BACHELOR IN CIVIL ENGINEERING, RAJARSHI JANAK UNIVERSITY

Building Technology

Course Code: CE 106

Lecturer: 2
Tutorial: 2
Practical: 0

Year: II
Part: I
Course Credit: 2

1. Course Description:

This course aims to provide students with essential knowledge and skills for designing, constructing, and managing building projects. It covers a wide range of construction materials, methods, and technologies. Through practical projects, case studies, and field visits, students will acquire hands-on experience while enhancing their critical thinking and problem-solving abilities.

Course Contents:

Unit 1: Introduction (2 hrs)

1.1 Building technology's importance in civil engineering and the construction industry
1.2 Buildings types by structure and uses
1.3 Building of main architectural, structural, and Service components, Heat phenomena (HVAC) in Building and orientation & planning of buildings.

Unit 2: Foundations and Basements (4 hrs)

2.1 Introduction to building components, Function of Foundation and Essential requirements a Foundation
2.2 Types of Foundation, Site investigation and methods of site exploration.
2.3 Common problem in existing foundations, Earthquake effects on foundation, water proofing of basement and their remedies.
2.4 Damp proof Course.
2.5 Shoring and underpinning

Unit 3: Masonry Works (3 hrs)

3.1 Types of Masonry works
3.2 Brick masonry, Block masonry, stone masonry (Types and Specification)
3.3 Bonds in Brick wall.
3.4 Types of Brick wall
3.5 Composite masonry

Unit 4: Floors, Vertical Transportation and Roof (4 hrs)

4.1 Floors and its types.
4.2 Different types of vertical transportation (ladder, ramps, Lift and escalators)
4.3 Stair and it's types, elements, essential
4.4 Requirements and space design of staircase.
4.5 Roof and it's types
4.6 Timber roofs (Single roof, Double roof and triple roof)

4.7 Steel trusses and their components.
4.8 Roof coverings. (Types and construction detail)

Unit 5: Openings, Joints and Earthquake Protection (5 hrs)

5.1 Door, Window and Ventilation types
5.2 Lintels and Arches (Types and details)
5.3 Types of joints: expansion joint, Contraction joints,
5.4 Construction joints, Sliding joints, cold joints, and Isolation joints
5.5 Treatment and detailing of joints at the Different level
5.6 Treatment and joints in external walls ,Shear wall
5.7 Earthquake Protection of Buildings
5.8 Techniques of Retrofitting and Retrofitting materials

Unit 6: Temporary Construction (2 hrs)

6.1 Scaffolding: Types of scaffolds and details
6.2 Timbering for excavations and trenches
6.3 Formworks for reinforced concrete construction
6.4 Shoring: horizontal, slant and vertical shores

Unit 7: External and Internal finishing (5 hrs)

7.1 Cladding for load bearing and framed structures
7.2 Brick and stone facing
7.3 Cladding in concrete panels and their construction details
7.4 Plastering, punning and pointing
7.5 Properties and application of paints
7.6 Partitions: types, functions and methods of construction
7.7 Mobile partitions (Details)
7.8 Suspended and false ceilings: types, functions and methods of construction

Unit 8: Water Supply and Drainage (3 hrs)

8.1 Mains of water supply: storage and distribution system
8.2 Hot water supply
8.3 Drainage of sewage and waste
8.4 Rainwater pipes and gutters
8.5 Septic tanks and Soak pit
8.6 Rainwater harvesting

Unit 9: Electrical Services (2 hrs)

9.1 Residential and commercial requirements General principles
9.2 Wiring system and factor affecting the choice of wiring
9.3 Trunkings, busbars and ducts for electrical distribution ,Safety precautions and Earthing

Tutorial: (30 Hours)

Students will be taught to design a residential/office building and prepare complete working drawings

with essential details. Student will be allowed to prepare a building plan to work out detailed drawings for tutorial exercises. There should case study about building types, building components.

- Drawings of site plan, foundation trench plan, section and timbering of foundation trench.
- Detailed drawings of important building components (foundation, plinth, and superstructure).
- Detailing of frames and shutters of doors and windows;
- Details of basement waterproofing, Construction details of the roof
- Drawing plan and section of dog legged stair case. Treatment of expansion joints
- Septic tank, soak pit and isometric view of pipe layout.
- Layout drawing of power, light circuit and other networks.

Reference Books

1. Punmia, B.C., Jain, Ashok K. & Jain, ArunK. (2008), Building Construction,Laxmi Publications (P) Ltd., New Delhi.1.
2. Chudley, R. (1987). Construction Technology, Longman Scientific and Technical, Harlow, England
3. Reid, E. Understanding Buildings, MIT Press.
4. Olin, H.B. Construction Principles, Methods and Materials
5. Ching, F.D.K. Building Construction Illustrated.
6. Kumar, S. (2010). Building Construction, Standard Publishers Distributors, New Delhi.
7. Singh G. (2010). Building Construction, Standard Book House, New Delhi.

Evaluation:

The final evaluation will have questions from all units. The marks distribution from different units shall be as follows:

Unit	Unit Title	Scheduled Hours	Marks*
Unit 1	Introduction	2	4
Unit 2	Foundations and Basements	4	8
Unit 3	Masonry Works	3	6
Unit 4	Floors, Vertical Transportation and Roof	4	8
Unit 5	Openings, Joints and Earthquake Protection	5	10
Unit 6	Temporary Construction	2	4
Unit 7	External and Internal finishing	5	10
Unit 8	Water Supply and Drainage	3	6
Unit 9	Electrical Services	2	4
	Total	30	60

**Note: The marks distribution shown in the table above might be subjected to minor changes.*

BACHELOR IN CIVIL ENGINEERING, RAJARSHI JANAK UNIVERSITY

SURVEYING I

Course Code: CE 105

Lecturer : 3 **Year: II**

Tutorial : 1 **Part: I**

Practical : 7

Course Objectives:

This course aims to equip students with foundational knowledge and practical skills in surveying, focusing on plane surveying techniques essential for Civil Engineering projects. Students will learn to apply appropriate methods, utilize modern tools, and produce accurate maps through a blend of theory and fieldwork.

