Pokhara University Faculty of Science and Technology	
Course Code: GTE 252 (3 Credit)	Full Marks: 100
Course Title: Soil Mechanics (3-2-2)	Pass Mark: 45
Nature of the Course: Theory and Practical	Total Lectures: 45 hours
Level: Bachelor/ Year: II/ Semester: IV	Program: Bachelor of Civil Engineering

1. Course Description:

The course in Soil Mechanics is designed for the bachelor's degree in civil engineering. It is the first series in Geotechnical Engineering course and is a core course for civil engineering in every college/university across the globe. The course covers each and every aspect of soil mechanics starting from the origin of the soil, its phases, properties and behavior under different conditions, its strength to the slope stabilization techniques. The course mainly emphasizes the study of the physical properties of soils and the relevance of these properties as they affect soil strength, stability, drainage, etc.

2. General Objectives:

- This course deals with the fundamental principles governing soil behavior, exploring critical geotechnical properties and various geotechnical applications.
- An understanding of these basic concepts enhances the ability of students for the design of foundations of structures, retaining walls, tunnels, excavations, earth fills, stability of earth slopes etc.

3. Methods of Instructions:

Lecture, Tutorial, Discussion, and Laboratory tests.

Specific Objectives	4. Course Contents
At the end of Unit 1, students will be able • To know and explain about rock, soil, rock cycle. • To define the soil and describe its formation process and types. • To visualize the Phase structure of soil and to derive the functional relationships. • To determine the different index properties of soil in laboratory • To know and explain about the types of clay minerals • To classify the soil using various systems based on the properties.	**Unit 1: Introduction to soil, its Phases, Properties, and Classification (8 hrs)** 1.1 Origin of Rocks and Soils; Rock cycle 1.2 Definition of soil, Soil formation process, and its types. 1.3 Phase Diagram of Soil: Basic Definitions, Functional Relations 1.4 Index Properties of soil and their determination: Density, Specific gravity and moisture content of soil, Particle shape and size, Grain Size Distribution: Sieve analysis and Hydrometer Analysis, Relative Density of Soil, Consistency Limit of Soil and their Indices, Clay minerals: Montmorillonite, Kaolinite, and Illite, and Soil Classification Systems (Particle size, Textural, USCS, ISCS, AASHTO)
At the end of Unit 2, students will be able	**Unit 2: Compaction of Soil (5 hrs)**
• To define and know about the	2.1 Definition, and purpose of Compaction

definition and purpose of compaction in the field of civil engineering. • To relate dry density with varying moisture content in soil in order to obtain compaction curve and its features. • To conduct laboratory test to determine the compaction characteristics of soil. • To analyze the factors affecting the compaction of soil. • To apply the different methods of compaction based on the site condition. • To determine different methods to determine field density. • To describe the behavior of soil while compacted at dry of optimum and wet of optimum	2.2 Dry density and moisture content relationship 2.3 Laboratory Compaction Tests 2.4 Factors affecting compaction of soil 2.5 Effects of compaction on the engineering behavior of soil 2.6 Methods of Field Compaction 2.7 Determination of field density: Core Cutter method, Sand Cone method, Rubber balloon method, Water displacement method 2.8 Relative Compaction
At the end of Unit 3, students will be able	**Unit 3: Permeability, Capillarity, Seepage, and Effective stress, (10 hrs)**
• To know the concept of permeability • To determine coefficient of permeability of soil in laboratory and field as well. • To calculate equivalent permeability of stratified soil. • To know the concept of surface tension • To know the concept of capillary rise through soil and to calculate capillary rise. • To analyze the concept of quick sand condition and liquefaction while designing foundation. • To analyze seepage through soil • To analyze failure of an earthen structure through piping mechanism and to apply its preventive measures. • To calculate effective stress in soil and its effects on the strength of soil.	3.1 Permeability, Darcy's law 3.2 Laboratory and field determination of Permeability 3.3 Surface tension and Capillary rise of water in soil 3.4 Quick Sand Condition and Liquefaction 3.5 Equivalent permeability in stratified soil 3.6 Definition of Seepage, and Laplace equation for two-dimensional flow 3.7 Introduction to flow net, their characteristics, applications, and analysis of seepage discharge 3.8 Seepage through Earthen Dam, Concept and construction of Phreatic Line. 3.9 Piping and its Preventive Measures 3.10 Principles of Effective Stress and its effects on soil strength
At the end of Unit 4, students will be able	**Unit 4: Stress Distribution on Soil below the Applied Vertical Load (6 hrs)**
• To calculate the vertical stress developed at any depth or at any radial	4.1 Concept of Stress Distribution on Soil, Boussinesq's and Westergaard's Theory

