SL) Activity	Number of Hours / Semester
1.	**MOOC +GATE/Open- Book Track.:** Complete selected FM MOOC modules and GATE-style tests, plus at least one integrated open-book exam on conceptual/design problems.	25

2.	**Case Study & Literature Portfolio**: Prepare 3–4 case briefs on real FM systems/events plus short reviews of 3–5 papers/standards (e.g., drainage, floods, water supply).	25

Rubric for Students learning activities - Mini-Project - (sample)

Criterion	**Exemplary (3)**	**Proficient (2)**	**Basic (1)**
Problem definition & scope	Clear objective, realistic hydraulic system, complete data and assumptions documented.	Objective mostly clear; minor gaps in data/assumptions.	Vague problem; key data/assumptions missing or inconsistent.
Fluid mechanics calculations	Correct, consistent application of FM principles with clear steps and units.	Mostly correct with a few non-critical errors; reasoning generally sound.	Frequent conceptual/arithmetical errors; reasoning unclear.
Design decisions & justification	Pipe/channel sizes, components, and operating conditions well-justified using results.	Most design choices linked to results; some justification qualitative or brief.	Design choices arbitrary or unsupported by analysis.
Use of diagrams/tools	Neat schematics and, where used, digital tools (Excel/MATLAB/EPANET) applied appropriately.	Diagrams or tools used but with minor omissions or limited integration.	Poor or missing diagrams; tools misused or not used when expected.
Documentation & reflection	Well-structured report with clear tables/figures and focused reflection on learning and limits.	Report understandable but uneven; reflection brief or descriptive.	Disorganized report; little or no reflection on learning.

Suggested rubrics for Practical continuous assessment:

Performance Indicators	**Excellent**	**Very Good**	**Good**	**Satisfactory**
Fundamental Knowledge (4) (PO1)	The student has well depth knowledge of the topics related to the course (4)	Student has good knowledge of some of the topics related to course (3)	Student is capable of narrating the answer but not capable to show in depth knowledge (2)	Student has not understood the concepts clear (1)
Design Of Experiment (5) (PO2 & PO3)	Student is capable of discussing more than one design for his/her problem statement and capable of proving the best suitable design with proper reason (5)	Student is capable of discussing few designs for his/her problem statement but not capable of selecting best (4)	Student is capable of discussing single design with its merits and de-merits (3)	Student is capable of explaining t design (1-2)

Implementation (8) (PO3 & PO8)	Student is capable of implementing the design with best suitable algorithm considering optimal solution. (7-8)	Student is capable of implementing the design with best suitable algorithm and should be capable of explaining it (5-6)	Student is capable of implementing the design with proper explanation. (3-4)	Student is cap of implement the design. (1
Result &Analysis (5) (PO4)	Student is able to run the program on various cases and compare the result with proper analysis. (5)	Student will be able to run the program for all the cases. (4)	Student will be able to run the code for few cases and analyze the output (3)	Student will able to run the program but able to analyze the output (1-
Demonstration (8) (PO9)	The lab record is well-organized, with clear sections (e.g., Introduction, Method, Results, Conclusion). Transitions between sections are smooth. (7-8)	The lab record is organized, with clear sections, but some sections are not well-defined. (5-6)	The lab record lacks clear organization or structure. Some sections are unclear or incomplete. (3-4)	The lab record poorly organize with missing unclear section (1-2)

Continuous Internal Evaluation (CIE) :

A. Theory component

The CIE marks of 25 shall be earmarked for two tests.

The first test shall be conducted after completing two modules of the syllabus and the second one after completing the rest three modules.

Each test shall be conducted for 25 marks. The average of the two tests scaled down to 25 marks shall constitute the test marks for a maximum of 25 marks.

B. **Laboratory component**

i. Out of 25 marks, 15 marks shall be assigned for assessment as per the rubrics listed in the course syllabus. The remaining 10 marks shall be based on the practical test conducted by two Internal examiners appointed by the HoD. The allotment of marks shall be as perthe rubrics defined for regular class work and practical test as indicated in the Table – ICs/IPCCs 1.

ii. To qualify and become eligible to appear for the SEE of the IC/IPCC, a student shall secure at least 40 % of 25 marks, i.e., 10 marks, in the CIE theory component, and at least 40 % of 25 marks, i.e., 10 marks in the CIE Practical component.

C. Passing requirement in SEE

i. For a pass in the Semester End Examination (SEE), a student shall secure a minimum of 35 marks out of

ii. 100. For the declaration of a pass grade, the sum of the Continuous Internal Evaluation (CIE) marks (out of 50) marks and the SEE marks scaled down to 50 shall be greater than or equal to 40 marks.

iii. If the total (CIE + SEE) is less than 40 marks, the student shall be awarded the grade 'F' (Fail).

Table – ICs/IPCCs 1 Distribution of marks		
Component	**Description**	**Marks**
Allotment of marks for regular class work		
Ability in Conducting Experiments	Initiative, skill, safety practices, teamwork, and independent handling of equipment during regular lab sessions.	5 marks
Laboratory Record / Journal	Regular and neat maintenance of lab record, accuracy of results, and timely submission.	10 marks
	Subtotal	**15**
Allotment of marks for CIE practical test		
Laboratory Test / Experiment Performance	Ability to set up apparatus, follow procedure, take observations, and obtain correct results in the test experiment.	5 marks
Viva-Voce	Understanding of theory, concepts, and experimental procedure; ability to explain results and answer related questions.	5 marks
	Subtotal	**10**
	Total	**25**

SOLID MECHANICS			
Course Code	1BCV303	Scheme	**2025**
Type of Course	Professional Core Course (PCC)	Semester	III
Teaching Hours/Week (L:T:P)	70 (42:28:0:50)	CIE Marks	50
Total Hours of Pedagogy per Semester CI (L /T): LI(P):TW&SL	120(42:28:0:50)	SEE Marks	50
Credits	**4**	Total Marks	100
Examination type (SEE)	**Theory**	Exam Hours	03

Course outcome (Course Skill Set)

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

1. CO1 (L2 – Understand): Explain fundamental concepts of stress, strain, elastic constants and factor of safety for common civil engineering materials.
2. CO2 (L3 – Apply): Apply equilibrium and deformation relations to determine stresses and elongations in axially loaded members and circular shafts under torsion.
3. CO3 (L3 – Apply): Construct shear force and bending moment diagrams for statically determinate beams and determine bending and shear stresses for standard cross sections.
4. CO4 (L4 – Analyze): Analyse two-dimensional stress states, determine principal stresses and maximum shear using transformation equations and Mohr's circle, and interpret their significance.
5. CO5 (L3 – Apply): Apply column buckling concepts to estimate critical loads and assess the stability of compression members under idealised end conditions.
6. CO6 (L4 – Analyze/Evaluate): Use strain energy and combined loading ideas to check safety and serviceability of simple civil engineering components and comment on the effect of modelling assumptions.

Module-1

Introduction, stress–strain and axial members:

- Concepts of rigid and deformable bodies; elastic and plastic behaviour; normal and shear stresses; normal and shear strains.
- Stress–strain curves for ductile and brittle materials (qualitative); proportional limit, yield point, ultimate and failure.
- Hooke's law for uniaxial stress; elastic constants: E, G, K, ν and their relationships (isotropic, homogeneous material).
- Axially loaded members: bars of uniform and varying cross-section; stepped bars; temperature stresses (simple cases with/without constraints).
- Factor of safety and working stress concept (introductory).

Linked COs: CO1, CO2 **Number of Hours: 14**

Module-2

Shear force, bending moment and stresses in beams:

- Types of loads and supports; concept of shear force (SF) and bending moment (BM).
- SF and BM diagrams for statically determinate beams: simply supported, cantilever and overhanging beams with point loads, UDL/UVL and simple combinations. Relationship between load, SF and BM diagrams.
- Flexural (bending) stresses: assumptions of simple bending theory; flexure formula $\sigma = \frac{My}{I}$ (statement and use); section modulus; bending stresses in rectangular, circular and I-sections (no built-up complex cases).
- Shear stresses in beams: shear formula $\tau = \frac{VQ}{Ib}$ (statement and use); shear stress distribution in rectangular and I-sections (qualitative curves + numericals).

Linked COs: CO2, CO3 **Number of Hours:14**

Module-3

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Torsion and combined stresses:

- Torsion of circular shafts: assumptions; torsion formula $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$ (statement and application); solid and hollow shafts, strength and stiffness comparisons.
- Power transmitted by shafts; design-style numericals (within course level).
- Combined axial and bending stresses in members (qualitative introduction + simple numericals).
- Introduction to thin cylindrical shells under internal pressure: hoop and longitudinal stresses (formulae and simple problems).

Linked COs: CO2, CO3, CO6 **Number of Hours:14**

Module-4

Two-dimensional stress analysis and Mohr's circle:

- Plane stress at a point: normal and shear stresses on inclined planes; transformation equations (no full derivation needed at length).
- Principal planes and principal stresses; maximum shear stress; orientation of principal planes.
- Construction and use of Mohr's circle for plane stress – determination of principal stresses and maximum shear; interpretation in terms of material failure.
- Plane strain (basic idea); brief mention of 3D generalisation (qualitative).

Linked COs: CO1, CO4, CO6 **Number of Hours: 14**

Module-5

Columns, buckling and strain energy:

- Columns and struts: classifications; slenderness ratio; Euler's buckling theory for ideal columns (pinned–pinned, fixed–free, fixed–pinned, fixed–fixed).
- Critical load, effective length and factor of safety in compression members; limitations of Euler theory.
- Introduction to empirical/Rankine or IS-based formula (statement and awareness).
- Strain energy: concept of energy stored in axially loaded members and in members under bending and torsion (formulae and simple numericals).
- Qualitative use of strain-energy methods for deflection and impact (no lengthy derivations); link to stiffness and serviceability checks.

Linked COs: CO5, CO6 **Number of Hours:14**

Suggested Learning Resources

Text books:

1. Beer, F. P., Johnston, E. R., DeWolf, J. T., & Mazurek, D. F. *Mechanics of Materials*. McGraw-Hill Education. Latest edition.
2. Hibbeler, R. C. *Mechanics of Materials*. Pearson. Latest edition.
3. Punmia, B. C., Jain, A. K., & Jain, A. K. *Strength of Materials*. Laxmi Publications.

Reference books / Manuals:

1. Ramamrutham, S. *Strength of Materials*. Dhanpat Rai Publishing.
2. Gere, J. M., & Goodno, B. J. *Mechanics of Materials*. Cengage.
1. Timoshenko, S., & Young, D. H. *Elements of Strength of Materials*.