1 Introduction to surveying (5 hours)

1.1 Overview of surveying: History, principles, and classification

1.2 Types of errors in surveying: Systematic, random, and blunders

1.3 Accuracy and precision in measurements

1.4 Map scales and their use in surveying

1.5 Instruments used in traditional and modern surveying

2 Linear Measurements and chain surveying (7 hours)

2.1 Instruments used for linear measurements: Chains, tapes, and measuring wheels

2.2 Principles of chain surveying: Direct and indirect measurements

2.3 Errors in linear measurements and how to correct them (temperature, slope, and tape sag)

2.4 Tape correction methods: Standard and temperature corrections

2.5 Calculations for chain surveying: Adjustments for measured distances

3 Compass surveying (6 hours)

3.1 Types of compasses and their uses in surveying

3.2 Bearings: Types, calculation methods, and conversions

3.3 Adjustments: Checking for and correcting errors due to local attraction

3.4 Compass traversing: Procedure and typical problems

3.5 Calculation of included angles in a traverse

3.6 Magnetic declination and its correction for field measurements

4 Levelling (8 hours)

4.1 Types of levelling: Differential levelling, profile levelling, and fly levelling

4.2 Instruments used: Dumpy level, auto level, and leveling rods

4.3 Levelling terminology: Benchmark, reduced level, height of instrument

4.4 Calculations in levelling: Rise and fall method, height of instrument method

4.5 Refraction and curvature corrections in levelling

4.6 Precautions to take to minimize errors in levelling

5 Theodolite Surveying (6 hours)

5.1 Components and working principle of a theodolite

5.2 Methods for measuring angles: Repetition and reiteration

5.3 Angle measurement errors: Types and corrections

5.4 Theodolite adjustment: Temporary and permanent

5.6 Calculating horizontal and vertical angles

5.7 Determining the accuracy of angle measurements and checking for consistency

6 Traversing and Tacheometer (7 hours)

6.1 Principles of Traversing: Types of traverses (open, closed) and basic procedures.

6.2 Errors in Traversing: Sources of angular and linear errors, and how to mitigate them.

6.3 Adjustment Methods: Applying Bowditch method for closed traverse adjustments.

6.4 Tacheometric Surveying: Principles of tacheometry, methods (stadia, tangential), and field applications.

6.5 Tacheometric Calculations: Determining distances and elevations using tacheometric measurements.

7 Triangulation and Trilateration (7 hours)

7.1 Principles and methods of triangulation and trilateration

7.2 Importance of well-conditioned triangles and strength of figures in triangulation

7.3 Methods for measuring angles and calculating distances in triangulation

7.4 Trilateration: Using distance measurements to determine positions

7.5 Error propagation in triangulation and trilateration

7.6 Application of triangulation in large-scale surveys and construction projects

8 Total Station and EDM (8 hours)

8.1 Components and working principle of a theodolite

8.2 Methods for measuring angles: Repetition and reiteration

8.3 Angle measurement errors: Types and corrections

8.4 Theodolite adjustment: Temporary and permanent

8.5 Calculating horizontal and vertical angles

8.6 Determining the accuracy of angle measurements and checking for consistency

9 Introduction to Modern Survey Techniques (6 hours)

9.1 Overview of Modern Technologies: Introduction to GPS and Total Stations.

9.2 Traditional vs. Modern Methods: Key differences and benefits of modern equipment.

9.3 Digital Data and Software: Role of digital systems in data recording and processing.

9.4 Emerging Trends: Brief introduction to Robotics, LiDAR, and UAV surveying.

9.5 Applications: Use of modern techniques in urban planning and infrastructure.

9.6 Future of Surveying: Integration of traditional methods with new technologies.

Tutorial (15 hours)

1. Conversion of units between different measurement systems (e.g., feet to meters, acres to hectares).
2. Corrections for incorrect length of tape or chain.
3. Calculation of horizontal distances for sloping ground using step and slope methods.
4. Calculation of bearings from given angles and vice versa.
5. Conversion between whole-circle bearings (WCB) and reduced bearings (RB).
6. Correction of magnetic declination for field measurements.
7. Calculation of Reduced Levels (RLs) using the height of the instrument (HI) and rise-and-fall methods.
8. Numerical examples on differential and profile leveling.
9. Calculation of horizontal distance and elevation using the tacheometric formula
10. Problems on determining the horizontal and vertical components of the distance when the line of sight is inclined

Practical (105 hours)

1. Introduction to Surveying Instruments
2. Horizontal, Vertical, and slope distance measurement
3. Chain survey and detailing
4. Compass traversing and detailing by compass and offset method
5. Two peg test and differential leveling, profile levelling, fly levelling
6. Angular measurement using theodolite

7. Measure horizontal distances and elevations using a tacheometer.
8. Traverse Computation using total station
9. Preparation of topographic map
10. Two set horizontal angle measurement of polygon by total station by manual recording
11. Digital data recording by total station for the close traverse and plotting

Evaluation Schedule:

The final evaluation will have questions from all units. The marks distribution from different units shall be as follows:

Chapters	Hours	Mark distribution*
1	5	5
2	7	7
3	6	7
4	8	7
5	6	7
6	7	6
7	7	7
8	8	8
9	6	6
Total	**60**	**60**

Text books

1. Bannister, A., Raymond S., Baker R. (1998). Surveying 7th Edition. Pearson,
2. Punmia B.C., Jain A.Kr., Jain A.K. (2005). SURVEYING VOL. I; VOL II & VOL III. Laxmi publication.
3. Wolf, P.R., Brinker, R.C. (2010). Elementary Surveying, Harper Collins college publishers
4. Basak N.N. (2004), Surveying and Levelling. Tata McGraw-Hill Education Pvt. Ltd.
5. Agor R. (1980). A Text Book of Surveying and Levelling. khanna publisher India
6. Duggal S.K. (2013). Surveying: Volume 1 & 2. Tata McGraw - Hill Education
7. Dhakal B.B., Karki B.K. (2019). Engineering surveying I & II. Second edition.

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FLUID MECHANICS

Course Code: CE 104

Lecturer: 4 **Year: II**

Tutorial: 2 **Part: I**

Practical: 1 **Course Credit: 4**

Course Objectives:

The objective of this course is to provide the concept of fluid behavior in both static and dynamic states, applying these principles to solve Civil Engineering problems. It involves studying fluid properties, fluid statics and dynamics, and using conservation laws to model fluid behavior. Moreover, it equips students with the skills to apply concepts like the momentum equation, boundary layer theory, and dimensional analysis in practical Civil Engineering applications.