distances due to the load applied on the ground surface using various stress distribution theories and related charts/tables. • To draw and know the variation of the vertical stress distribution on horizontal and vertical plane below the ground surface. • To locate the significant depth of foundation using the concept of pressure bulb.	4.2 Concept of Pressure Bulb and Vertical Stress Distribution on horizontal & vertical plane 4.3 Vertical Stress Distribution beneath the loaded area (Line load, Strip load, circular area, and Rectangular area), Newmarks and Fadum's chart 4.4 Approximate Method of Stress Distribution
At the end of Unit 5, students will be able	**Unit 5: Compressibility and Consolidation of Soil (8 hrs)**
• To define and understand the principles of consolidation, its type, and related theories. • To know the mechanism of consolidation given by Terzaghi's spring analogy model. • To calculate the time of consolidation • To conduct consolidation test in the laboratory. • To draw void ratio pressure relationship • To determine consolidation parameters of saturated soil • To know the types of consolidated clay and to determine pre-consolidation pressure • To determine consolidation settlement	5.1 Definition, Principles of consolidation, its type 5.2 Terzaghi's spring analogy model 5.3 One-Dimensional Consolidation theory 5.4 Consolidation test 5.5 Void ratio pressure relationships: Compressibility Characteristics (i.e. Compression Index, Coefficient of Compressibility, Recompression Index, Swelling Index, Coefficient of Volume change, etc.) 5.6 Normally Consolidated Clay and Over Consolidated Clay and determination of Over Consolidation (i.e. Pre-consolidation) Pressure 5.7 Determination of Consolidation Settlement 5.8 Determination of Coefficient of Consolidation by square root and logarithm of time fitting method
At the end of Unit 6, students will be able to understand about	**Unit 6: Shear Strength Soil, and Slope Stabilization Techniques (8 hrs)**
• To know the shear strength of soil and governing parameters. • To understand the Mohr-Coulomb's theory, plane of failure and principle planes and stresses. • To determination the shear strength parameters conducting different laboratory test. • To determine shear strength of clay and sand. • To know the types of slope and to find the causes and mechanism of slope failure.	6.1 Concept of shear strength of soil 6.2 Mohr-Coulomb's Failure Criteria 6.3 Mohr Circle, Normal Stress, Shear Stress, Principle planes, Principle stresses, and plane of failure 6.4 Determination of Shear Strength Parameters: (i) Direct Shear Test, (ii) Triaxial test: Consolidated Drained (CD) Test, Consolidated Undrained (CU) test, Unconsolidated Undrained (UU) Test, (iii) Unconfined Compression Test, and (iv) Vane Shear Test 6.5 Shear Strength of Clay and Sand 6.6 Types of slope, cause and mechanism of slope failure

• To determine the FOS and critical surface. • To stabilize the slopes using different techniques.	6.7 Factor of safety and critical surface 6.8 Slope Stabilization Techniques

5. List of Tutorials	
SN	**Numerical problems related to**
1.	Phase relationship and properties of soil
2.	Soil classification
3.	Compaction characteristics
4.	Effective stresses on hydrostatic, uniform seepage, Capillary, and uniform surcharge condition
5.	Determination of permeability of soil
6.	Computation of pore pressure at any point of flow net and Calculation of Seepage discharge through soil
7.	Computation of vertical stresses due to applied load (point load, line load, strip load, and UDL on circular Rectangular area)
8.	Use of Newmark and Fadum's chart to compute vertical stress
9.	Consolidation Settlement and Time Rate of Consolidation
10.	Shear strength of soil (c, φ, τ, principal planes, principal stresses, etc.)

6. List of Practical	
SN	**List of Practical**
1.	Determination of specific gravity and water content of soil
2.	Grain size analysis of soil (i.e. Sieve Analysis and Hydrometer Analysis)
3.	Determination of wet density of soil.
4.	Consistency Limits Test for fine-grained soil (i.e. LL, PL, and SL)
5.	Compaction Test
6.	Direct Shear Test
7.	Triaxial Test (Demonstration)
8.	Unconfined Compression Test
9.	Vane Shear Test
10.	Consolidation Test (Demonstration)
11.	Visual Classification Test of Soil (Demonstration)
12.	Experimental demonstration of water effect on sandcastle

5. Evaluation System and Students' Responsibilities

Evaluation System

The internal evaluation of a student may consist of assignments, attendance, term-exams, lab reports and projects etc. The tabular presentation of the internal evaluation is as follows:

Internal Evaluation	Weight	Marks	External Evaluation	Marks
Theory		**30**	**Semester End**	**50**
Attendance & Class Participation	10%			
Assignments	20%			
Presentations/Quizzes	10%			
Internal Assessment	60%			
Practical		**20**		
Attendance & Class Participation	10%			
Lab Report/Project Report	20%			
Practical Exam/Project Work	40%			
Viva	30%			
Total Internal		**50**		
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

8. Prescribed Books and References

Name of Authors / Name of Book / Publishers

Text Books:

1. Murthy, V.N.S. (2007). *Text Book of Soil Mechanics and Foundation Engineering (Geotechnical Engineering Series),* CBS Publishers and Distributors Pvt. Ltd. India
2. Ranjan, Gopal & Rao, A.S.R. (2000), *Basic and Applied Soil Mechanics,* New Age International Publishers, New Delhi, India.