Web links and Video Lectures (e-Resources):

1. NPTEL (IITs): "Strength of Materials", "Mechanics of Materials", "Solid Mechanics" – full lecture series, worked examples and assignments aligned to Indian civil curricula.
2. MIT OCW / other MOOCs: Open course materials on "Solid Mechanics" and "Mechanics of Materials" for additional concept explanation and problem practice.

Teaching-Learning Process (Innovative Delivery Methods):
Suggested Innovative Delivery Methods may include (but are not limited to) in addition to chalk and talk .

- Flipped Classroom
- Problem-Based Learning (PBL)
- Case-Based Teaching
- Simulation and Virtual Labs
- Partial Delivery of course by Industry expert/ industrial visits
- ICT-Enabled Teaching
- Role Play

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching-learning process and facilitate the achievement of course outcomes.

1. Concept-driven lectures using visualisation of stress states, real civil-engineering examples (beams, columns, slabs) and frequent micro-questions.
2. Regular tutorial/problem-solving sessions focusing on typical exam and design-style numericals.
3. Short case snippets (e.g., beam cracking, column buckling) to connect theory with practice and safety.
4. Encouraging use of spreadsheets/graphing tools to explore parameter sensitivity (Industry 5.0 orientation and NEP 2020 self-learning spirit).

Assessment Structure:
The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.

- To qualify and become eligible to appear for SEE, in the **CIE**, a student must score at least **40% of 50 marks**, i.e., **20 marks**.
- To pass the **SEE**, a student must score at least **35% of 50 marks**, i.e., **18 marks**.
- Notwithstanding the above, a student is considered to have **passed the course,** provided the combined total of **CIE and SEE** is at least **40 out of 100 marks**.

Continuous Comprehensive Assessments (CCA)+ Internal Assessment Test (IA) = Continuous Internal Evaluation CIE [25+25=50 marks]. A minimum of two Internal Assessment Tests (IA) shall be conducted, carrying a total of 25 marks. In addition, Continuous Comprehensive Assessment (CCA) shall be conducted for a total of 25 marks. It is recommended to include a maximum of two learning activities as part of the CCA to foster the holistic development of students. These activities shall be:

- Course Project
- Case Study Presentation
- Programming Assignment
- Tool/Software Exploration
- Literature Review
- Open Book Test (preferably at RBL4 and RBL5 levels)
- GATE-based Aptitude Test
- Assignment (at RBL3, RBL4, or RBL5 levels)
- Any other relevant and innovative academic activity

Students' activities for TW/SL under NCrF: Samples only		
As per National credit farmwork (NCrF) students must spend 120 hours of study for 4 credit courses, which include Course instructions (CI-52 hour) and Teamwork/ Selfe learning (TW/Sl-64 hours). Hence, students must complete minimum of two learning actives as part of NCrF. These learning activities shall be considered as CCA components of CIE. The evaluation activities will be done using set of rubrics developed for each activity. The following sample activities are listed below.		
Term Work (TW) and Self Learning (SL) components in Number of Hours per semester		
Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)		
Sl. No.	Term Work (TW) Activity	Number of Hours / Semester
1.	Activity A – Beam SF–BM and stress study (CO2, CO3, CO6): Students model a simple beam (e.g., corridor beam) with assumed loads, construct SF–BM diagrams and estimate max bending and shear stresses, short reflection on safety and serviceability.	25
2.	Activity B – Column buckling mini-case (CO5, CO6): Group exercise: given dimensions/material of a column, estimate Euler load for various end conditions and discuss practical limitations and safety margins.	25
3.	Activity C – Mohr's circle concept card (CO4): Students prepare a one-page "Mohr's circle card" with step-by-step procedure and one worked example, share and critique peers' versions.	25
SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.		
Sl. No.	Self-Learning (SL) Activity	Number of Hours / Semester
1.	NPTEL (IITs): "Strength of Materials", "Mechanics of Materials", "Solid Mechanics" – full lecture series, worked examples and assignments aligned to Indian civil curricula..	25
2.	MIT OCW / other MOOCs: Open course materials on "Solid Mechanics" and "Mechanics of Materials" for additional concept explanation and problem practice	25

Rubrics for Learning Activity (TW) (example – Activity A: Beam SF–BM and stress study)

Criteria	4 – Excellent	3 – Good	2 – Fair	1 – Needs Improvement
Problem understanding (CO2)	Beam, loads and boundary conditions clearly and correctly defined.	Mostly correct; minor omissions.	Basic attempt; some incorrect assumptions.	Beam/problem not clearly defined.
SF–BM diagrams (CO3)	Correct, neat diagrams with key values and shapes accurate.	Largely correct; minor errors in values/shape.	Partially correct; several mistakes.	Incorrect or missing diagrams.
Stress calculation & interpretation (CO3, CO6)	Correct stresses; clear comment on safety/serviceability.	Mostly correct; limited commentary.	Some correct calculations; interpretation weak.	Wrong calculations; no meaningful interpretation.
Presentation & clarity (CO6)	Well-organised, neat, easy to follow.	Generally clear; some issues in layout.	Understandable but untidy.	Very unclear or incomplete.

Continuous Internal Evaluation (CIE):

(i) The CIE marks shall be decided based on internal tests and other outcome-based activities. The continuous internal evaluation shall be carried out by the teacher handling the course.
(ii) Out of 50 marks earmarked for CIE, 25 marks shall be assigned for internal tests. The first test shall be conducted after completing two modules of the syllabus and the second one after completing the remaining three modules.
(iii) The remaining 25 marks shall be assigned for Continuous Course Assessment (CCA), conducted as per the rubrics listed in the assessment section of the respective syllabus.
(iv) A student shall obtain a minimum of 40% marks or 20 out of 50 marks allotted to CIE to become eligible to appear for the SEE.

Passing requirement in SEE:

i. For a pass in the Semester End Examination (SEE), a student shall secure a minimum of 35 marks out of 100.
ii. For the declaration of a pass grade, the sum of the Continuous Internal Evaluation (CIE) marks (out of 50) marks and the SEE marks scaled down to 50 shall be greater than or equal to 40 marks.
iii. If the total (CIE + SEE) is less than 40 marks, the student shall be awarded the grade ‘F’ (Fail).

BUILDING MATERIALS AND CONSTRUCTION METHODS			
Course Code	**1BCV304**	Scheme	**2025**
Type of Course	Professional Core Course (PCC)	Semester	III
Teaching Hours/Week (L:T:P)	42 (3:0:0)	CIE Marks	50
Total Hours of Pedagogy per Semester CI (L /T): LI(P):TW&SL	90(42:0:0:48)	SEE Marks	50
Credits	**3**	Total Marks	100
Examination type (SEE)	**Theory**	Exam Hours	03

Course outcome (Course Skill Set)

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

1. CO1 (L2 – Understand): Explain the properties, classification, specifications, and uses of common building materials used in civil engineering works.
2. CO2 (L3 – Apply): Select suitable building materials for specific construction applications based on performance, durability, economy, and sustainability.
3. CO3 (L3 – Apply): Describe and interpret standard construction practices for foundations, masonry, walls, floors, roofs, doors, windows, plastering, and finishing works.
4. CO4 (L4 – Analyze): Analyse construction details and identify appropriate methods, tools, and precautions for safe and durable execution of building components.
5. CO5 (L3 – Apply): Apply principles of quality control, construction sequencing, and safety measures in building construction activities.
6. CO6 (L4 – Analyze/Evaluate): Evaluate building material choices and construction practices with respect to sustainability, economy, maintainability, and serviceability.

Module-1

Introduction to building materials and their properties:

- Introduction to building materials; classification as natural, manufactured, conventional, and modern materials.
- Physical, mechanical, thermal, chemical, and durability properties of building materials.
- Requirements of a good building material: strength, durability, workability, fire resistance, weather resistance, availability, and economy.
- Overview of material selection criteria for civil engineering applications.
- Basic concepts of sustainability in construction materials and embodied energy.

Linked COs: CO1, CO2 **Number of Hours: 8**

Module-2

Stones, bricks, blocks, cement, lime, mortar and Concrete:

- Stones: types, properties, quarrying, dressing, uses, and defects.
- Bricks: manufacturing process, classification, tests, properties, and uses.
- Concrete blocks, hollow blocks, fly ash bricks, and compressed stabilized earth blocks.
- Cement: ingredients, manufacturing process, types, properties, storage, and tests.
- Lime: types, properties, and uses.
- Mortar: ingredients, proportions, types, properties, and applications.

Linked COs: CO1, CO2, CO5 **Number of Hours: 9**

Module-3

Timber, metals, glass, paints, and protective materials:

- Timber: classification, defects, seasoning, preservation, plywood, veneers, particle boards, and fibre boards.
- Metals used in building construction: steel, aluminium, and their common applications.
- Glass: types, properties, and uses in buildings.
- Paints, varnishes, distempers, and polishes: types, ingredients, application, and defects.
- Corrosion protection, waterproofing materials, and damp-proofing materials.

Linked COs: CO1, CO2, CO6 **Number of Hours:** 9

Module-4

Building components and construction practices:

- Foundations: types, functions, and general construction principles.
- Masonry construction: stone masonry and brick masonry, types, bond patterns, and defects.
- Walls and partitions: load-bearing walls, partition walls, cavity walls, and retaining walls.
- Floors and roofs: ground floors, upper floors, flat roofs, sloping roofs, and basic roof coverings.
- Doors, windows, lintels, sunshades, staircases, parapets, and coping.
- Basic construction details for slabs, beams, and column interfaces in buildings.

Linked COs: CO3, CO4, CO5 **Number of Hours: 8**

Module-5

Construction methods, finishing, quality control, and sustainability:

- Plastering, pointing, cladding, flooring, and finishing works.
- Scaffolding, centering, shoring, and formwork: purpose and general types.
- Construction tools and equipment used in building works.
- Quality control in construction: workmanship, inspection, defects, and remedial measures.
- Basic construction safety practices and housekeeping at site.
- Green building concepts, sustainable construction practices, reuse, recycling, and life-cycle thinking.

Linked COs: CO4, CO5, CO6 **Number of Hours: 8**

Suggested Learning Resources

Text books:

1. S. C. Rangwala, Engineering Materials. Charotar Publishing House. Latest edition.
2. P. C. Varghese, Building Materials. Prentice Hall India / PHI Learning. Latest edition.
3. B. C. Punmia, Building Construction. Laxmi Publications. Latest edition.

Reference books / Manuals:

1. Gurucharan Singh, Building Construction. Standard Publishers.
2. R. S. Khurmi and J. K. Gupta, Building Construction. S. Chand.
3. National Building Code of India, latest edition, relevant parts.

Web links and Video Lectures (e-Resources):

1. NPTEL (IITs): Building Materials, Building Construction, and Construction Practices lecture series.
2. MoUs/MOOCs and open educational resources on sustainable building materials and construction methods.

Teaching-Learning Process (Innovative Delivery Methods):

Suggested Innovative Delivery Methods may include, but are not limited in addition to calk and talk.