Course Contents:

Unit 1: Fundamental of Fluids **(10 Hrs)**

1.1 Definition, scope and application in civil engineering

1.2 Control volume and continuum concept

1.3 Fluid Properties: mass density, specific weight, specific gravity, specific volume, cavitation, vapor pressure, surface tension, capillarity and viscosity

1.4 Types of fluid pressure, pressure head and laws of pressure

1.5 Measurement of Pressure: Pressure head of a liquid, Pascal's Law, manometers (piezometer, U-tube manometer and micro-manometers)

Unit 2: Hydrostatic Forces on Submerged Surfaces **(8 Hrs)**

2.1 Concept of hydrostatics on plane and curved surfaces

2.2 Total pressure and center of pressure (horizontal, vertical, inclined plane and curve surfaces)

2.3 Pressure diagram (horizontal, vertical and inclined plane and curve surfaces)

2.4 Computation of pressure forces on gates, dams, water tank and other hydraulic structures (plane and curve)

Unit 3: Buoyancy and Floatation **(8 Hrs)**

3.1 Buoyancy and Archimedes principle, floatation concept

3.2 Condition of equilibrium: stability of submerged and floating bodies

3.3 Metacenter and metacentric height

3.4 Determination of metacentric height (analytical and experimental method)

3.5 Liquid in relative equilibrium: liquid in a container subjected to uniform acceleration in horizontal, vertical and inclined directions; uniform radial acceleration about vertical axis

Unit 4: Fluid Kinematics (6 Hrs)

4.1 Lagrangian and Eulerian concept in fluid flow

4.3 Types of fluid flow: uniform and non-uniform; steady and unsteady; one, two, and three dimensional; laminar and turbulent; rotational and irrotational; compressible and incompressible

4.2 Fluid flow patterns: streamlines, streak lines, path lines, stream tube, stream functions and velocity potentials functions, basis of flow nets

4.4 Conservation principle of mass; Continuity equation: continuity equation in Cartesian and Polar coordinates

4.5 Flow through stream tube, discharges and mean velocity of flow

Unit 5: Fluid Dynamics (6 Hrs)

5.1 Various forces acting on fluid in motion (gravitational, pressure, viscous, turbulent, surface tension and compression)

5.2 Introduction to Navier-Stokes' equation of motion

5.3 Development of Euler's equation of motion and its application

5.4 Bernoulli's equation: derivation, assumptions, application examples

5.5 Momentum principle and equations (one and two-dimensional)

Unit 6: Application of Energy and Momentum Equations (10 Hrs)

6.1 Flow measurement devices: Venturi-meter (horizontal, inclined & vertical), Orifice meter, Nozzle meter and Pitot tube

6.2 Flow through orifices: small, large, partially and totally submerged

6.3 Hydraulic coefficients (Cv, Cc and Cd) and their determination

6.4 Flow over notches and weirs: Discharge equations, concept of end contraction and approach velocity

6.5 Force exerted by jets striking a flat plate, moving plane and curve vanes

6.6 Force exerted on pipe bends and closed conduits

Unit 7: Dimensional Analysis and Similitude (6 Hrs)

7.1 Introduction to dimensional analysis (physical quantity and their dimensions)

7.2 Methods of dimensional analysis: Rayleigh’s method and Buckingham’s π-theorem

7.3 Application of dimensional analysis

7.4 Concept of physical modelling and its relation to dimensional analysis

7.5 Laws of similarity

7.6 Model laws: Application of Reynold's and Froude Model law

Unit 8: Boundary Layer Theory (6 Hrs)

8.1 Description of boundary layer, application and its thickness

8.2 Laminar and turbulent boundary layer on a flat plate with zero pressure gradient

8.3 Friction drags for laminar and turbulent boundary layer

8.4 Effect of pressure gradient and flow separation

8.5 Concept of drag and lift, Drag on cylinder and flat plate

List of Tutorials (30 hours)

1. Numerical exercises for the calculation of capillary rise/fall, surface tension, viscosity, shear stress, and pressure measurement using piezometer and manometer (Unit 1) (5 Hrs)
2. Numerical exercise on calculation of total pressure force and Centre of pressure (horizontal, vertical, inclined, plane and curve surfaces) using formulas and pressure diagram Computation of pressure forces on gates, dams, head water tank and other hydraulic structures (plane and curve) (Unit 2) (5 Hrs)
3. Numerical exercises for the determination of metacentric height, condition of stability of floating object, position of liquid in moving container, amount of spill (Unit 3) (3 Hrs)
4. Numerical exercises on verification of continuity equation, determination of components of Velocities (Unit 4) (3 Hrs)
5. Numerical exercises on flow calculation using Bernoulli's equation in pipes (Unit 5)(3 Hrs)
6. Numerical exercises on Determination of flow by using venturi-meter, orifice meter, calculation of hydraulic coefficient, determination of force using impulse-momentum equation, forces on pipe bends (Unit 6) (6 Hrs)
7. Numerical exercises on Solving the problems related to dimensional analysis (Rayleigh's and Buckingham's π); Calculation of model/prototype dimensions using Reynold's and Froude Model law (Unit 7) (3 Hrs)
8. Numerical exercises for the calculation of drag and lift forces (Unit 8) (2 Hrs)

List of Practical (15 hours)

1. Determination of viscosity of fluid
2. Determine the hydrostatic force on a submerged body

3. Determine the stability of a floating body
4. Verification of Bernoulli's theorem
5. Determination of impact of flow jet
6. Determine the coefficients of Flow through orifice, over broad-crested weir

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Reference Books

1. Rajput, R. K. “Fluid Mechanics and Hydraulic Machines” S. Chand and Company Limited
2. Modi, P.N. and Seth, S. M. “Hydraulics and Fluid Mechanics in including Hydraulics Machines” Rajsons Publications PVT LTD
3. Bansal, R. K., “A Text book of Fluid Mechanics and Hydraulic Machines” Laxmi Publications (P) LTD
4. Jain, A.K., “Fluid Mechanics: Including Hydraulic Machines” Khanna Publishers (rs)
5. John M. K. Gasiorek, Lynne Jack, J. F. Douglas, John Swaffield, “Fluid Mechanics” Pearson College
6. Pritchard, Fox and McDonalds. *Introduction to Fluid Mechanics*