References:

1. Terzaghi, Karl, Peck, R.B. & John, Wiley (1967). *Soil Mechanics in Engineering Practice,* New York.
2. T. William Lambe, Robert V. Whitman (1969), *Soil Mechanics*, JOHN WILEY & SONS, New York
3. T. William Lambe, *SOIL TESTING for Engineers*, John Wiley & Sons, Inc. New York
4. Dante Fratta, Jennifer Aguettant, Lynne Roussel-Smith (2007), *Introduction to Soil Mechanics Laboratory Testing*, CRC Press, New York
3. Braja M. Das (2002), *Principles of Geotechnical Engineering,* Thomson, Asia
4. Venkatramaiah, C. (Third Edition), *Geotechnical Engineering*, New Age International (P) Limited Publisher, India
5. Punmia, B.C, Jain, A.K.& Jain, Arun K. (Seventh Edition 2017). *Soil Mechanics and Foundation engineering,* Laxmi Publication Pvt. Ltd. India.
6. Adhikari P.B., Thapa H.J. A Text Book of Soil Mechanics, (2023), Sanskriti Prakashan, Kathmandu, Nepal

Pokhara University Faculty of Science and Technology	
Course Code: MGT 250 (3 Credit)	Full Marks: 100
Course Title: Engineering Economics (3-1-0)	Pass Mark: 45
Nature of the Course: Theory and Tutorial	Total Lectures: 45 hours
Level: Bachelor/ Year: III/ Semester: VI	Program: Bachelor in Civil Engineering

1. Course Description:

The course introduces concepts and economic analysis procedures to assist with decision-making in engineering projects. Concepts include fundamentals of economics and engineering economics, cost analysis, time value of money and cash flow diagrams; interest rates, different techniques of evaluation, risk, replacement, depreciation and inflation. Economic analysis procedure includes selection and ranking of projects and analyze the associated risk including, replacement analysis, calculation of depreciation amount and adjustment of taxes and inflation.

2. General Objectives:

The basic purpose of this course is to provide a sound understanding of concepts and principles of economy and engineering economy and to develop proficiency with methods for making rational decisions regarding financial analysis of engineering problems likely to be encountered in professional practice.

3. Methods of Instructions:

Lecture, tutorials, discussions, assignments, quizzes, project work

Specific Objective	4 Course Content
	Unit 1: Basics of Engineering Economics (3 hrs)
• Explain the meaning and principles of economics • Describe the law of demand, Law of supply, production and utility theory • Explain the meaning and importance of engineering economics and its principles	1.1 Definition of economics and principles of economics 1.2 Introduction to demand, supply, production, and utility 1.3 Definition of engineering economics, principles of engineering economics and its applications. 1.4 Terminologies used in engineering economic analysis
	Unit 2: Cost Concept and Analysis (3 hrs)
• Describe various elements and types of cost	2.1 Elements of cost-material, labor and expenses 2.2 Various types of costs: Direct cost, indirect cost, fixed cost, variable cost, marginal cost, opportunity cost, sunk cost, manufacturing cost and non manufacturing cost.

	Unit 3: Interest and Time Value of Money (6 hrs)
• Define different types of interest rates and describe their relationship. • Develop interest formulas for equivalent calculations of different types of cashflows	3.1 Simple interest, compound interest, nominal interest rate and effective interest rates 3.2 Economic equivalence: Definitions, simple calculations, and general principles 3.3 Development of formulas for equivalence calculations: Types of cashflows, single cashflow formulas, equal payment series, linear gradient series, geometric gradient series, irregular (mixed payment) series.
	Unit 4: Basic Methodologies of Engineering Economic Studies (6hrs)
• Define and describe minimum attractive rates of return • Explain the process to calculate Payback period, equivalent worth, internal and external rates of return as well as Benefit cost ration and their interpretation • To explain the meaning and differences of economic and financial analysis	4.1 Minimum attractive rate of return (MARR) : Concept and its calculation 4.2 Payback period: Simple and discounted 4.3 Equivalent worth: Present worth, future worth and annual worth 4.4 Rate of return: Internal rate of return (IRR) and External rate of return (ERR) 4.5 Benefit cost ratio: Normal, conventional and modified 4.6 Economic and financial analysis: Basic concept
	Unit 5: Comparative Analysis of Alternatives (6 hrs)
• To be able to rank and select the projects having same and different useful lives economically and financially based on values obtained from Payback period, Equivalent worth, rate of return and benefit cost ration • To be able to select combinations of projects.	5.1 Concept of mutually exclusive, independent and contingent projects 5.2 Comparing alternatives having same useful life 5.2.1 Payback period, present worth and future worth methods 5.2.2 IRR, ERR and BCR method using incremental analysis 5.3 Comparing alternatives having different useful lives: 5.3.1 Repeatability assumptions 5.3.2 Co-terminated assumptions 5.3.3 Capitalized worth method 5.4 Selecting best project for different combinations of project among mutually exclusive, independent and contingent project
	Unit 6: Replacement Analysis (4 hrs)
• To explain the process to calculate the economic service life of the machine • To be able to decide the right time to replace the existing	6.1 Basic concept of defender and Challenger 6.2 Economic service life 6.3 Replacement strategies under finite and infinite planning horizon