- Flipped Classroom.
- Problem-Based Learning (PBL).
- Case-Based Teaching.
- Site Visit / Industrial Visit.
- ICT-Enabled Teaching.
- Simulation and Virtual Demonstration.
- Role Play.
- Mini project and material survey exercises.

The following sample strategies may be adopted to enhance teaching-learning effectiveness and support course outcome attainment:

1. Use real samples, photographs, and videos of construction materials and building components.
2. Encourage comparison of traditional and modern materials through case-based discussions.
3. Conduct field/site observations of masonry, formwork, finishing, and roof systems.
4. Use charts, specimen collections, and simple testing demonstrations to connect theory with practice.

Assessment Structure:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.

- To qualify and become eligible to appear for SEE, in the **CIE**, a student must score at least **40% of 50 marks**, i.e., **20 marks**.
- To pass the **SEE**, a student must score at least **35% of 50 marks**, i.e., **18 marks**.
- Notwithstanding the above, a student is considered to have **passed the course,** provided the combined total of **CIE and SEE** is at least **40 out of 100 marks**.

Continuous Comprehensive Assessments (CCA)+ Internal Assessment Test (IA) = Continuous Internal Evaluation CIE [25+25=50 marks]. A minimum of two Internal Assessment Tests (IA) shall be conducted, carrying a total of 25 marks. In addition, Continuous Comprehensive Assessment (CCA) shall be conducted for a total of 25 marks. It is recommended to include a maximum of two learning activities as part of the CCA to foster the holistic development of students. These activities shall be:

- Course Project
- Case Study Presentation
- Programming Assignment
- Tool/Software Exploration
- Literature Review
- Open Book Test (preferably at RBL4 and RBL5 levels)
- GATE-based Aptitude Test
- Assignment (at RBL3, RBL4, or RBL5 levels)
- Any other relevant and innovative academic activity

Students' activities for TW/SL under NCrF: Samples only

As per National credit farmwork (NCrF) students must spend 90 hours of study for 3 credit courses, which include Course instructions (CI-42 hour) and Teamwork/ Selfe learning (TW/Sl-48 hours). Hence, students must complete minimum of two actives as part of NCrF. These learning activities shall be considered as CCA components of CIE .The evaluation activities will be done using set of rubrics developed for each activity. The following sample activities are listed below.

Term Work (TW) and Self Learning (SL) components in Number of Hours per semester		
Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)		
Sl. No.	**Term Work (TW) Activity**	**Number of Hours / Semester**
1.	Activity A – Building material selection case study (CO1, CO2, CO6): Students compare two or more materials for a chosen building element and justify selection based on strength, durability, economy, and sustainability.	24

2.	Activity B – Construction component observation report (CO3, CO4, CO5): Students document building elements observed in a site visit or through case photos and explain construction sequence, precautions, and quality issues.	24
SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.		
Sl. No.	**Self-Learning (SL) Activity**	Number of Hours / Semester
1.	NPTEL or MOOC modules on building materials, construction technology, and sustainable construction.	24
2.	Preparation of material comparison charts, short notes, and digital portfolio of building components	24

Rubrics for Evaluation of Term Work (TW) Activities:

Criteria	**4 – Excellent**	**3 – Good**	**2 – Fair**	**1 – Needs Improvement**
Problem Understanding	Clearly defines materials/techniques with sound reasoning.	Mostly accurate with minor omissions in selection.	Basic attempt; some incorrect material/technique choices.	Concept not clearly defined.
Construction/Design Details	Sketches/details are accurate, neat, and professional.	Largely correct with minor layout errors.	Partially correct; several technical mistakes.	Incorrect or missing diagrams/details.
Safety & Sustainability	Insightful analysis of safety, durability, and eco-impact.	Generally covers safety with limited sustainability comment.	Weak analysis; mostly mechanical application of theory.	No meaningful interpretation of safety/impact.
Presentation & Clarity	Well-organized, easy to follow, and high-quality report.	Generally clear; some minor layout/formatting issues.	Understandable but somewhat untidy.	Very unclear or incomplete submission.

Continuous Internal Evaluation (CIE):

(i) The CIE marks shall be decided based on internal tests and other outcome-based activities. The continuous internal evaluation shall be carried out by the teacher handling the course.
(ii) Out of 50 marks earmarked for CIE, 25 marks shall be assigned for internal tests. The first test shall be conducted after completing two modules of the syllabus and the second one after completing the remaining three modules.
(iii) The remaining 25 marks shall be assigned for Continuous Course Assessment (CCA), conducted as per the rubrics listed in the assessment section of the respective syllabus.
(iv) A student shall obtain a minimum of 40% marks or 20 out of 50 marks allotted to CIE to become eligible to appear for the SEE.

Passing requirement in SEE:

i. For a pass in the Semester End Examination (SEE), a student shall secure a minimum of 35 marks out of 100.
ii. For the declaration of a pass grade, the sum of the Continuous Internal Evaluation (CIE) marks (out of 50) marks and the SEE marks scaled down to 50 shall be greater than or equal to 40 marks.
Iii. If the total (CIE + SEE) is less than 40 marks, the student shall be awarded the grade ‘F’ (Fail)

ENGINEERING GEOLOGY FOR INFRASTRUCTURE PROJECTS			
Course Code	**1BCV305**	Scheme	**2025**
Type of Course	Professional Core Course (PCC)	Semester	III
Teaching Hours/Week (L:T:P)	42 (3:0:0)	CIE Marks	50
Total Hours of Pedagogy per Semester CI (L /T): LI(P):TW&SL	90(42:0:0:48)	SEE Marks	50
Credits	**3**	Total Marks	100
Examination type (SEE)	**Theory**	Exam Hours	03

Course outcome (Course Skill Set)

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

1. **CO1 (L2 – Understand):** Explain the origin, classification and properties of rocks and soils relevant to civil engineering infrastructure.
2. **CO2 (L3 – Apply):** Interpret geological maps, structures and subsurface information for siting and planning of foundations, tunnels, dams and highways.
3. **CO3 (L3 – Apply):** Identify and describe engineering significance of geological structures such as joints, faults, folds and unconformities.
4. **CO4 (L4 – Analyze):** Analyse unstable slopes and mass-movement conditions qualitatively and suggest suitable stabilisation and drainage measures.
5. **CO5 (L3 – Apply):** Apply basic principles of groundwater occurrence and movement in planning wells, dewatering and seepage control measures.
6. **CO6 (L4 – Analyze/Evaluate):** Assess geological hazards and geo-environmental issues, and relate them to resilient and sustainable infrastructure in line with SDG 6, SDG 9, SDG 11 and SDG 13.

Module-1

Introduction, minerals and rocks:

- Scope of engineering geology in planning, design and construction of infrastructure.
- Internal structure of the earth and rock cycle (qualitative).
- Minerals – physical properties of important rock-forming minerals (quartz, feldspar, mica, calcite etc.).
- Rocks – classification into igneous, sedimentary and metamorphic; textures and structures; engineering significance of common rock types (granite, basalt, sandstone, limestone, shale, gneiss, schist).

Linked COs: CO1, partial CO2, CO6 **Number of Hours (CI) = 8 hrs**

Module-2

Geological Structures and Engineering significance:

- Primary and secondary structures; bedding, laminations and joints – types, spacing, infilling and their effect on strength and permeability.
- Folds – terminology, classification based on attitude; impact on tunnels, slopes and foundations.
- Faults – elements, types and recognition in field and maps; engineering problems due to faults.
- Unconformities and their recognition; importance in site selection and groundwater.
- Interpretation of simple geological maps and sections (qualitative).
- Joints: Types of joints and engineering significance
- Rock Quality Determination (RQD) for infrastructures projects, Study of engineering geological conditions for site selection.
- Detailed Core logging (Hardness, Dip, Strike, Fold, Fault, Joint, Unconformities) and its importance in foundations.

Linked COs: CO2, CO3, CO6 **Number of Hours (CI)= 8 hrs**

Module-3

Weathering, soil profile and site investigation:

- Soil formation and soil profile and engineering importance.
- Weathering of rocks – physical, chemical and biological processes; residual and transported soils; engineering implications.
- Soil profile, laterites and black cotton soils – occurrence and problems for foundations (qualitative).
- Concept of bearing strata, overburden, rock mass quality (awareness of RQD).
- Role of engineering geologist in reconnaissance and detailed site investigations.
- Reconnaissance survey and detailed site investigations

Linked COs: CO1, CO2, CO4, CO6. **Number of Hours (CI) = 8 hrs.**

Module-4

Hydrogeology and Geomorphology:

- Groundwater occurrence in different terrains ; Igneous Rocks, Sedimentary Rocks and Metamorphic rocks
- Water Bearing Formations, aquifers, aquitard, water table and piezometric surface.
- Concept of porosity, permeability and Transmissivity at qualitative level.
- Springs, wells and boreholes; influence of geological formations on groundwater yield.
- Seepage and leakage issues in foundations, underground structures and slopes; basic drainage and grouting concepts (qualitative).
- Seepage and leakage issues in foundations, underground structures and slopes; basic drainage and grouting concepts (qualitative).
- Geophysical exploration, Hydrological cycle. Vertical distribution of groundwater, artesian groundwater in soil and rock. Artificial recharge structure, Rain water harvesting
- Groundwater Pollution. Floods and its control, Cyclone and its effects. Landforms, different drainage pattern and types.

Linked COs: CO2, CO5, CO6. **Number of Hours (CI) = 8 hrs.**

Module-5

Geo-Hazards, Landslides, GIS and Remote Sensing

- Natural slopes in rock and soil, factors affecting stability – material, structure, groundwater and external loading.
- Landslides – types, causes, warning signs and basic preventive measures (drainage, retaining structures, bioengineering – qualitative).
- Geological considerations in dam and reservoir sites – suitable and unsuitable conditions, seepage and uplift issues.
- Tunnels and underground constructions – influence of rock type, joints, faults and water; concept of rock support systems (awareness).Earthquakes, seismic zoning (India – awareness), geotechnical amplification and resilient infrastructure; linkage to SDG 11 and SDG 13.
- Engineering problems related to Earthquakes, Tsunami causes and effects, Volcanic Eruptions. Remote Sensing – Concept, Application and its Limitations; Natural Disasters and their mitigation.
- Geographic Information System (GIS) and Global Positioning System (GPS) and its applications in Civil Engineering Projects.
- Remote Sensing concept and its Applications in Natural Resource Management.
- Aerial Photography, LISS 4 data, Sentinel-2 and LANDSAT Imagery in urban planning.