Evaluation:

The final evaluation will have questions from all units. The marks distribution from different units shall be as follows:

Units	Unit Title	Scheduled Hours	Marks*
Unit 1	Fundamental of Fluids	10	10
Unit 2	Hydrostatic Forces on Submerged Surfaces	8	8
Unit 3	Buoyancy and Floatation	8	8
Unit 4	Fluid Kinematics	6	6
Unit 5	Fluid Dynamics	6	6
Unit 6	Application of Energy and Momentum Equations	10	6
Unit 7	Dimensional Analysis and Similitude	6	6
Unit 8	Boundary Layer Theory	6	6
	Total	**60**	**60**

**Note: The marks distribution shown in the table above might be subjected to minor changes.*

Math 4: Differential Equations

Course Code: SH 107

Lecturer: 2 **Year: II**

Tutorial: 1 **Part: I**

Practical: 0 **Course Credit: 2**

Course Objectives:

This course is intended to provide students with the concept and its applications in addressing first- and second-order ordinary differential equations, Laplace transforms, and partial differential equations.

Course Contents:

Unit 1: First Order Ordinary Differential Equations (ODE's) (6 hours)

1.1 Introduction

1.2 Separable equations, Exact differential equations, Integrating factors, initial value problems

1.3 Linear first order differential equations, Bernoulli's equation

1.4 Applications of first order differential equations (Like; Newton law of cooling and Falling body problems).

Unit 2: Linear Second Order Ordinary Differential Equations (9 hours)

2.1 Introduction

2.2 The fundamental theorem, Homogeneous second order linear ordinary differential equation with constant and variable coefficients

2.3 Non-homogeneous second order ordinary differential equation, Solution by method of undetermined coefficient and method of variation of parameters

2.4 Applications of second order differential equations (Like: Harmonic motions, Deflection of beam and Mass-spring system).

Unit 3: Laplace Transforms (9 hours)

1.1 Introduction

1.2 Definition of Laplace transform, Laplace transform of derivatives and integrals, Derivatives and integrals of Laplace transforms

1.3 Inverse Laplace transforms, Shifting Theorems, Laplace transforms of periodic functions, Partial fractions, Convolution

1.4 Application to differential equation with constant coefficient.

Unit 4: Partial Differential Equations (PDEs) (6 hours)

1.1 Introduction

1.2 Some important forms of PDEs, Types and Normal forms of Linear PDEs

1.3 Solution techniques: Solvable as Ordinary differential equations, Variable separations
1.4 Applications on wave equations, 1D- dimensional heat flow equation.

List of Tutorials (15 hours)

There shall be related tutorials exercised in class and given as regular homework exercise.

Tutorial can be as following for each specified chapters

1. Solution of Separable equations, Exact differential equations, Integrating factors, Bernoulli's equations (2hrs)
2. Solution of linear first order differential equations initial problems and their applications.(1hr)
3. Solutions of Homogeneous second order linear differential equations with constant and variable coefficients (3hrs)
4. Non-homogeneous second order differential equations, solution by method of undetermined coefficient and method of variation of parameters and their applications.(2hrs)
5. Problems on Laplace and Inverse Laplace transform of different functions.(3hrs)
6. Solution of IVP using Laplace transform (1hr)
7. Solutions of partial differential equations solutions (3hrs)

Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics (10th Edition), Wiley Eastern Ltd.
2. SS Sastry, Advanced Engineering Mathematics, PHI.
3. BS Grawel, Higher Engineering Mathematics, Khanna Publication.
4. Toya Narayan Poudel, Hem Raj Pandey and Youb Raj Gaire, Calculus-I & II, KEC Publication and Distribution Pvt. Ltd, Kathmandu, Nepal.
5. Advanced Engineering Mathematics by H. K. Das, S. Chand, and New Delhi.

Evaluation:

The final evaluation will have questions from all units. The marks distribution from different units shall be as follows:

Units	Unit Title	Scheduled Hours	Marks*
Unit 1	First Order Ordinary Differential Equations (ODE's)	6	12
Unit 2	Linear Second Order Ordinary Differential Equations	9	18
Unit 3	Laplace Transforms	9	18

Unit 4	Partial Differential Equations (PDEs)	6	12
	Total	**30**	**60**

**Note: The marks distribution shown in the table above might be subjected to minor changes.*

Probability and Statistics

Course Code: SH 108

Lecturer: 3 **Year: II**

Tutorial: 1 **Part: I**

Practical: 0 **Course Credit: 3**

Course objectives:

This course is intended to develop the student's skill on various statistical methods and techniques for analyzing data in civil engineering fields. The course provides overview of descriptive statistics, probability and probability distributions, sampling and estimation, hypothesis testing, simple correlation and regression with emphasis on examples of engineering field. At the end of completion of this course, the students will be able to understand and apply:

- Summarize, present and compute various descriptive statistics
- Find probabilities, mean and variance of different probability distributions, joint probability distribution
- Identify appropriate sample size, use interval estimation to estimate population parameter
- Design and make tests of hypothesis about population parameter
- Identify regression models that describe the dependent and independent variables

Course Contents:

1: Descriptive Statistics (5 hrs)

1.1 Introduction of statistics and its applications in engineering
1.2 Sources of data: primary and secondary source
1.3 Collection and presentation of data (Diagrammatic as well as graphical presentation)
1.4 Measure of central tendency, partition values and measures of dispersion

2: Probability (7 hrs)

2.1 Basic probability, additive law, multiplicative law, Baye's theorem, conditional probability and independence
2.2 Random variables, probability mass/density function and probability distribution function
2.3 Mathematical expectation of random variables

3: Discrete Probability Distributions: (4 hrs)

3.1 Binomial distribution
3.2 Poisson distribution
3.3 Negative Binomial distribution
3.4 Hyper geometric distribution

4: Continuous Probability Distributions: (5 hrs)

4.1 Rectangular or uniform distribution
4.2 Normal distribution
4.3 Gamma and Beta distributions
4.4 Exponential distribution