machine by new one.	
	Unit 7: Risk Analysis (6 hrs)
• To define risk and their origin in Engineering projects • To explain different methods of dealing with project risk and their application	7.1 Concept and sources of risk in engineering project 7.2 Methods of dealing with risk: 7.2.1 Breakeven analysis 7.2.2 Sensitivity analysis 7.2.2 Decision tree analysis 7.2.4 Scenario analysis 7.2.5 Concept of Monte Carlo simulations
	Unit 8: Depreciation and Taxes (6 hrs)
• Define depreciation, depletion, their causes and explain their application • Explain the process to calculate depreciation and corresponding Book values uses various methods. • Define different types of taxes • Explain the process to prepare after tax cashflow and profitability	8.1 Depreciation and depletion, causes and application 8.2 Methods of depreciation: Straight line method; Units of production method; Sum of year digit method; Declining balance methods; MACRS method and Sinking fund method 8.3 Depletion: Cost depletion and percentage depletion 8.4 Taxes: Direct and indirect tax, tax rates and VAT 8.5 After tax cashflow calculation, NPV and IRR calculations
	Unit 9: Capital Budgeting Decision (3 hrs)
• Define capital budgeting decision • Explain sources of fund/method of financing with their advantages and disadvantages • To calculate the cost of capital	9.1 Define capital budgeting their importance 9.2 Methods of financing: Equity financing, debt financing and Capital structure their merits and demerits 9.3 Cost of capital: Cost of equity, cost of debt and cost of capital
	Unit 10: Inflation (2 hrs)
• Define inflation, their causes and explain the methods to explain inflation • To derive the relationship between inflation, Interest rate and inflation adjusted interest rate • Define constant dollar and actual dollar, explain their relationship	10.1 Meaning and measure of Inflation 10.2 Actual vs constant dollar 10.3 Market and inflation free interest rates 10.4 Constant dollar and actual dollar analysis

5. List of Tutorials	
SN	**Tutorials**
1.	Application of simple interest, compound interest, nominal interest rate and effective interest rates; Calculation of present value, future value, annual value for different types of

	cashflows (Unit 3)
2.	Payback period (simple and discounted), Net present value, Net Future Value, Net Annual Value, IRR/ERR, Benefit Cost Ratio (Conventional and modified) calculation (Unit 4)
3.	Ranking of project using all methods and perform incremental analysis for projects having same useful life where applicable; Ranking of projects having different useful lives (Repeatability, co- terminated and capitalized worth methods); Selection of combinations of projects (Unit 5)
4.	Find Economic service life, Finding best replacement strategy for finite and infinite planning horizon. (Unit 6)
5.	Breakeven analysis, Sensitivity analysis and Decision tree analysis (Unit 7)
6.	Calculate depreciation amount and corresponding book values using different methods of depreciation; Prepare after tax cash flow and find corresponding NPV and IRR. (Unit 8)
7	Calculate cost of capital for debt and equity financing (Excluding and including tax) (Unit 9)
8.	Calculate average inflation, Relationship between inflation, interest rate and inflation free interest rates; Find NPV and IRR for Actual dollar and Constant dollar cashflow (Unit 9)

6. Evaluation System and Students' Responsibilities

Evaluation System

The internal evaluation of a student may consist of attendance/class participation, assignment, project report and internal Assessment. The tabular presentation of the internal evaluation is as follows:

Internal Evaluation	Weight	Marks	External Evaluation	Marks
Theory				
Attendance & Class Participation	10%			
Assignments	20%	**50**	**Semester End examination**	**50**
Project Report	10%			
Internal Assessment	60%			
Total Internal		**50**		**50**
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

8. Prescribed Books and References
Text Books: 1. Fundamentals of Engineering Economics by Chan S Park; Pearson 2. **Engineering Economy by** by William Sullivan , Elin Wicks , C Koelling; Pearson
References: 1. **A text book of Engineering Economics by OP Giri** 2. **Principles of Engineering Economic analysis by D Adhikari,** 3. **Fundamentals of Engineering Economic Analysis by SK Shrestha, Bikash Gautam**

Pokhara University
Faculty of Science and Technology

Course Code: STR 252 (3 Credits)
Course title: Structural Analysis I (3-2-1)
Nature of the Course: Theory & Practical
Level: Bachelor

Full Marks: 100
Pass Marks: 45
Total Lectures: 45 hours
Program: BE

1. Course Description

This course provides the basic concept and knowledge of structural analysis of statically determinate structure. It enables students to analyze statically determinate beam, frame, truss, arch and cable both by manual calculation as well as computer simulation.

2. General Objectives

The general objectives of this course are:

- To equip the students with the fundamental concept structural analysis and its practical application.
- To familiarize the students with strain energy, virtual work, slope, deflection, influence line diagram, arch, cable and space truss.