Linked COs: CO2, CO4, CO5, CO6. **Number of Hours (CI) = 10 hrs..**

Suggested Learning Resources

Text books:

1. Parbin Singh, *Engineering and General Geology*. S.K. Kataria & Sons. 8th Edition (2018 or latest).
2. Chenna Kesavulu N., *Textbook of Engineering Geology*. Macmillan Publishers India Ltd. 2nd Edition (2019 or latest).
3. K. V. G. K. Gokhale, *Principles of Engineering Geology*. B.S. Publications. 2nd Edition (2017 or latest).

Reference Books/Manuals:

1. F.G.H. Blyth and M.H. de Freitas, *Geology for Engineers*. Butterworth-Heinemann. 7th Edition (2017).
2. Bureau of Indian Standards, National Building Code of India (NBC) 2016, Vol. 1, Part 6 (Structural Design - Section 2: Soils and Foundations), 2016.

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology and Rock Engineering.

Teaching-Learning Process (Innovative Delivery Methods):
Suggested Innovative Delivery Methods may include, but are not limited to:

- Flipped Classroom.
- Problem-Based Learning (PBL).
- Case-Based Teaching.
- Site Visit / Industrial Visit.
- ICT-Enabled Teaching.
- Simulation and Virtual Demonstration.
- Role Play.
- Mini project and material survey exercises.

The following sample strategies may be adopted to enhance teaching-learning effectiveness and support course outcome attainment:

1. Flipped classroom for structural geology concepts, case-based teaching for dam/tunnel failure analysis, and virtual demonstrations of geophysical testing.
2. Use of geological maps/sections, field/site observations (if applicable), and integration of real-world infrastructure disaster case studies.

Assessment Structure:
The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.

- To qualify and become eligible to appear for SEE, in the **CIE**, a student must score at least **40% of 50 marks**, i.e., **20 marks**.
- To pass the **SEE**, a student must score at least **35% of 50 marks**, i.e., **18 marks**.
- Notwithstanding the above, a student is considered to have **passed the course,** provided the combined total of **CIE and SEE** is at least **40 out of 100 marks**.

Continuous Comprehensive Assessments (CCA)+ Internal Assessment Test (IA) = Continuous Internal Evaluation CIE [25+25=50 marks]. A minimum of two Internal Assessment Tests (IA) shall be conducted, carrying a total of 25 marks. In addition, Continuous Comprehensive Assessment (CCA) shall be conducted for a total of 25 marks. It is recommended to include a maximum of two learning activities as part of the CCA to foster the holistic development of students. These activities shall be:

- Course Project
- Case Study Presentation
- Programming Assignment
- Tool/Software Exploration
- Literature Review
- Open Book Test (preferably at RBL4 and RBL5 levels)
- GATE-based Aptitude Test
- Assignment (at RBL3, RBL4, or RBL5 levels)
- Any other relevant and innovative academic activity

Students' activities for TW/SL under NCrF: Samples only

As per National credit farmwork (NCrF) students must spend 90 hours of study for 3 credit courses, which include Course instructions (CI-42 hour) and Teamwork/ Selfe learning (TW/Sl-48 hours). Hence, students must complete minimum of two actives as part of NCrF. The evaluation activities will be done using set of rubrics developed for each activity. The following sample activities are listed below.

Term Work (TW) and Self Learning (SL) components in Number of Hours per semester

Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

Sl. No.	Term Work (TW) Activity	Number of Hours / Semester
1.	**Activity A – Geological Site Analysis**: Students interpret borehole/map data for a proposed infrastructure site and recommend stability measures (CO2, CO4, CO5).	24
2.	**Activity B – Case Study Presentation:** Document a major civil project failure caused by geological factors; analyze remedial measures (CO4, CO6).	24

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

Sl. No.	**Self-Learning (SL) Activity**	Number of Hours / Semester
1.	NPTEL/MOOC modules on Engineering Geology, Rock Mechanics, or Geotechnical Exploration.	24
2.	Preparation of geological profile charts and digital portfolio of common rock/mineral specimens.	24

Rubrics for Evaluation of Term Work (TW) Activities:

Criteria	4 – Excellent	3 – Good	2 – Fair	1 – Needs Improvement
Problem Understanding	Clearly links geology to project stability with sound reasoning.	Mostly accurate with minor gaps in geological interpretation.	Basic attempt; some incorrect geological assumptions.	Concept not defined.
Analysis/Interpretation	Insightful analysis of rock data/site reports.	Correct analysis with some implicit assumptions.	Limited analysis; mainly descriptive.	No analysis; irrelevant content.
Presentation & Clarity	Well-organized, professional reports and clear geological sketches.	Generally clear; minor formatting issues.	Understandable but somewhat untidy.	Incomplete submission.

Continuous Internal Evaluation (CIE):

3. The CIE marks shall be decided based on internal tests and other outcome-based activities. The continuous internal evaluation shall be carried out by the teacher handling the course.
4. Out of 50 marks earmarked for CIE, 25 marks shall be assigned for internal tests. The first test shall be conducted after completing two modules of the syllabus and the second one after completing the remaining three modules.
5. The remaining 25 marks shall be assigned for Continuous Course Assessment (CCA), conducted as per the rubrics listed in the assessment section of the respective syllabus.
6. A student shall obtain a minimum of 40% marks or 20 out of 50 marks allotted to CIE to become eligible to appear for the SEE.

Passing requirement in SEE:

i. For a pass in the Semester End Examination (SEE), a student shall secure a minimum of 35 marks out of 100.
ii. For the declaration of a pass grade, the sum of the Continuous Internal Evaluation (CIE) marks (out of 50) marks and the SEE marks scaled down to 50 shall be greater than or equal to 40 marks.
Iii. If the total (CIE + SEE) is less than 40 marks, the student shall be awarded the grade 'F' (Fail)

BUILDING CAD AND 3D MODELLING LAB		Scheme	2025
Course Code	**1BCVL306**	Semester	III
Teaching Hours/Week (L:T:P)	28 (0:0:2)	CIE Marks	50
Total Hours of Pedagogy CI(L:T):LI(P):SL/TW	30 (0:0:28:2)	SEE Marks	50
Credits	1	Total Marks	100
Examination type (SEE)	**Practical**	Exam Hours	03

Course outcome (Course Skill Set)

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

1. CO1: Describe CAD interface, units, layers, snaps, and aids for building drafting. (L2)
2. CO2: Create detailed 2D plans, elevations, sections of institutional buildings using layers, hatches, dimensions. (L3)
3. CO3: Develop 3D models of buildings, generate multi-views, and apply basic rendering. (L3)
4. CO4 : Organize complex drawings with blocks, XREFs, layouts for collaboration and standards compliance. (L4)
5. CO5: Export models for estimation, BIM intro, presentations; reflect on civil applications. (L3)

Note:

1. The laboratory syllabus consists of PART-A and PART-B. While PART-A has 6 conventional experiments, PART-B has 6 typical open-ended experiments. The maximum marks for the laboratory course are 100.
2. Both PART-A and PART-B are considered for CIE and SEE.
3. Students have answer 1(one) question from PART-A and 1(one) question from PART-B.
   a. The questions set for SEE shall be from among the experiments under PART-A. It is evaluated for **70 marks** out of the maximum 100 marks.
   b. The open-ended question set for SEE shall be any other open-ended question and not selected from the experiments under PART-A. It shall be evaluated for **30 marks.**
4. For Continuous Internal Evaluation (CIE) during the semester, classwork shall typically include open-ended questions from **Part-B**, along with other similar questions designed to enhance the students' skills.

PART – A
FIXED SET OF EXPERIMENTS

Students shall perform practical exercises related to:

1. CAD basics: Interface setup, units (metric), limits, layers (walls, doors, dimensions), OSNAPs, modify commands; draw simple room shapes, annotate.
2. Residential plan: Detailed plan with rooms, doors/windows (standard sizes: doors 900x2100mm, windows 1200x1200mm), furniture blocks, dimensions 1:100 scale.
3. Residential elevation/section: Matching elevation, cross-section with hatching (walls 230mm brick, slab 150mm), stairs, roof.
4. School building plan: Ground +1 floor plan (classrooms 7x8m, staff room, hall 20x10m, toilets, corridors), doors/windows, ramps for accessibility, grid lines, 1:100 scale.
5. School elevation/sections: Front/side elevations, longitudinal section showing plinth (750mm), parapet, solar panels; hatches for materials.
6. Office building plan: G+2 commercial office (reception, cabins 4x4m, open workstations, conference 10x6m, parking layout), lifts, services ducts, 1:100.
7. Office elevations/sections: Multi-level elevations, sections with column grids (6x6m bay), beam details, glazing.
8. Primary health center (PHC) plan: OPD rooms, waiting area, lab, pharmacy, wards (4 beds), admin, generator backup, circulation for patients, 1:100 scale.
9. PHC elevations/sections: Elevations with ramps (1:12), sections showing ventilation, septic tank stub, green features.

PART – B
OPEN ENDED EXPERIMENTS

Open-ended experiments are a type of laboratory activity where the outcome is not predetermined and students are given the freedom to explore, design, and conduct the experiment based on the problem statements as per the concepts defined by the course coordinator. It encourages creativity, critical thinking, and inquiry-based learning. Students may be assigned any one of the open-ended problem statements during assessment. **The sample open-ended problems are provided as reference. Course coordinators are encouraged to design and assign context-specific open-ended problem statements aligned with the defined Course Outcomes (COs), ensuring relevance to contemporary practices and learner needs.**

1. Complete working drawings (plan, 2 elevations, 2 sections) for school/office/PHC variant; advanced layers, dynamic blocks, title block with BOM.
2. 3D modeling: Extrude school/office/PHC plans to full model (floors, roof, doors/windows), UCS views, section planes, basic materials/rendering (Revit/AutoCAD 3D).
3. Collaborative set: XREF plans/elevations/3D from peers, assemble layout sheets, plot PDFs; BIM export intro (IFC format).
4. Quantity takeoff: Area/volume from 3D model (floors, walls), Excel link; sustainability check (green area >20%)

Suggested Learning Resources:

Text books:

1. MG Shah, CM Kale, SY Patki, "Building Drawing with an Integrated Approach to Built Environment Drawing", Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. S.S. Bhavikatti and M.V. Chitawadagi, "Building Planning and Drawing", I K International Publishing House Pvt. Ltd., New Delhi.
3. Gurucharan Singh, "Building Construction", Standard Publishers & Distributors, New Delhi.
4. RS Malik and GS Meo, "Civil Engineering Drawing", Asian Publishers / Computech Publications Pvt. Ltd., New Delhi.
5. Sham Tickoo. AutoCAD 2024 for Engineers and Designers (or latest edition) – 2D drafting and 3D modelling with civil/architectural examples.
6. Munir Hamad. AutoCAD for Architectural Drawing and Design – building plans, elevations and basic 3D for buildings.
7. Elise Moss. Introducing AutoCAD Civil 3D – site, road and basic infrastructure modelling using Civil 3D.