5: Bivariate Random Variables and Joint Probability Distribution (4 hrs)

5.1 Joint probability mass function, joint probability density function, joint probability distribution function
5.2 Marginal probability mass function, marginal probability density function and conditional probabilities

6: Sampling and Estimation (7 hrs)

6.1 Sampling and its importance
6.2 Probability and non probability sampling
6.3 Sampling distribution of mean and standard error
6.4 Central limit theorem and concepts of student's t-distribution
6.5 Concept of point and interval estimation
6.6 Sample size determination
6.7 Confidence interval for single mean and difference of two population means
6.8 Confidence interval for population proportion

7: Testing of Hypothesis (8 hrs)

7.1 Basic concept in statistical hypothesis and hypothesis testing
7.2 Errors in hypothesis testing, critical value and p-value
7.3 One sample test for mean and proportion
7.4 Two sample test for mean and proportions
7.5 Dependent/paired t - test
7.6 Chi-square test of independence

8: Correlation and Regression (5 hrs)

8.1 Simple correlation and its properties
8.2 Simple linear regression, estimation of regression coefficient by using least square estimation method
8.3 Standard error of estimate and coefficient of determination

List of Tutorials (15 hours)

Numerical problems as demanded by the theory of each chapter will be assigned for the students and they are encouraged to solve the problems by using appropriate statistical software. Tutorial can be as following for each specified chapter:

1. Basic Concept of statistical software (Microsoft excel, SPSS etc) (3 hours)

2. Descriptive statistics (2 hours)

3. Probability and probability distributions chapter 2, 3, 4 (5 hours)

4. Sampling and estimation (2 hours)

5. Hypothesis testing (2 hours)

6. Simple correlation and regression analysis (1 hour)

Reference Books

1. Johnson, Richard A. *Probability and Statistics for Engineers* (Eighth edition) New Delhi: PHI learning private limited 2018.

2. Sheldom, M. Ross. *Probability and Statistics for Engineers and Scientist* (Forth edition) New Delhi: Cengage learning.

3. S.C Gupta and V.K Kapoor. *Fundamentals of Mathematical Statistics*, (Ninth revised edition) , Sultan Chand & Sons Educational Publishers, 2007.

4. Budhathoki T.B. *Probability and Statistics for Engineers*, (Fifth edition) Heritage Publishers and Distributors Pvt. Ltd, Kathmandu, Nepal.

5. Paudel T.N, Pradeep Kumar. Probability and Statistics for Engineers, Sukunda Pustak Bhawan (Publishers and Distributers), Bhotahity Kathmandu

6. Devore, Jay L. *Probability and Statistics for Engineering and Sciences* (Eighth edition) New Delhi: Cengage learning.

Evaluation:

The final evaluation will have questions from all units. The marks distribution from different units shall be as follows:

Units	Unit Title	Scheduled Hours	Marks*
Unit 1	Descriptive statistics	5	7
Unit 2	Probability	7	10
Unit 3	Discrete probability distribution	4	4
Unit 4	Continuous probability distribution	5	8
Unit 5	Bivariate r.v. and joint probability	4	5
Unit 6	Sampling and estimation	7	9
Unit 7	Hypothesis testing	8	10
Unit 8	Correlation and regression	5	7
	Total	**45**	**60**

**Note: The marks distribution shown in the table above might be subjected to minor changes.*

Engineering Geology

Course Code: CE 107

Lecturer: 3 **Year: II**

Tutorial: 1 **Part: I**

Practical: 2 **Course Credit: 3**

Course Objectives:

This course is intended to give students studying civil engineering a foundational understanding of geology. After successful completion of this course the students will be able:

- to identify different types of rocks and their significance in physical infrastructure
- to understand the various natural dynamic processes and their influence on the surficial features, natural material and their consequences
- to develop skills on geological interpretation for engineering structures and natural phenomena.
- to enhance the knowledge on hydrogeology, engineering geology, geological setting of the Himalaya.
- to develop the skill for the site investigation for the construction of various engineering infrastructures.

Course Contents:

Unit 1: Introduction to Engineering Geology (2 hrs)

1.1 Introduction of Geology and Engineering Geology: Definition of Engineering Geology, Different branches of Geology and their interrelations

1.2 Scope, Objective, Importance and Application of Geology in Civil Engineering Projects

1.3 Engineering Geological System (EGS) in Infrastructure Development and its evaluation

1.4 Engineering geological maps, their classification and preparation

Unit 2: Earth and its Structure (2 hrs)

2.1 The Earth: its origin, Geological Time Scale, and Internal Structure

2.2 Physical Features of the earth surface: Continental & oceanic features

2.3 Plate Tectonics, Mountain Building Process, and the Himalayas Formation

Unit 3: Geology of Nepal Himalayas (3 hrs)

3.1 Major discontinuities system and Tectonic divisions of the Nepal Himalaya

3.2 Geology and Engineering Geological Challenges of the Terai, Siwaliks, Lesser Himalaya, the Higher Himalaya, and Tibetan-Tethys zone with their mitigation strategies

Unit 4: Mineralogy and Petrology (5 hrs)

4.1 Formation of minerals, crystal morphology, physical and chemical properties of minerals

4.2 Rock forming minerals and their significance

4.3 Introduction to Rock and Rock Cycle: Petrographic classification of rocks

4.4 Introduction, classification, structure, texture, Engineering Significance, and uses of igneous, sedimentary, and metamorphic rocks

4.5 Engineering properties and field identification of common rock types (Sedimentary, Metamorphic, and Igneous)

Unit 5: Measurement, Analysis, and interpretation of structural Geological data (10 hrs)

5.1 Rock deformation: Types and causes

5.2 Attitude /Orientations of Geological structures (Dip, Strike, Plunge, Trend) and their measurement

5.3 Geological structures: Primary sedimentary structures (bedding plane, lamination, cross bedding, graded bedding ripple marks, mud cracks etc.) and Secondary structures: Continuous (lineation, foliation, boudinage, crenulation cleavage, folds) and discontinuous (cracks fractures, joints, faults & thrusts)

5.4 Engineering Significance and Field Identification criteria of Geological structures

5.5 Introduction to rock mass, its properties, classification systems: Rock Mass Rating (RMR), NGI-Q system and Geological strength index (GSI)