3. Methods of Instruction

Lecture, Tutorial, Discussion, Readings and Practical works

4. Contents in Detail

Specific Objectives	Contents
Know the types of structures, linearity and non-linearity of structural analysis, degree of static and kinematic indeterminacy, understand the role of structural analysis in structural engineering.	**Unit I: Introduction (3 hrs)** 1.1 Introduction to structural analysis 1.2 Role of structural analysis in structural engineering projects 1.3 Types of structures and structural elements 1.4 Stability and determinacy of structures 1.5 Approaches of structural analysis 1.6 Linearity and non-linearity in structural analysis 1.7 Degree of static and kinematic indeterminacy
Determine the deflection of beams, frames and truss of the structure by work-energy method.	**Unit II: Deflection of Beams, Frames and Trusses: Work-Energy Methods (12 hrs)** 2.1 Strain energy and complementary strain energy; work and complementary work 2.2 Strain energy due to gradually, suddenly applied direct load: dynamic multipliers 2.3 Strain energy due to axial force, shear force, bending moment and torsion 2.4 Displacement of beam, frame and truss by strain energy method 2.5 Principle of virtual work

	2.6 Deflection of beams, frames and trusses by virtual work method 2.7 Betti's law and Maxwell's law of reciprocal deflections 2.8 Castigliano's theorems and application for beams and plane frames
Determine the slope and deflection of beams by various geometric methods.	**Unit III: Slope and Deflections of Beams: Geometric Methods (6 hrs.)** 3.1 Double integration method 3.2 Macaulay's method 3.3 Superposition method 3.4 Conjugate beam method 3.5 Moment area method 3.6 Conjugate-beam method
Understand the importance of influence line diagram for analysis of structure, determine reaction, shear force, bending moment at particular point and absolute maximum response of structure by influence line method	**Unit IV: Influence Lines for Simple Structures (9 hrs.)** 4.1 Influence lines for statically determinate beams 4.2 Influence lines for statically determinate trusses 4.3 Influence lines for girders with floor systems 4.4 Response at a particular location due to a single moving concentrated load 4.5 Response at a particular location due to a uniformly distributed live load 4.6 Response at a particular location due to a series of moving concentrated loads 4.7 Absolute maximum response
Understand the uses of the statically determinate circular and parabolic arch. Solve problems related to electrostatics statically determinate arches by analytical and influence line diagram method.	**Unit V: Statically Determinate Arches (6 hrs.)** 5.1 Types of arches 5.2 Three-hinged arches with support at same and different level 5.3 Determination of support reactions, normal thrust, radial shear and bending moment of circular and parabolic arches 5.4 Axial force, shear force and bending moment diagrams in three hinged parabolic arches 5.5 Influence line diagrams for reactions, bending moments, radial shear, normal thrust 5.6 Maximum internal forces (axial force, shear force and bending moment) in three hinged parabolic arches
Understand the importance of cable structures, analysis of parabolic cable structures and three-hinged stiffening girder Determine shear force and bending moment of three-hinged stiffening girder by influence line diagram	**Unit VI: Cable Structures (6 hrs.)** 6.1 Introduction to cable structures 6.2 Elements of a simple suspension bridges 6.3 Analysis of parabolic cables 6.4 Analysis of three-hinged stiffening girder 6.5 Influence line diagrams and determination of shear forces and bending moments for three-hinged

approach.	stiffening girder
Know the practical application of statically determinate space truss Determine the member force of statically determinate space truss	**Unit VII: Statically Determinate Space Trusses (3 hrs.)** 7.1 Introduction to simple space trusses 7.2 Types of supports 7.3 Determinacy and stability 7.4 Analysis of space truss by tension coefficient method

Note: The figures in the parentheses indicate the approximate periods for the respective units.

5. List of Tutorials

The following tutorial activities of 2 hours/ week per group of maximum 24 students should be conducted to cover all the required contents of this course.

S.N.	Tutorials
1	Determination of static and kinematic indeterminacy of various structures.
2	Solving and analyzing the problems related to work-energy method.
3	Determination of slope and deflection of different types of beam by various geometric methods.
4	Determination of angle of acceptance for working of optical fiber and finding population of atoms in different energy states. Solving the problems of beam and truss structures by influence line diagram method.
5	Solving the problems of three hinged parabolic and circular arch both analytical and influence line diagram method
6	Solving the problems related to suspension cable bridge
7	Determination of support reactions and member forces of space truss.

6. Practical Works (Any Eight)

S.N.	Practical works
1	To determine the deflection of beam experimentally and verify the result by computer simulation.
2	To determine the displacement of frame experimentally and verify the result by computer simulation.
3	To determine the displacement of truss experimentally and verify the result by computer simulation.
4	To measure the effect of Influence lines for beam experimentally and verify the result by computer simulation.
5	To determine the horizontal thrust of three-hinged arch experimentally and verify the result by computer simulation.
6	To determine the tension in cable of suspension bridge by experimentally and verify the result by computer simulation.
7	To determine the support reactions and member forces of space truss by computer simulation.

7. Evaluation system and Students' Responsibilities

Evaluation System

In addition to the formal exam(s), the internal evaluation of a student may consist of quizzes, assignments, lab reports, projects, class participation, etc. The tabular presentation of the internal evaluation is as follows.