<u>Reference books / Manuals:</u>

1. Dodge F.W., *"Time Saver Standards for Building Types"*, F.W. Dodge Corp., New York.
2. IS: 962 – 1989 – *"Code of Practice for Architectural and Building Drawing"*, BIS, New Delhi.
3. *"National Building Code of India"*, BIS, New Delhi.
4. Prof. Anil A. Patil. Computer Aided Building Drawing
5. Louisa Jahn, Dustin Manning. Mastering Autodesk Civil 3D – advanced corridor, grading and infrastructure workflows.

Web links and Video Lectures (e-Resources):

1. NPTEL: Computer Aided Design – Introductory CAD concepts and 3D modelling (lecture series by IIT Delhi / IITs).
2. NPTEL / IIT Hyderabad: Computer Aided Engineering Drawing and Design – 2D/3D CAD, drafting standards, projections useful before AutoCAD practice.
3. NPTEL / BIM-related courses: Building Information Modeling (BIM) – conceptual and workflow understanding for 3D model-based building/infrastructure projects (IITM Pravartak / similar)

Assessment Structure:
The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying **50% weightage** (i.e., 50 marks each).
The CIE marks awarded shall be based on the continuous evaluation of the laboratory report using a defined set of rubrics. Each experiment report can be evaluated for 30 marks. Total marks for the all report shall be scaled down to 30 marks. The laboratory test (duration 03 hours) at the end of the last week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and Marks scored shall be scaled down to 20 marks. Final average of marks for report and test shall be out of 50 marks.
For both CIE and SEE, the student is required to conduct one experiment each from both Part A and Part B.
Eligibility for SEE:

- To qualify and become eligible to appear for SEE, in the **CIE component**, a student must secure **a minimum of 40% of 50 marks**, i.e., **20 marks.**
- To pass the **SEE component**, a student must secure **a minimum of 35% of 50 marks**, i.e., **18 marks.**
- A student is deemed to have **successfully completed the course** if the **combined total of CIE and SEE is at least 40 out of 100 marks**.

Rubrics suggested for Practical continuous assessment

Performance Indicators	Excellent	Very Good	Good	Satisfactory
Fundamental Knowledge (4) (PO1)	The student has well depth knowledge of the topics related to the course (4)	Student has good knowledge of some of the topics related to course (3)	Student is capable of narrating the answer but not capable to show in depth knowledge (2)	Student has not understood the concepts clearly (1)
Design Of Experiment (5) (PO2 & PO3)	Student is capable of discussing more than one design for his/her problem statement and capable of proving the best suitable design with proper reason (5)	Student is capable of discussing few designs for his/her problem statement but not capable of selecting best (4)	Student is capable of discussing single design with its merits and de-merits (3)	Student is capable of explaining the design (1-2)
Implementation (8) (PO3 & PO8)	Student is capable of implementing the design with best suitable algorithm considering optimal solution. (7-8)	Student is capable of implementing the design with best suitable algorithm and should be capable of explaining it (5-6)	Student is capable of implementing the design with proper explanation. (3-4)	Student is capable of implementing the design. (1-2)
Result &Analysis (5) (PO4)	Student is able to run the program on various cases and compare the result with proper analysis. (5)	Student will be able to run the program for all the cases. (4)	Student will be able to run the code for few cases and analyze the output. (3)	Student will be able to run the program but not able to analyze the output. (1-2)
Demonstration (8) (PO9)	The lab record is well-organized, with clear sections (e.g., Introduction, Method, Results, Conclusion). Transitions between sections are smooth. (7-8)	The lab record is organized, with clear sections, but some sections are not well-defined. (5-6)	The lab record lacks clear organization or structure. Some sections are unclear or incomplete. (3-4)	The lab record is poorly organized, with missing or unclear sections. (1-2)

MATLAB & SPREADSHEET APPLICATIONS FOR CIVIL ENGINEERING			
Course Code	**1BCVL307A**	Scheme	2025
Type of Course	Ability Enhancement Course (Laboratory)	Semester	III
Teaching Hours/Week (L :T : P)	28 (0:0:2)	CIE Marks	50
Total Hours of Pedagogy CI(L :T):LI(P):SL:TW	30 (0:0:28:2)	SEE Marks	50
Credits	1	Total Marks	100
Type of Examination	Practical	Exam Hours	03

Course outcome (Course Skill Set):

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

1. **CO1 (L3 – Apply):** Apply MATLAB and spreadsheet tools to perform basic numerical computations and data presentation for civil engineering problems.
2. **CO2 (L3 – Apply):** Implement mathematical and engineering calculations using scripts, formulas, and built-in functions in MATLAB and spreadsheets.
3. CO3 (L4 – Analyze): Analyze civil engineering datasets using charts, trendlines, interpolation, regression, and statistical summaries.
4. **CO4 (L3 – Apply):** Develop spreadsheet models for quantity estimation, rate analysis, and simple design calculations relevant to civil engineering.
5. **CO5 (L4 – Analyze):** Interpret outputs from MATLAB and spreadsheet simulations to support engineering decisions and report preparation.
6. **CO6 (L5 – Evaluate):** Evaluate the suitability of computational results for civil engineering applications and communicate findings in a professional report aligned with sustainability and digital engineering practices.

SET OF EXPERIMENTS (LI =28 hours)

Students shall perform practical exercises related to:

1. Introduction to MATLAB environment, command window, variables, matrices, and basic plotting.
2. Arithmetic operations, unit conversions, and engineering calculator using MATLAB.
3. Solution of simultaneous equations relevant to structural and water resources problems.
4. Plotting of load–deflection, stress–strain, and discharge–head graphs using MATLAB.
5. Interpolation and curve fitting for civil engineering data.
6. Numerical differentiation and integration for engineering applications.
7. Spreadsheet creation for civil engineering calculations using formulas and cell referencing.
8. Preparation of quantity estimation sheet for a simple building component.
9. Rate analysis sheet for common civil engineering items.
10. Data entry, sorting, filtering, and conditional formatting for field/lab data in spreadsheets.
11. Statistical analysis of test data using spreadsheet functions, averages, standard deviation, and charts.
12. Regression analysis and trendline-based prediction using spreadsheet tools.

Suggested Learning Resources

Text Books

1. Chapra, S. C. Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill Education, 4th Edition, 2018.
2. Attaway, S. MATLAB: A Practical Introduction to Programming and Problem Solving, Butterworth-Heinemann, 4th Edition, 2019.
3. Bansal, R. K. A Textbook of Engineering Mechanics and Spreadsheet Applications, Laxmi Publications, 1st Edition, 2020.
4. Dhanpat Rai & Company MS Excel for Engineers and Analysts, Dhanpat Rai Publications, 2nd Edition, 2021.
5. Borah, D. Computational Methods in Civil Engineering Using MATLAB, Khanna Publishers, 1st Edition, 2022.

Reference Books

1. Rao, S. S. Numerical Methods for Engineers, Elsevier, 7th Edition, 2018.
2. Kreyszig, E. Advanced Engineering Mathematics, Wiley, 10th Edition, 2011.
3. Dewri, H. Spreadsheet Modeling for Civil and Structural Engineering, McGraw-Hill, 1st Edition, 2020.
4. Chapra, S. C., and Canale, R. P. Numerical Methods for Engineers, McGraw-Hill Education, 8th Edition, 2016.
5. Perry, L. Excel Applications for Engineers, Pearson, 2nd Edition, 201

Web links and Video Lectures (e-Resources):

1. MATLAB Documentation
2. MATLAB Onramp
3. Spreadsheet functions reference
4. NPTEL engineering computation resources

Assessment Structure:

The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying **50% weightage** (i.e., 50 marks each).

The CIE marks awarded shall be based on the continuous evaluation of the laboratory report using a defined set of rubrics. Each experiment report can be evaluated for 30 marks. Total marks for the all report shall be scaled down to 30 marks. The laboratory test (duration 03 hours) at the end of the last week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and Marks scored shall be scaled down to 20 marks. Final average marks for report and test shall be out of 50 marks.

Eligibility for SEE:

- To qualify and become eligible to appear for SEE, in the **CIE component**, a student must secure **a minimum of 40% of 50 marks**, i.e., **20 marks.**
- To pass the **SEE component**, a student must secure **a minimum of 35% of 50 marks**, i.e., **18 marks**.
- A student is deemed to have **successfully completed the course** if the **combined total of CIE and SEE is at least 40 out of 100 marks.**

Rubrics suggested for Practical continuous assessment

Performance Indicators	Excellent	Very Good	Good	Satisfactory
Fundamental Knowledge (4) (PO1)	The student has well depth knowledge of the topics related to the course (4)	Student has good knowledge of some of the topics related to course (3)	Student is capable of narrating the answer but not capable to show in depth knowledge (2)	Student has not understood the concepts clearly (1)
Design Of Experiment (5) (PO2 & PO3)	Student is capable of discussing more than one design for his/her problem statement and capable of proving the best suitable design with proper reason (5)	Student is capable of discussing few designs for his/her problem statement but not capable of selecting best (4)	Student is capable of discussing single design with its merits and de-merits (3)	Student is capable of explaining the design (1-2)
Implementation (8) (PO3 & PO8)	Student is capable of implementing the design with best suitable algorithm considering optimal solution. (7-8)	Student is capable of implementing the design with best suitable algorithm and should be capable of explaining it (5-6)	Student is capable of implementing the design with proper explanation. (3-4)	Student is capable of implementing the design. (1-2)

Result &Analysis (5) (PO4)	Student is able to run the program on various cases and compare the result with proper analysis. (5)	Student will be able to run the program for all the cases. (4)	Student will be able to run the code for few cases and analyze the output. (3)	Student will be able to run the program but not able to analyze the output. (1-2)
Demonstration (8) (PO9)	The lab record is well-organized, with clear sections (e.g., Introduction, Method, Results, Conclusion). Transitions between sections are smooth. (7-8)	The lab record is organized, with clear sections, but some sections are not well-defined. (5-6)	The lab record lacks clear organization or structure. Some sections are unclear or incomplete. (3-4)	The lab record is poorly organized, with missing or unclear sections. (1-2)

GRAPHIC STATICS LABORATORY			
Course Code	**1BCV307B**	Scheme	2025
Type of Course	Ability Enhancement Course (Laboratory)	Semester	III
Teaching Hours/Week (L :T : P)	28 (0:0:2)	CIE Marks	50
Total Hours of Pedagogy CI(L :T):LI(P):SL:TW	30 (0:0:28:2)	SEE Marks	50
Credits	1	Total Marks	100
Type of Examination	Practical	Exam Hours	03

Course outcome (Course Skill Set)

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

1. **CO1 (L3 – Apply):** Apply graphical methods to represent forces, vectors, and structural actions in civil engineering systems.
2. **CO2 (L3 – Apply):** Construct force and funicular polygons for given load systems using accurate graphical procedures.
3. **CO3 (L4 – Analyze):** Analyze reactions, member forces, and equilibrium conditions of simple structural systems through graphic statics.
4. **CO4 (L3 – Apply):** Develop graphical solutions for beams, trusses, and cable systems relevant to civil engineering applications.
5. **CO5 (L4 – Analyze):** Interpret graphical results to assess load paths, stability, and force distribution in structures.
6. **CO6 (L5 – Evaluate):** Evaluate the suitability of graphical methods for civil engineering problems and communicate results in a professional report aligned with engineering practice.