5.6 Stereographic projection (Plotting a line & plane), Structural geological data analysis using stereo net, rose diagrams, block diagrams and histogram

5.7 Kinematic analysis of discontinuity for rock slope stability: Plane, Wedge, & Toppling failures analysis using stereographic projection

Unit 6: Geomorphology and Hydrogeology (8 hrs)

6.1 Geomorphological processes: Weathering and erosion

6.2 Geological agents and landforms produced by the various geological agents (Running water, Glaciers, groundwater, sea water and wind)

6.3 River channel morphology

6.4 Basic groundwater Movement, its Origin, and types

6.5 Different types of aquifers and spring water system in the context of Nepal

6.6 Groundwater recharging: Natural processes and Artificial technique

Unit 7: Geological Hazards and their Mitigation (6 hrs)

7.1 Major Geological hazard in soil mass and rock mass: Subsidence, Mass Wasting, Landslides, Earthquake, Flood, Liquefaction, GLOF (Glacial Lake Outburst Flood) and Volcanism

7.2 Integrated Approaches for Mitigating Geological Hazards: Bio-Engineering and Structural Control Measures

Unit 8: Role of Engineering Geology in Site selection and Investigation (5 hrs)

8.1 Site Investigation and its elements: Types of Site Investigations (Direct, Semi-Direct and Indirect Methods)

8.2 Introduction of bore hole drilling, logging, sampling; and bore hole problems

8.3 Study of topographic, geological and engineering geological maps, satellite imagery, and Synthetic-Aperture Radar (SAR) images

8.4 Geological investigation and site selection for dams, reservoirs, buildings, roads, bridges, and underground excavation/Tunnels

Unit 9: Reserve Estimation of construction Materials (4 hrs)

9.1 Construction materials: aggregates, clay, sand, limestone, marbles, slates & other building stones

9.2 Reserves and their Types, exploration, and estimation of reserve for construction materials

9.3 Role of different types of maps (geological, engineering geological, and topographic) and aerial photograph for construction material survey

List of Tutorials (30 hours)

There shall be related tutorials exercised in class and given as regular homework exercises. The tutorial can be as follows for each specified chapter. The following tutorial activities of 15 hours per group of maximum 24 students should be conducted to cover all the required contents of this course:

1. Study drawings of various geological structures and solving their attitudes/orientations related problems (2 hours)
2. Solve the bore hole/three-point problems (2 hours)
3. Study of thickness of bedrock (3 hours)
4. Stereographic projection (plane and pole) (3 hours)
5. Kinematic analysis of rock slope stability (stereographic projection/stereo net) (3 hours)
6. Exercise on rock mass classification system and their uses (2 hours)

List of Practicals (30 hours for a group of maximum 24 students)

1. To identify the rocks (Igneous, sedimentary and metamorphic) (5 hrs)
2. To study and identify the rock forming minerals and their distribution using binocular microscope (5 hrs)
3. Study of weathering profiles and their effect on rock mass properties (5 hrs)
4. Interpretation of topographic, geomorphologic and geologic maps (5 hrs)
5. Measurement of strike, dip and dip direction of geological structures in Field: use of geological compass in field (5 hrs)
6. To study and prepare engineering geological maps (5 hrs)

A **three-day fieldwork** to provide practical on-site knowledge on preparation and interpretation of engineering geological mapping (Petrology, Structural geology, active

faults, Geomorphology, Geo-hazards, River morphology, Rock mass, and engineering geological site investigation and so on). Also, visit any one of the Road / Highway Projects under construction or have severe geo-hazard Problem /any one of the Hydropower Projects under construction. Students must submit report after the fieldwork (*Attendance in Fieldwork is Compulsory).*

Reference Books

1. Sivakugan, N., Shukla, S. K., & Das, B. M. (2013). Rock mechanics: an introduction. CRC Press.
2. Prabin, S. (2023). Engineering & General Geology. S.K. Kataria & Sons. ISBN 978-93-5014-267-7
3. Dhital, M.R. (2015). Geology of the Nepal Himalaya, Springer International Published, Switzerland.
4. BB. Deoja, Meghraj Dhital, A. Wagner, K.B. Thapa "Mountain Risk Engineering Handbooks" , ICIMOD
5. Krynine, D., & Judd, W. R. (2005). Principles of Engineering Geology and Geotechnics. CBS Publishers.
6. DEBASIS, D. E. B., & KUMAR, V. A. (2016). Fundamentals and applications of rock mechanics. PHI Learning Pvt. Ltd.
7. Jonson, R.B., Degraff, J.V, John Wiley and Sons Inc. "Principles of Engineering Geology"
8. Deoja, B., Dhital, M., Wagner, A., & K.B, T. (1991). Mountain Risk Engineering Handbooks I and II. ICIMOD.
9. Price, D. (2009). Engineering Geology- Principles and Practice. (M. H. de Freitas, Ed.) Springer.
10. Hoek, E., and Brown, E.T. (2019). The Hoek-Brown failure criterion and GSI-2018 edition, Journal of Rock Mechanics and Geotechnical Engineering, 11, 445-463.
11. Vallejo, L.G.de., Ferrer, M., 2011. Geological Engineering, Routledge, Taylor and Francis Group,
12. Hoek "Rock Engineering",E A.A. Balkema Publishers
13. Krynione, D.P., Judd, W.R "Principles of Engineering Geology and Geotechnics" CBS Publishers and Distributers, New Delhi

Evaluation:

The final evaluation will have questions from all units. The marks distribution from different units shall be as follows:

Units	Unit Title	Scheduled Hours	Marks*
Unit 1	Introduction to Engineering Geology	2	3
Unit 2	Earth and its Structure	2	3
Unit 3	Geology of Nepal Himalayas	3	4
Unit 4	Mineralogy and Petrology	5	7
Unit 5	Measurement, Analysis, and interpretation of structural Geological data	10	13
Unit 6	Geomorphology and Hydrogeology	8	10
Unit 7	Geological Hazards and their Mitigation	6	8
Unit 8	Role of Engineering Geology in Site selection and Investigation	5	7
Unit 9	Reserve Estimation of construction Materials	4	5
	Total	**45**	**60**

**Note: The marks distribution shown in the table above might be subjected to minor changes.*

BACHELOR IN CIVIL ENGINEERING, RAJARSHI JANAK UNIVERSITY

Strength of Materials

Course Code: CE 103

Lecturer: 3
Tutorial: 2
Practical: 1

Year: II
Part: I
Course Credit: 3

Course Objectives:
The primary goal of the course is to build the fundamental understanding of students on material behavior, stress-strain relations, and failure types in the structural elements due to external loads and temperature variations, evaluate geometric properties of complex geometric figures and analyze structural members under flexure, shear, torsion and buckling.