Internal Evaluation	Weight	Marks	External Evaluation	Marks
Theory		30	Semester-End examination	50
Attendance & Class Participation	10%			
Assignments	20%			
Presentations/Quizzes	10%			
Internal Assessment	60%			
Practical		20		
Attendance & Class Participation	10%			
Lab Report/Project Report	20%			
Practical Exam/Project Work	40%			
Viva	30%			
Total Internal		50		
Full Marks: 50 + 50 = 100				

Student's Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

8. Prescribed Books and References

Text Books

1. Kassimali, A. (2009). *Structural Analysis*. Cengage Learning.
2. Norris, C. H., & Wilbur, J. B. (1960). *Elementary Structural Analysis*. McGraw-Hill.

References

1. Bhavikatti, S. S. (2011). *Structural Analysis I*. New Delhi: Vikas Publishing House Pvt. Ltd.
2. Darkov, A. & Kuznetsov, V. (2011). *Structural Mechanics*, Moscow: Mir Publishers.
3. Hibbeler, R.C. (2009). *Structural Analysis*. Pearson.
4. Jain, A.K. (2012). *Strength of Materials and Structural Analysis (2012)*. Roorkee: Nem Chand & Bros.
5. Reddy, C.S. (1999). *Basic Structural Analysis*. Tata McGraw-Hill Education.

Pokhara University Faculty of Science and Technology	
Course Code: WRE 211 (3 Credit)	Full Marks: 100
Course Title: Hydraulics (3 – 2 – 2)	Pass Mark: 45
Nature of the Course: Theory and Practice	Total Lectures: 45 hours
Level: Bachelor/ Year: II/ Semester: IV	Program: Bachelor in Civil Engineering

1. Course Description:
This course deals with the study of hydraulic analysis and its application to hydraulic structures (e.g., pipe network, power turbine, reservoir, dam, spillway, weir etc.) for designing water supply system, hydropower generation, irrigation channels, flood control and other water-related infrastructures. Specifically, this course discusses: different flow phenomena; governing laws, applications for closed conduit flow, and open channel flow systems.
2. General Objectives:
Overall objective of this course is to enable students to analyze flow characteristics in pipe flow as well as in open channel flow systems, which aims to impart the concept of hydraulic phenomena in water resources engineering and their application in the field of civil engineering.
3. Methods of Instructions:
Lecture, Tutorial, Discussion, Readings and Practical works

4. Course Contents	
Specific Objective	**Contents**
• Understanding concept of laminar and turbulent flow in pipes • Enable to understand and derive relationships for shear and velocity distributions in pipe flow • Enable to derive equations for estimation of major (frictional) loss in pipe flow	Unit 1: Laminar and Turbulent Flow in Pipes (6 hrs) 1.1 Introduction to pipe flow, Reynolds experiment and flow based on Reynolds` number 1.2 Laminar flow: Steady-uniform-incompressible flow in a circular pipe; Shear stress and velocity distribution; Loss of head due to friction (Hagen-Poisseuille equation) 1.3 Turbulent flow: Shear stress development; Prandtl's mixing length theory; Velocity distribution; Loss of head due to friction (Darcy- Weisbach equation) 1.4 Hydrodynamically smooth and rough boundaries; Nikuradse's experiment, Variation of friction factor with Reynolds number; Resistance for commercial pipes; Colebrook-White equation; Use of Moody's

	diagram
• Understanding and calculation of various minor losses associated with pipe flow • Understanding of simple and complex pipe flow networks; and their comparative advantages and disadvantages • Understanding and calculation of various flow variables in simple and complex pipe network systems	Unit 2: Pipe Flow Systems (9 hrs) 2.1 Introduction to pipe system (fittings, bends, valves); Minor head losses in pipes (losses in sudden enlargement, sudden contraction, exit loss, entry loss, losses due to sudden obstruction, losses in bends and losses due to different fittings); HGL and TEL lines 2.2 Three types of pipe flow problems and their solution 2.3 Pipe Line System (Pipes in series and parallel): Dupuit's equation, concept of equivalent pipe length/diameter in series and parallel; Concept of economic diameter of pipes 2.4 Siphons: Definition, application, conditions for continuous supply, different type of problem in siphon (simple and trial & error) 2.5 Pipe network solution by Hardy-Cross method for single and double loops of pipe networks
• Understanding concept of unsteady flow and water hammer phenomena, • Enable to compute the rise in pressure due to water hammer, and • Enable to understand the necessity and working of a surge tank	Unit 3: Water Hammer in Pipes (4 hrs) 3.1 Basic concept of unsteady flow; Water hammer, its causes & effects in pipes 3.2 Velocity of pressure wave in a rigid pipe; Propagation of pressure wave; pressure variation with time at different sections 3.3 Water Hammer due to gradual and sudden closure of valve for the cases of rigid and elastic pipes; Equations of pressure rise for water hammer
• Understand how flow in open channels differs from pressurized flow in pipes • Learn the different flow regimes in open channels and their characteristics	Unit 4: Open Channel Flow (3 hrs) 4.1 Introduction; Difference between open channel and pipe flows 4.2 Types of open channel flows: steady & unsteady; uniform & non-uniform flows (gradually, rapidly and spatially varied flows); Sub-critical, critical and super critical flows 4.3 Classification of open channels (natural and artificial channel, prismatic and