SET OF EXPERIMENTS (LI =28 hours)

Students shall perform practical exercises related to:

1. Introduction to graphic statics, scaling, instruments, and construction of force vectors.
2. Resolution and composition of forces using force polygons.
3. Determination of resultant of concurrent force systems by graphical method.
4. Analysis of coplanar force systems and equilibrium of a rigid body using force polygon.
5. Construction of funicular polygon for a system of parallel forces.
6. Determination of reactions of simply supported beams using graphical statics.
7. Graphical analysis of beams with point loads and uniformly distributed loads.
8. Construction of load line and link polygon for structural force distribution.
9. Analysis of simple trusses using method of joints through graphical representation.
10. Determination of member forces in statically determinate trusses by graphic method.
11. Graphical study of cable structures and suspension systems.
12. Analysis of funicular shapes for given loading conditions.

Suggested Learning Resources

Text books:

1. **Text Books**
2. Hibbeler, R. C. *Engineering Mechanics: Statics*, Pearson, latest edition.
3. Hartsuijker, C. *Graphic Statics*, Springer, latest edition.
4. Zienkiewicz, O. C. *Mechanics of Structures*, Elsevier, latest edition.
5. Bansal, R. K. *Engineering Mechanics*, Laxmi Publications, latest edition.
6. Negi, L. S. *Structural Analysis*, McGraw-Hill Education, latest edition.

Reference Books

1. Bow, R. H. *Engineering Mechanics of Statics*, Wiley, latest edition.
2. Weaver, W., and Gere, J. M. *Matrix Analysis of Framed Structures*, CBS Publishers, latest edition.
3. Timoshenko, S. P., and Young, D. H. *Theory of Structures*, McGraw-Hill, latest edition.
4. Ghali, A., Neville, A. M., and Brown, T. G. *Structural Analysis: A Unified Classical and Matrix Approach*, CRC Press, latest edition.
5. Hulse, R., and Cain, J. *Structural Mechanics*, Palgrave, latest edition.

Web links and Video Lectures (e-Resources):

1. NPTEL Structural Analysis resources
2. Engineering Mechanics and Statics video lectures
3. Graphic statics tutorials and demonstrations
4. Online structural analysis learning modules

Assessment Structure:

The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying **50% weightage** (i.e., 50 marks each).

The CIE marks awarded shall be based on the continuous evaluation of the laboratory report using a defined set of rubrics. Each experiment report can be evaluated for 30 marks. Total marks for the all report shall be scaled down to 30 marks. The laboratory test (duration 03 hours) at the end of the last week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and Marks scored shall be scaled down to 20 marks. Final average marks for report and test shall be out of 50 marks.

Eligibility for SEE:

- To qualify and become eligible to appear for SEE, in the **CIE component**, a student must secure **a minimum of 40% of 50 marks**, i.e., **20 marks**.
- To pass the **SEE component**, a student must secure **a minimum of 35% of 50 marks**, i.e., **18 marks**.
- A student is deemed to have **successfully completed the course** if the **combined total of CIE and SEE is at least 40 out of 100 marks.**

Rubrics suggested for Practical continuous assessment

Performance Indicators	Excellent	Very Good	Good	Satisfactory
Fundamental Knowledge (4) (PO1)	The student has well depth knowledge of the topics related to the course (4)	Student has good knowledge of some of the topics related to course (3)	Student is capable of narrating the answer but not capable to show in depth knowledge (2)	Student has not understood the concepts clearl (1)
Design Of Experiment (5) (PO2 & PO3)	Student is capable of discussing more than one design for his/her problem statement and capable of proving the best suitable design with proper reason (5)	Student is capable of discussing few designs for his/her problem statement but not capable of selecting best (4)	Student is capable of discussing single design with its merits and de-merits (3)	Student is capabl of explaining the design (1-2)
Implementation (8) (PO3 & PO8)	Student is capable of implementing the design with best suitable algorithm considering optimal solution. (7-8)	Student is capable of implementing the design with best suitable algorithm and should be capable of explaining it (5-6)	Student is capable of implementing the design with proper explanation. (3-4)	Student is capable of implementing the design. (1-2)
Result &Analysis (5) (PO4)	Student is able to run the program on various cases and compare the result with proper analysis. (5)	Student will be able to run the program for all the cases. (4)	Student will be able to run the code for few cases and analyze the output. (3)	Student will be able to run the program but not able to analyze the output. (1-2)

PYTHON PROGRAMMING LAB FOR CIVIL ENGINEERS			
Course Code	1BCVL307C	Scheme	2025
Type of Course	Ability Enhancement Course (Laboratory)	Semester	III
Teaching Hours/Week (L :T : P)	28(0:0:2)	CIE Marks	50
Total Hours of Pedagogy CI(L :T):LI(P):SL:TW	30 (0:0:28:2)	SEE Marks	50
Credits	1	Total Marks	100
Type of Examination	Practical	Exam Hours	03

Course outcome (Course Skill Set)

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

1. CO1 (L3 – Apply): Apply Python programming basics to solve civil engineering-related numerical and logical problems.
2. CO2 (L3 – Apply): Implement conditional statements, loops, functions, and arrays for engineering computations.
3. CO3 (L4 – Analyze): Analyze civil engineering data using Python libraries and interpret computational results.
4. CO4 (L3 – Apply): Develop Python scripts for structural, transportation, environmental, and geotechnical engineering applications.
5. CO5 (L4 – Analyze): Interpret outputs from Python-based solutions to support engineering decision-making.
6. CO6 (L5 – Evaluate): Evaluate the suitability of Python as a computational tool and communicate results in a professional report aligned with engineering practice.

SET OF EXPERIMENTS (LI =28 hours)

1. Introduction to Python, installation, IDE usage, and basic syntax.
2. Input, output, data types, operators, and simple engineering calculations.
3. Conditional statements and looping constructs for civil engineering problem solving.
4. Functions and modular programming for reusable engineering computations.
5. Arrays, lists, tuples, and dictionaries for data handling.
6. Plotting using Python libraries for basic civil engineering data visualization.
7. Solution of simultaneous equations relevant to structural or water resources problems.
8. Computation of area, volume, centroid, and moment of inertia for standard sections.
9. Program for slope, deflection, or load calculation in simple structural members.
10. Program for beam reactions under point loads and uniformly distributed loads.
11. Data analysis of survey, rainfall, traffic, or material test data using Python.
12. Application of Python in design-oriented civil engineering case studies.

Suggested Learning Resources:

Textbooks:

1. Hibbeler, R. C., *Engineering Mechanics: Statics*, Pearson, latest edition.
2. Hartsuijker, C., *Graphic Statics*, Springer, latest edition.
3. Zienkiewicz, O. C., *Mechanics of Structures*, Elsevier, latest edition.
4. Ramalho, M., and co-authors, *Programming with Python for Engineers*, Springer, latest edition.
5. Downey, A. B., *Think Python: How to Think Like a Computer Scientist*, O'Reilly, latest edition.
6. Bansal, R. K., *Engineering Mechanics*, Laxmi Publications, latest edition.

Reference Books:

1. Severance, C. R., *Python for Everybody*, Exploring Data Using Python 3, Open book version / equivalent publisher edition.
2. Lutz, M., *Learning Python*, O'Reilly, latest edition.
3. Gaddis, T., *Starting Out with Python*, Pearson, latest edition.
4. Necaise, R., *Data Structures and Algorithms Using Python*, Wiley, latest edition.

5. Langtangen, H. P., *A Primer on Scientific Programming with Python*, Springer, latest edition.

Web links and Video Lectures (e-Resources):

1. NPTEL Python programming resources.
2. Python tutorials for engineers and scientific computing.
3. Python file handling and data visualization video lectures.
4. Online practice modules for Python programming in engineering applications.

Assessment Structure:

The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying **50% weightage** (i.e., 50 marks each).

The CIE marks awarded shall be based on the continuous evaluation of the laboratory report using a defined set of rubrics. Each experiment report can be evaluated for 30 marks. Total marks for the all report shall be scaled down to 30 marks. The laboratory test (duration 03 hours) at the end of the last week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and Marks scored shall be scaled down to 20 marks. Final average marks for report and test shall be out of 50 marks.

Eligibility for SEE:

- To qualify and become eligible to appear for SEE, in the **CIE component**, a student must secure **a minimum of 40% of 50 marks**, i.e., **20 marks**.
- To pass the **SEE component**, a student must secure **a minimum of 35% of 50 marks**, i.e., **18 marks**.
- A student is deemed to have **successfully completed the course** if the **combined total of CIE and SEE is at least 40 out of 100 marks.**

Rubrics suggested for Practical continuous assessment

Performance Indicators	Excellent	Very Good	Good	Satisfactory
Fundamental Knowledge (4) (PO1)	The student has well depth knowledge of the topics related to the course (4)	Student has good knowledge of some of the topics related to course (3)	Student is capable of narrating the answer but not capable to show in depth knowledge (2)	Student has not understood the concepts clearly (1)
Design Of Experiment (5) (PO2 & PO3)	Student is capable of discussing more than one design for his/her problem statement and capable of proving the best suitable design with proper reason (5)	Student is capable of discussing few designs for his/her problem statement but not capable of selecting best (4)	Student is capable of discussing single design with its merits and de-merits (3)	Student is capable of explaining the design (1-2)
Implementation (8) (PO3 & PO8)	Student is capable of implementing the design with best suitable algorithm considering optimal solution. (7-8)	Student is capable of implementing the design with best suitable algorithm and should be capable of explaining it (5-6)	Student is capable of implementing the design with proper explanation. (3-4)	Student is capable of implementing the design. (1-2)

Result &Analysis (5) (PO4)	Student is able to run the program on various cases and compare the result with proper analysis. (5)	Student will be able to run the program for all the cases. (4)	Student will be able to run the code for few cases and analyze the output. (3)	Student will be able to run the program but not able to analyze the output. (1-2)
Demonstration (8) (PO9)	The lab record is well-organized, with clear sections (e.g., Introduction, Method, Results, Conclusion). Transitions between sections are smooth. (7-8)	The lab record is organized, with clear sections, but some sections are not well-defined. (5-6)	The lab record lacks clear organization or structure. Some sections are unclear or incomplete. (3-4)	The lab record is poorly organized, with missing or unclear sections. (1-2)