1 Simple Stress and Strain (10 hours)

1.1 Basics of Strength of Materials
1.2 Objectives of Structural Design (Strength, Stiffness, Stability and Economy)
1.3 Concept of internal force and Deformation
1.4 Stresses and strains and their types
1.5 Material behavior under axial loading (Stress-strain diagram for mild steel, yield stress, proportional limit, elastic limit, strain hardening, ultimate stress/strength, ductility, toughness, elastic and inelastic strains)
1.6 Concept of factor of safety and allowable/permissible stress
1.7 Stress-strain behavior for ductile and brittle materials, proof stress
1.8 Hooke's law(axial, shear and volumetric), Young's modulus of elasticity, Modulus of Rigidity and Bulk Modulus of Elasticity
1.9 Lateral Strain and Poisson's ratio
1.10 Elongation of bars under axial loadings: Uniform and varying cross-sections, tapered sections, compound and composite bars
1.11 Use of compatibility equations for axially loaded indeterminate bars

1.12 Thermal stress and strain in simple, compound, composite and indeterminate bars
1.13 Multi-axial loading and generalized Hooke's law
1.14 Relationships between elastic constants
1.15 Saint-Venant's principle and stress concentrations

2 Geometric Properties of Sections (5 hours)

2.1 Review of Centre of gravity and Moment of Inertia for plane and built-up area sections, Parallel axis theorem, Perpendicular axis theorem (Polar moment of inertia) and Radius of gyration
2.2 Product moment of inertia
2.3 Principal axes and principal moment of inertia
2.4 Mohr's circle for principal moment of inertia

3 Principal Stress Analysis in 2D planes (5 hours)

3.1 Stresses in inclined plane: Normal stress under uniaxial loading, Normal and shear stress subjected to two mutually perpendicular planes
3.2 Principal planes and principal stresses
3.3 Maximum shear stresses
3.4 Mohr's circle diagram for principal stresses

4 Principal Strain Analysis (4 hours)

4.1 Plane strain: Normal and shear strains in inclined planes
4.2 Principal strains, maximum in-plane shear strains and their positions
4.3 Mohr's circle diagram for plane strain
4.4 Absolute maximum shear strain
4.5 Strain rosettes
4.6 Modes of failure for different materials and Introduction to failure theories

5 Thin Walled Vessels (3 hours)

5.1 Definition and characteristics
5.2 Types of stresses and strains in cylindrical and spherical pressure vessels
5.3 Calculation of stresses and strains in pressure vessels
5.4 Built-up Cylindrical and Spherical Pressure vessels

6 Torsion (5 hours)

6.1 Introduction to torsion

6.2 Derivation of torsion formula for a circular shaft
6.3 Torsional moments: Series and parallel combination of shafts and composite shaft
6.4 Comparison between solid and hollow shafts
6.5 Power transmitted by shafts
6.6 Statically indeterminate shafts
6.7 Combined bending and torsion
6.8 Torsion in non-circular shafts

7 Theory of Flexure (8 hours)

7.1 Introduction to flexure
7.2 Coplanar and pure bending
7.3 Derivation of bending equation
7.4 Distribution of bending stress across the different beam cross-sections
7.5 Analysis of beams for symmetric and composite sections
7.6 Shear equation, shear stress variation in rectangular, circular, I and T sections
7.7 Slope and deflection in beams using double integration method (Macaulay's method): Simply supported and cantilever beams

8 Column Theory (5 hours)

8.1 Buckling and stability of columns
8.2 Classification based on slenderness ratio
8.3 Effect of support conditions and effective length
8.4 Derivation of Euler's formulae for different end conditions,
8.5 Limitations of Euler's formulae

Tutorial (30 hours)

1. Problems on stresses and strains on regular and irregular structural members due to external forces, self-weight and temperature change
2. Problems on geometrical properties of 2-D sections
3. Problems on principal stresses
4. Problems on principal strains
5. Problems on thin walled vessels
6. Problems on circular shafts due to torsion
7. Problems on flexure and deformation of beams
8. Problems on Buckling of columns

Practical (15 hours)

1. Tensile test and stress-stress curve for mild steel bar, HYSD bar, timber
2. Simple bending test on timber, steel, aluminum beams: Deflection, flexural relations and MOI comparisons
3. Torsion test on simple shaft to determine modulus of rigidity

4. Test on column behavior and buckling

Evaluation:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	10	13
2	5	7
3	5	7
4	4	5
5	3	4
6	5	7
7	8	10
8	5	7
Total	**45**	**60**

* There may be minor deviation in marks distribution.

Reference Books:

1. Motra G.B. (2021). A text book of strength of materials, 2nd Edition. Heritage Publishers & Distributors.
2. Rajput R.K., (2018). A Textbook of Strength of Materials, 7th Edition. S. Chand and Company Limited
3. Beer F.P. and Johnston E.R., (2015). Mechanics of Material. Tata McGraw Hill.
4. Hibbeler R.C., (2004). Statics and Mechanics of Materials, SI Edition. Prentice-Hall.
5. Popov E.P., (1978).Mechanics of Material, 2nd Edition. Prentice Hall of India
6. Vavikatti S. S., (2013).Strength of Materials, 4th Edition. Vikas Publishing House, New Delhi.
7. Gere J.M., Timoshenko S.P.,(2002). Mechanics of Materials, 5th Edition.Nelson Thornes.
8. Pytel A., Singer F.L.,(1998). Strength of Materials, 4th Edition. Harper Collins, India.