	non-prismatic channel, rigid boundary and mobile boundary channel); Geometric properties of open channels (depth, flow area, top width, wetted perimeter, hydraulic radius, hydraulic mean depth, bed slope, hydraulic or energy slope, water surface slope), Shapes of open channel
• Describe concept and conditions of uniform flow and conditions in open channel, • Explain equations for handling of uniflow problems in open channel • Explain conditions and formulae for designing efficient channel sections	Unit 5: Uniform Flow in Open Channels (6 hrs) 5.1 Conditions of uniform flow in a prismatic channel, expression for shear stress on boundary of channel, velocity and shear stress distribution in open channel and mean velocity 5.2 Fundamental equations of uniform flow: Manning's equation and Chezy's equation, relationship between Chezy's coefficients (C), Manning's and Darcy's-Weisbach co-efficient 5.3 Factors affecting manning's roughness coefficient. 5.4 Conveyance, section factor and hydraulic exponent for uniform flow computation 5.5 Determination of normal depth, velocity and slope 5.6 Design of economic channel sections (rectangular, triangular, trapezoidal and circular)
• Understanding concept and derivations of energy and momentum principles in open channel • Explain concept and formulae of specific energy; specific force; conditions for critical flow, maximum discharge • Explain various applications including discharge measurement	Unit 6: Energy and Momentum Principles in Open Channel (6hrs) 6.1 Specific energy, specific energy diagram, critical depth of flow 6.2 Critical depth computations for all kind of channel sections (prismatic) and criteria for critical state of flow 6.3 Alternate depth, depth-discharge relationship 6.4 Application of energy principle and critical depth concept: channel width reduction, rise in channel bed, venture flume and broad crested weir 6.5 Momentum principle, specific force, specific force curve, criteria for critical state

	of flow, conjugate depth
• Explain concept and governing equations of gradually varied flow • Understanding various types of channel bed slopes and flow profiles • Enable to compute gradually varying water surface profiles	Unit 7: Gradually Varied Flows (GVF) and its Analysis (6 hrs) 7.1 Introduction to GVF, reasons and examples of GVF 7.2 Basic assumptions, governing /dynamic equation and its physical meaning 7.3 Classification of channel bed slopes (mild, critical, steep, horizontal and adverse) and Characteristics of flow profiles in prismatic channels 7.4 Computation of GVF in prismatic channels by graphical integration, direct step and standard step methods
• To study the development of rapidly varied flow and hydraulic jump • Enable to investigate the rapidly varied flow in open channel and compute various hydraulic jump variables	Unit 8: Hydraulic Jump and its Analysis (5 hrs) 8.1 Characteristics of Rapidly Varied Flow (RVF) 8.2 Hydraulic jump and its uses as an energy dissipater: jumps in a horizontal rectangular channel, jump variables (conjugate depth, height of jump, length of jump) 8.3 Energy loss in jump 8.4 Classification of the jump based on the tail water level and Froude number

5. Evaluation System and Students' Responsibilities

Evaluation System

The internal evaluation of a student may consist of assignments, attendance, term-exams, lab reports and projects etc. The tabular presentation of the internal evaluation is as follows:

Internal Evaluation	Weight	Marks	External Evaluation	Marks
Theory		**30**	**Semester End**	**50**
Attendance & Class Participation	10%			
Assignments	20%			
Presentations/Quizzes	10%			
Internal Assessment	60%			
Practical		**20**		
Attendance & Class Participation	10%			
Lab Report/Project Report	20%			
Practical Exam/Project Work	40%			

Viva	30%			
Total Internal		**50**		
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

6. List of Tutorials	
SN	
1.	Computation of shear stress, velocity, pressure, flow rate, major and minor head losses for laminar and turbulent flow in pipes
2.	Computation of head loss, flow (Q) and size (diameter) in a simple pipe
3.	Computation of discharge, head loss, pressure in a siphon
4.	Computation of discharge, length, diameter in pipe in series and parallel
5.	Computation of head losses and discharge in pipe network using Hardy-cross method
6.	Computation of discharge, head losses, elevation in case of three interconnected reservoirs
7.	Computation of risk for pipe burst; rise in pressure in pipe for gradual and sudden closure of valves, time of closure of valves
8.	Computation of flow rate, shear stress, velocity, normal depth, slope in open channels
9.	Computation of most economical cross-sections for triangular, rectangular, trapezoidal and circular open channels
10.	Computation of Froude number, normal slope, critical slope, flow rate, alternate depths, specific energy, specific force, critical velocity, critical depths, conjugate depths for flow in open channels
11.	Computation of depth of flow, width reductions, floor rise (height of hump) for critical flow conditions in open channel
12.	Computation of type of flow profiles; characteristics (e.g., depth, distance) for GVF by direct and standard step methods
13.	Computation of jump location, heights, surface profiles for hydraulic jump

7. List of Practicals	
SN	
1.	Reynolds' experiment
2.	Head loss in a pipeline
3.	Flow through open sluice gate
4.	Hydraulic jump analysis in open channel
5.	Hump and constricted flow analysis: discharge measurement in open channel (channel

	width reduction, rise in channel bed and venture flume)
6.	Introduction to open-source hydraulic software (e.g., HEC-RAS)