ENGINEERING GEOLOGY AND SOIL IDENTIFICATIONS LAB			
Course Code	1BCVL307D	Scheme	2025
Type of Course	Ability Enhancement Course (Laboratory)	Semester	III
Teaching Hours/Week (L :T : P)	28 (0:0:2)	CIE Marks	50
Total Hours of Pedagogy CI(L :T):LI(P):SL:TW	30 (0:0:28:2)	SEE Marks	50
Credits	1	Total Marks	100
Type of Examination	Practical	Exam Hours	03

Course outcome (Course Skill Set)

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

1. CO1 (L3 – Apply): Identify and classify common rock-forming minerals and rocks based on physical properties, textures, and structures relevant to civil engineering applications.
2. CO2 (L3 – Apply): Perform standard laboratory tests to determine physical and index properties of soils including moisture content, specific gravity, grain size distribution, and Atterberg limits.
3. CO3 (L4 – Analyze): Analyze soil classification using Unified Soil Classification System (USCS) and Indian Standard Classification (IS) based on laboratory test results and plasticity characteristics.
4. CO4 (L3 – Apply): Use geological instruments (clinometer compass, Brunton compass) to measure dip and strike of geological formations and interpret geological maps and cross- sections.
5. CO5 (L4 – Analyze): Evaluate engineering properties of rocks (specific gravity, porosity, water absorption) and assess their suitability for construction materials and infrastructure projects.
6. CO6 (L5 – Evaluate): Assess geological and geotechnical site conditions, relate laboratory findings to field observations, and recommend suitable foundation types and construction practices aligned with SDG 9 (Industry, Innovation and Infrastructure) and SDG 11 (Sustainable Cities and Communities).

SET OF EXPERIMENTS (LI =28 hours)

1. Study of geological maps and symbols.
2. Identification of common rock-forming minerals by physical properties.
3. Identification and description of igneous rocks/sedimentary rocks/metamorphic rocks.
4. Study of structural features of rocks such as folds, faults, joints, and bedding planes.
5. Study of topographical maps and contour interpretation.
6. Interpretation of geological sections and rock strata.
7. Study of aerial photographs / stereoscopic photo interpretation.
8. Study of engineering geological conditions for site selection.
9. Visual manual identification and description of soil samples.
10. Field identification of coarse and fine -grained soils.
11. Geophysical survey to determine subsurface strata characteristics for foundations.
12. Field exposure to identify topography, rocks, minerals and soil and suitable dam selection area.

Suggested Learning Resources

Text books:

1. Parbin Singh. Engineering and General Geology. Katson Publishing House.
2. Venkat Reddy, D. Engineering Geology for Civil Engineers. Oxford & IBH Publishing.
3. Murthy, V. N. S. Soil Mechanics and Foundation Engineering (7th Edition). CBS Publishers.
4. Punmia, B. C., Jain, A. K., & Jain, A. K. Soil Mechanics and Foundations (17th Edition). Laxmi Publications. Reference Books:

Reference books:

1. Krynine, D. P., & Judd, W. R. Principles of Engineering Geology and Geotechnics. McGraw-Hill.
2. 2.Goodman, R. E. Engineering Geology – Rock in Engineering Construction. Wiley.
3. 3.IS 2720 (Parts I to XXII) – Methods of Test for Soils – Indian Standard Code of Practice.
4. 4.Rahn, P. H. Engineering Geology: An Environmental Approach (2nd Edition). Prentice Hall.
5. Das, B. M. Principles of Geotechnical Engineering (9th Edition). Cengage Learning

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2. NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3. Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in
4. Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
5. YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments).
6. American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

Assessment Structure:

The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying **50% weightage** (i.e., 50 marks each).

The CIE marks awarded shall be based on the continuous evaluation of the laboratory report using a defined set of rubrics. Each experiment report can be evaluated for 30 marks. Total marks for the all report shall be scaled down to 30 marks. The laboratory test (duration 03 hours) at the end of the last week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and Marks scored shall be scaled down to 20 marks. Final average marks for report and test shall be out of 50 marks.

Eligibility for SEE:

- To qualify and become eligible to appear for SEE, in the **CIE component**, a student must secure **a minimum of 40% of 50 marks**, i.e., **20 marks.**
- To pass the **SEE component**, a student must secure **a minimum of 35% of 50 marks**, i.e., **18 marks**.
- A student is deemed to have **successfully completed the course** if the **combined total of CIE and SEE is at least 40 out of 100 marks.**

Rubrics suggested for Practical continuous assessment

Performance Indicators	Excellent	Very Good	Good	Satisfactory
Fundamental Knowledge (4) (PO1)	The student has well depth knowledge of the topics related to the course (4)	Student has good knowledge of some of the topics related to course (3)	Student is capable of narrating the answer but not capable to show in depth knowledge (2)	Student has not understood the concepts clearly (1)
Design Of Experiment (5) (PO2 & PO3)	Student is capable of discussing more than one design for his/her problem statement and capable of proving the best suitable	Student is capable of discussing few designs for his/her problem statement but not capable of selecting best (4)	Student is capable of discussing single design with its merits and de-merits (3)	Student is capable of explaining the design (1-2)

		design with proper reason (5)			
	Implementation (8) (PO3 & PO8)	Student is capable of implementing the design with best suitable algorithm considering optimal solution. (7-8)	Student is capable of implementing the design with best suitable algorithm and should be capable of explaining it (5-6)	Student is capable of implementing the design with proper explanation. (3-4)	Student is capable of implementing the design. (1-2)
	Result &Analysis (5) (PO4)	Student is able to run the program on various cases and compare the result with proper analysis. (5)	Student will be able to run the program for all the cases. (4)	Student will be able to run the code for few cases and analyze the output. (3)	Student will be able to run the program but not able to analyze the output. (1-2)
	Demonstration (8) (PO9)	The lab record is well-organized, with clear sections (e.g., Introduction, Method, Results, Conclusion). Transitions between sections are smooth. (7-8)	The lab record is organized, with clear sections, but some sections are not well-defined. (5-6)	The lab record lacks clear organization or structure. Some sections are unclear or incomplete. (3-4)	The lab record is poorly organized, with missing or unclear sections. (1-2)

COMMUNITY PROJECT / SOCIETAL PROJECT			
Course Code	**1BCP308**	Scheme	2025
Type of Course	SDC	Semester	III
Teaching Hours/Week (L :T : P)	30 (0:0:30)	CIE Marks	50
Total Hours of Pedagogy CI(L :T):LI(P):SL:TW	30 (0:0:30:0)	SEE Marks	50
Credits	1	Total Marks	100
Type of Examination	Practical	Exam Hours	02

Course objective:

Rapid urbanisation, population growth, environmental concerns, energy demand, water scarcity, waste management, transportation issues and rural development challenges have created practical problems affecting communities and public welfare. This course aims to integrate technical knowledge, field exposure and societal engagement so that students identify real community issues, frame problem statements and attempt appropriate, feasible and sustainable engineering responses within the scope of a one-semester project.

Course outcome (Course Skill Set):

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

1. **CO1 (L2 – Understand):** Identify and analyse societal problems through field interaction and technical assessment.
2. **CO2 (L3 – Apply):** Develop skills in project planning, field survey, data collection, implementation, documentation and reporting.
3. **CO3 (L4 – Analyze):** Formulate feasible engineering problem statements and solutions considering practical constraints and sustainability aspects.
4. **CO4 (L3 – Apply):** Apply principles of environmental responsibility, ethics and societal welfare in engineering practice through community-oriented interventions.
5. **CO5 (L4 – Analyze):** Exhibit multidisciplinary learning and problem-solving ability based on collected data, user feedback and baseline conditions.
6. **CO6 (L5 – Evaluate):** Demonstrate teamwork and communication skills while interacting with technical and non-technical stakeholders and reflect on project impact on society.

Restrictions and professional conduct:

Community / Societal Projects shall remain **academic, socially responsible, technically focused, and politically neutral**. Students and faculty shall maintain professionalism, ethical conduct, public respect and institutional integrity while interacting with communities, public groups, organisations and stakeholders.

Students and faculty **shall avoid** the following during project execution:

- Association with political party activities, campaigns or propaganda.
- Participation in activities that may disturb communal harmony, public order or institutional reputation.
- Use of the project platform for personal, political, ideological or commercial promotion.
- Disrespectful, discriminatory or unethical interaction with community members or stakeholders.

Projects must also recognise constraints related to **cost, resources, environment and safety, and stakeholder behaviour/cooperation/acceptance** when planning and implementing activities.

SET OF PROJECT ACTIVITIES (TW/SL = 30 HOURS)

Methods for project identification:

Students may identify the project topic using one or more of the following methods:

- Interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.
- Review of issues highlighted in print and electronic media, and social networks (WhatsApp,

Facebook, X, Instagram, etc.).

- After selecting a broad topic, students shall collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and then define the problem statement and objectives clearly.

List of Project Topics and Engineering Outcomes:

The following structured sequence of activities is to be carried out during the semester:

Sl. No.	Project title	Measurable engineering outcome	Mapped POs	SDGs
1	Rural and urban water conservation and management systems	Prepare a site-specific water-saving plan, estimate water demand–supply gap, and propose a feasible conservation intervention with quantified savings.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 6, SDG 11, SDG 12
2	Waste management and recycling	Conduct waste audit, classify waste streams, and design a segregation/recycling workflow with measurable reduction in mixed waste.	PO2, PO3, PO4, PO6, PO8, PO10	SDG 11, SDG 12, SDG 13
3	Afforestation	Identify a degraded area, prepare plantation layout, and demonstrate survival-rate tracking and maintenance schedule for saplings.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
4	Biogas generation and power generation	Estimate organic waste availability, size a small biogas system, and document expected gas output or energy yield.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 11, SDG 12
5	DPR for solar power rural plant	Prepare a DPR with load assessment, panel sizing, cost estimate, and projected energy generation and payback.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 9, SDG 11
6	DPR for electrification of village/tribal community	Map unserved/underserved households, propose electrification layout, and estimate coverage, losses, and implementation cost.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 7, SDG 9, SDG 10
7	DPR for rural drainage system	Survey drainage bottlenecks, develop a drainage layout, and estimate runoff handling capacity and flood-risk reduction.	PO1, PO2, PO3, PO4, PO6, PO10	SDG 6, SDG 9, SDG 11
8	Sustainability and environmental health projects	Assess local environmental health issues and propose interventions with measurable improvement in hygiene, safety, or resource use.	PO2, PO3, PO4, PO6, PO7, PO8	SDG 3, SDG 6, SDG 11, SDG 12
9	Plastic free campaigns	Measure plastic usage before and after awareness intervention and report percentage reduction or behavioural change.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
10	Health and nutrition awareness	Conduct baseline and post-program awareness survey and document improvement in awareness score or	PO2, PO6, PO7, PO8, PO9, PO10	SDG 2, SDG 3, SDG 11