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SURVEYING I

Course Code: CE 105

Lecturer : 3 **Year: II**

Tutorial : 1 **Part: I**

Practical : 7 **Course Credit: 3**

Course Objectives:

This course aims to equip students with foundational knowledge and practical skills in surveying, focusing on plane surveying techniques essential for Civil Engineering projects. Students will learn to apply appropriate methods, utilize modern tools, and produce accurate maps through a blend of theory and fieldwork.

1 Introduction to surveying (5 hours)

1.1 Overview of surveying: History, principles, and classification

1.2 Types of errors in surveying: Systematic, random, and blunders

1.3 Accuracy and precision in measurements

1.4 Map scales and their use in surveying

1.5 Instruments used in traditional and modern surveying

2 Linear Measurements and chain surveying (7 hours)

2.1 Instruments used for linear measurements: Chains, tapes, and measuring wheels

2.2 Principles of chain surveying: Direct and indirect measurements

2.3 Errors in linear measurements and how to correct them (temperature, slope, and tape sag)

2.4 Tape correction methods: Standard and temperature corrections

2.5 Calculations for chain surveying: Adjustments for measured distances

3 Compass surveying (6 hours)

3.1 Types of compasses and their uses in surveying

3.2 Bearings: Types, calculation methods, and conversions

3.3 Adjustments: Checking for and correcting errors due to local attraction

3.4 Compass traversing: Procedure and typical problems

3.5 Calculation of included angles in a traverse

3.6 Magnetic declination and its correction for field measurements

4 Levelling (8 hours)

4.1 Types of levelling: Differential levelling, profile levelling, and fly levelling

4.2 Instruments used: Dumpy level, auto level, and leveling rods

4.3 Levelling terminology: Benchmark, reduced level, height of instrument

4.4 Calculations in levelling: Rise and fall method, height of instrument method

4.5 Refraction and curvature corrections in levelling

4.6 Precautions to take to minimize errors in levelling

5 Theodolite Surveying (6 hours)

5.1 Components and working principle of a theodolite

5.2 Methods for measuring angles: Repetition and reiteration

5.3 Angle measurement errors: Types and corrections

5.4 Theodolite adjustment: Temporary and permanent

5.6 Calculating horizontal and vertical angles

5.7 Determining the accuracy of angle measurements and checking for consistency

6 Traversing and Tacheometer (7 hours)

6.1 Principles of Traversing: Types of traverses (open, closed) and basic procedures.

6.2 Errors in Traversing: Sources of angular and linear errors, and how to mitigate them.

6.3 Adjustment Methods: Applying Bowditch method for closed traverse adjustments.

6.4 Tacheometric Surveying: Principles of tacheometry, methods (stadia, tangential), and field applications.

6.5 Tacheometric Calculations: Determining distances and elevations using tacheometric measurements.

7 Triangulation and Trilateration (7 hours)

7.1 Principles and methods of triangulation and trilateration

7.2 Importance of well-conditioned triangles and strength of figures in triangulation

7.3 Methods for measuring angles and calculating distances in triangulation

7.4 Trilateration: Using distance measurements to determine positions

7.5 Error propagation in triangulation and trilateration

7.6 Application of triangulation in large-scale surveys and construction projects

8 Total Station and EDM (8 hours)

8.1 Components and working principle of a theodolite

8.2 Methods for measuring angles: Repetition and reiteration

8.3 Angle measurement errors: Types and corrections

8.4 Theodolite adjustment: Temporary and permanent

8.5 Calculating horizontal and vertical angles

8.6 Determining the accuracy of angle measurements and checking for consistency

9 Introduction to Modern Survey Techniques (6 hours)

9.1 Overview of Modern Technologies: Introduction to GPS and Total Stations.

9.2 Traditional vs. Modern Methods: Key differences and benefits of modern equipment.

9.3 Digital Data and Software: Role of digital systems in data recording and processing.

9.4 Emerging Trends: Brief introduction to Robotics, LiDAR, and UAV surveying.

9.5 Applications: Use of modern techniques in urban planning and infrastructure.

9.6 Future of Surveying: Integration of traditional methods with new technologies.

Tutorial (15 hours)

1. Conversion of units between different measurement systems (e.g., feet to meters, acres to hectares).
2. Corrections for incorrect length of tape or chain.
3. Calculation of horizontal distances for sloping ground using step and slope methods.
4. Calculation of bearings from given angles and vice versa.
5. Conversion between whole-circle bearings (WCB) and reduced bearings (RB).
6. Correction of magnetic declination for field measurements.
7. Calculation of Reduced Levels (RLs) using the height of the instrument (HI) and rise-and-fall methods.
8. Numerical examples on differential and profile leveling.
9. Calculation of horizontal distance and elevation using the tacheometric formula
10. Problems on determining the horizontal and vertical components of the distance when the line of sight is inclined

Practical (105 hours)

1. Introduction to Surveying Instruments
2. Horizontal, Vertical, and slope distance measurement
3. Chain survey and detailing
4. Compass traversing and detailing by compass and offset method
5. Two peg test and differential leveling, profile levelling, fly levelling
6. Angular measurement using theodolite

7. Measure horizontal distances and elevations using a tacheometer.
8. Traverse Computation using total station
9. Preparation of topographic map
10. Two set horizontal angle measurement of polygon by total station by manual recording
11. Digital data recording by total station for the close traverse and plotting

Evaluation Schedule:

The final evaluation will have questions from all units. The marks distribution from different units shall be as follows:

Chapters	Hours	Mark distribution*
1	5	5
2	7	7
3	6	7
4	8	7
5	6	7
6	7	6
7	7	7
8	8	8
9	6	6
Total	**60**	**60**

Text books

1. Bannister, A., Raymond S., Baker R. (1998). Surveying 7th Edition. Pearson,
2. Punmia B.C., Jain A.Kr., Jain A.K. (2005). SURVEYING VOL. I; VOL II & VOL III. Laxmi publication.
3. Wolf, P.R., Brinker, R.C. (2010). Elementary Surveying, Harper Collins college publishers
4. Basak N.N. (2004), Surveying and Levelling. Tata McGraw-Hill Education Pvt. Ltd.
5. Agor R. (1980). A Text Book of Surveying and Levelling. khanna publisher India
6. Duggal S.K. (2013). Surveying: Volume 1 & 2. Tata McGraw - Hill Education
7. Dhakal B.B., Karki B.K. (2019). Engineering surveying I & II. Second edition.

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