		adoption of healthier practices.		
11	Societal projects involving health wellness	Identify a community health need and develop an awareness/service module with measurable participation and feedback outcomes.	PO2, PO3, PO6, PO8, PO9, PO10	SDG 3, SDG 11, SDG 17
12	Air quality monitoring system	Collect air-quality data, compare with reference limits, and present trends along with possible mitigation suggestions.	PO2, PO3, PO4, PO5, PO6, PO10	SDG 3, SDG 11, SDG 13
13	Plastic waste reduction campaign	Track collection, segregation, and replacement actions, and quantify reduction in plastic waste generation or littering.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
14	Urban greening projects	Prepare greening plan, identify planting locations, and assess environmental benefits such as shade, aesthetics, or heat mitigation.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
15	Smart agriculture solution	Design a low-cost monitoring or irrigation support solution and estimate improvement in water use efficiency or crop support.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 9
16	Smart irrigation system	Estimate crop water requirement, propose control logic, and quantify water savings compared with conventional irrigation.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 12
17	Youth mentoring programmes	Deliver a structured mentoring activity and measure participation, engagement, and skill/awareness improvement.	PO6, PO8, PO9, PO10, PO11	SDG 4, SDG 10, SDG 17
18	Adult education	Conduct learner-needs assessment, prepare instructional content, and measure improvement in basic literacy or numeracy indicators.	PO6, PO8, PO9, PO10, PO11	SDG 4, SDG 10, SDG 17
19	Food security initiatives / cold storage system	Estimate storage need, design a simple cold-chain concept, and document reduction in spoilage or wastage.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 9, SDG 12
20	Human rights awareness with legal systems	Prepare and deliver an awareness module and assess increase in legal awareness and access-to-rights understanding.	PO6, PO7, PO8, PO9, PO10	SDG 5, SDG 10, SDG 16
21	House tax collection through digital media	Develop a simple digital workflow or awareness support and measure improvement in compliance, convenience, or response time.	PO2, PO3, PO4, PO5, PO10, PO11	SDG 9, SDG 11, SDG 16
22	Use of application / application program	Build or demonstrate a useful community app and measure usability, adoption, or efficiency improvement.	PO1, PO3, PO4, PO5, PO9, PO10	SDG 9, SDG 11, SDG 17

23	Creation of Panchayat library	Plan the library model, catalogue resources, and measure usage, accessibility, or participation outcomes.	PO6, PO8, PO9, PO10, PO11	SDG 4, SDG 10, SDG 11, SDG 17

Suggested Learning Resources:

Textbooks:

1. **Phadke, N. D.** Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. **Garg, N. R.** Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3. **Gupta, A. and P. Singh.** Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. **Wilson, G.** Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: https://sdgs.un.org
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2. NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3. Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in
4. Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
5. YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments).
6. American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

Teaching Learning Process:

The suggested TLP for Community / Societal Project is as follows ;

Week / Phase	Teaching–Learning Activity	Faculty Role	Student Activity	Output / Evidence
1	Course introduction, objectives, ethics, conduct, and assessment briefing	Explain course scope, rules, rubrics, and expected deliverables	Understand course requirements and form teams	Team list, course plan
2	Community problem identification and topic selection	Guide topic framing and feasibility	Identify local issues through discussion and observation	Shortlisted project topic
3	Stakeholder interaction and preliminary survey	Demonstrate survey methods and stakeholder engagement	Collect initial data from community/users	Survey notes, interview record
4	Problem statement and objective	Review and refine problem statement	Prepare problem statement, scope, and	Approved problem statement

	formulation		objectives	
5	Literature/case study review and baseline analysis	Suggest relevant references and examples	Study existing solutions and compare approaches	Baseline analysis summary
6	Project planning and role assignment	Help teams organize tasks, timeline, and responsibilities	Plan activities, divide roles, and prepare schedule	Work plan / Gantt chart
7	Feasibility analysis and solution brainstorming	Check technical feasibility and practicality	Generate possible engineering solutions	Solution alternatives sheet
8	Selection of final solution and design approach	Review final concept and design logic	Finalize concept, methods, and expected outcome	Concept note / design outline
9	Data processing / calculations / sizing / mapping	Support computations and technical review	Analyze data, perform calculations, prepare maps/charts	Technical analysis sheet
10	Prototype / model / audit / DPR / app development	Monitor progress and correct technical issues	Develop the selected output	Working model / draft DPR / map / app
11	Testing, refinement, and implementation planning	Evaluate technical correctness and improvements	Test prototype or validate proposal with users	Test results / revised output
12	Field implementation / demonstration / awareness activity	Facilitate community interaction and documentation	Conduct implementation or demonstration	Photos, attendance, implementation record
13	Documentation of outcomes, feedback, and impact	Review report structure and completeness	Compile findings, stakeholder feedback, and observations	Draft report
14	Presentation preparation and viva practice	Conduct mock presentation and feedback	Prepare slides/poster and rehearse	Presentation deck
15	Final presentation, submission, and reflection	Evaluate performance using rubrics	Present project, submit report, reflect on learning	Final report, presentation, viva

Assessment structure:

A. Continuous Internal Evaluation (CIE) – 50 marks

- Students, in batches of 3–4, shall undertake at least one project (or a combination of two related activities) aiming, as far as possible, at a logical implemented or implementable outcome.
- CIE will be conducted by a departmental committee (HoD/nominee, guide and one senior faculty) using the following rubrics totalling 50 marks:

CIE pass requirement:

- A student shall secure a minimum of 20 marks out of 50 in CIE to become eligible to appear for SEE.

- Students who fail to earn the required CIE marks may be given additional opportunities before closure of the semester; no re-doing of CIE is permitted after the end of the semester.

B. Semester End Examination (SEE) – 100 marks (scaled to 50)

- Examination duration: 2 hours.
- Maximum examination marks: 100 (entered as 100 in the VTU portal; the ITI-SMU module automatically scales 100 → 50 for result processing).
- The SEE shall be conducted batch-wise by a committee of three faculty: project guide, one faculty from the same department and one from a different department.

SEE pass requirement and overall passing rule:

- For a pass in SEE, a student shall secure minimum 35 marks out of 100.
- For declaration of a pass grade, the sum of CIE marks (out of 50) and scaled SEE marks (out of 50) shall be ≥ 40; otherwise, the student is awarded grade F (Fail).

CIE Rubric — Continuous Internal Evaluation (Total 50 marks):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & Relevance to society/industry/community	8	Problem is clearly identified with strong evidence of societal relevance and well-defined scope.	Problem is relevant and scope is clear with adequate supporting evidence.	Problem defined but justification or evidence is weak.	Problem unclear or not relevant; little/no supporting evidence.
Formation of problem statement; Engineering approach, innovation & feasibility	10	Problem statement is precise; approach is sound, innovative and clearly feasible.	Problem statement adequate; approach feasible with minor gaps.	Problem statement partial; approach feasibility is marginal.	Problem statement missing or approach not feasible.
Interaction with stakeholders; Data collection, analysis & interpretation	8	Thorough stakeholder engagement; data collection is comprehensive; analysis is well-interpreted	Good engagement; data and analysis adequate with minor gaps.	Limited engagement; data incomplete and analysis superficial.	Little/no stakeholder contact; insufficient or no data/analysis.
Project documentation; Clarity, organization & problem-solving demonstrated	10	Documentation is complete, well-organized, analytical, and shows strong problem-solving	Documentation complete and clear with some analytical content.	Documentation on basic with omissions; problem-solving limited.	Documentation missing/poorly organized; no clear problem-solving.

Communication & Presentation skills	6	Presentation is confident, structured, and answers queries fully; visuals effective.	Presentation clear and satisfactory; responds to most queries.	Presentation acceptable but lacks clarity or confidence; weak responses.	Presentation poor or absent; unable to respond.
Contribution & Benefit to society (impact, sustainability)	8	Clear, demonstrable societal benefit and sustainability; realistic path to implementation.	Benefit plausible; sustainability considered with minor gaps.	Limited or unclear societal benefit; sustainability not well addressed.	No evident benefit or sustainability; project not community-oriented.

Notes for CIE rubric:

- Minimum CIE pass requirement: 20/50 to be eligible for SEE. [Use departmental committee (HoD/guide + senior faculty) to apply the rubric and record marks.]

SEE Rubric — Semester End Examination (Enter marks out of 100; scaled to 50 later):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & Relevance to society/industry/ community	16	Problem and relevance are articulated clearly with strong evidence and context.	Problem relevance clear with reasonable evidence.	Problem stated but evidence/ context weak.	Problem poorly defined or irrelevant.
Formation of problem statement; Engineering approach, innovation & feasibility	20	Problem statement is precise; approach demonstrates engineering depth, novelty and feasibility.	Approach is technically sound and feasible with minor limitations.	Approach basic; limited technical depth or feasibility concerns.	No viable engineering approach or infeasible plan.
Interaction with stakeholders; Data collection, analysis & interpretation	16	Excellent stakeholder engagement; rigorous data collection and insightful analysis.	Good engagement and acceptable analysis.	Superficial data collection and limited analysis.	Inadequate or no data; poor analysis.
Project documentation; Clarity, technical rigor & problem-solving demonstrated	20	Report is comprehensive, technically rigorous, and demonstrates systematic problem-solving.	Report is complete and technically correct with minor gaps.	Report lacks technical depth or has notable omissions.	Report missing key elements or technically incorrect.

Communication, Presentation & Viva-voce responses	12	Candidate presents expertly, defends work persuasively and answers all queries correctly.	Good presentation and satisfactory answers to most queries.	Presentation adequate but fails to answer some technical questions.	Poor presentation and unable to defend work.
Contribution & Benefit to society; Impact assessment & sustainability	16	Clear, evidence-based assessment of social impact and sustainability with scaling recommendations.	Reasonable impact discussion and sustainability considerations.	Limited evaluation of impact or sustainability.	No coherent assessment of impact or sustainability.

SEE pass rule:

- Student must secure at least 35/100 in SEE itself to be eligible for pass consideration.
- Final passing is based on CIE (out of 50) + SEE (scaled to 50) >= 40. Otherwise, grade F (Fail) is awarded.

Suggested implementation notes (for BoS / exam committees):

- Use numerical scores from the rubric and keep brief evaluator comments for each criterion.
- For team projects: record individual contribution within the documentation and adjust individual marks using a peer-evaluation sheet or guide's assessment.
- Maintain evidence (field notes, photos, questionnaires, DPRs, reports) as annexures for SEE moderation.
- Use standardized score sheet (spreadsheet) mapping rubric items to columns for easy aggregation and archival.