8. Prescribed Books and References
Text Books: 1. Modi, P. N. & Seth, S. M. Fluid Mechanics and Hydraulics. New Delhi: Standard Books. 2. Subramanya, K. Flow in Open Channel. New Delhi: Tata McGraw Hill. 3. Bansal, R. K. A text book of Fluid Mechanics and Hydraulic Machines, New Delhi: Laxmi Publications.
References: 1. Chow, V.T. Open Channel Hydraulics, New Delhi: McGraw-Hill. 2. K. G. Ranga Raju. Flow through Open Channel. New Delhi: Tata McGraw Hill Publishing Company Ltd. 3. Jain, A. K. Fluid Mechanics and Hydraulics. New Delhi: Khanna Publication. 4. Kumar, D.S. Fluid Mechanics and Fluid Power Engineering. Delhi: S.K. Kataria and Sons. 5. Rajput, R. K. Fluid Mechanics and Hydraulic Machines. New Delhi: S. Chand. 6. Sangraula, D. P. & Bhattarai, P. A text book of Hydraulics.

Pokhara University
Faculty of Science and Technology

Course Code: MTH 216 (2 – 2 - 0 Credit)
Course Title: Probability and Statistics
Nature of the Course: Theory
Level: Bachelor

Full Marks: 100
Pass Mark: 45
Total Lectures: 30 hours
Program: BE

1. Course Description

This course is designed to familiarize students with various statistical methods and techniques for analyzing data. The contents include descriptive statistics, probability, probability distributions, sampling and estimation, hypothesis testing, simple correlation and regression analysis with emphasis on engineering field.

2. General Objectives

The general objectives of this course are;

- To familiarize students with various statistical methods and techniques for analyzing data.
- To impart analytical skills in the students required for the application of statistical methods for analyzing data in the field of engineering.
- To enable students with the skills to use of real data in the practical engineering-based applications.

3. Methods of Instruction

Lecture, Tutorial, Discussion and Readings

4. Contents in Detail

Specific Objectives	Contents
• Identify concepts of statistics and its application in the field of engineering • Summarize, present and compute various descriptive statistics	**Unit I: Introduction and Descriptive Statistics (3 hrs)** 1.1 Introduction of statistics and its applications in engineering 1.2 Collection and presentation of data (Diagrammatic as well as graphical presentation) 1.3 Measure of central tendency, location and Measures of variability
• Identify basic probability concepts • Define conditional probability and use Bayes' theorem to revise probabilities • Define random variable and compute expected value and variance of a probability distribution	**Unit II: Probability (5 hrs)** 2.1 Basic probability, additive law, multiplicative law and Bayes' theorem 2.2 Random variables (Discrete and Continuous) and probability distribution function, 2.3 Mathematical expectation of random variables

• Explain and apply discrete probability distributions (Binomial, Poisson distribution, Negative Binomial and Hyper geometric distribution)	**Unit III: Discrete Probability Distributions (3 hrs)** 3.1 Binomial distribution, 3.2 Poisson distribution 3.3 Negative Binomial distribution 3.4 Hyper geometric distribution
• Explain and apply the Normal distribution and other continuous probability distributions (uniform distribution, Gamma and Beta distributions, and Exponential distribution)	**Unit IV: Continuous Probability Distributions (4 hrs)** 4.1 Rectangular or uniform distribution 4.2 Normal distribution 4.3 Gamma and Beta distributions 4.4 Exponential distribution
• Define the concept of bivariate random variables and joint probability distribution • Explain and calculate joint probability mass, marginal probability and density function	**Unit V: Bivariate Random Variables and Joint Probability Distribution (2 hrs)** 5.1 Joint probability mass function, marginal probability mass function, 5.2 Joint probability density function, marginal probability density function
• Define and apply sampling, sampling distribution, and central limit theorem • Construct and interpret confidence interval estimate for the means and proportion	**Unit VI: Sampling Distribution and Estimation (5 hrs)** 6.1 Review of terms used in sampling 6.2 Probability and non-probability sampling 6.3 Sampling distribution of mean and standard error 6.4 Central limit theorem 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 and population proportion
• Describe and apply the procedures hypothesis testing of various tests.	**Unit VII: Hypothesis Testing (5 hrs)** 7.1 Basic concept in hypothesis testing 7.2 One sample test for mean and proportion 7.3 Two sample tests for mean and proportions 7.4 Paired t – test 7.5 Chi-square test of independence
• Define and apply correlation and regression in the field of engineering	**Unit VIII: Correlation and Regression (3 hrs)** 8.1 Simple correlation and its properties 8.2 Simple linear regression

Note: The figures in the parentheses indicate the approximate periods for the respective units.

5. List of Tutorials (30 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.

Unit No.	Unit Name	List of Tutorials	Tutorial hours
I	Introduction and Descriptive Statistics	1.1 Collection and presentation of data (Diagrammatic as well as graphical presentation)	1 hr.
		1.2 Measure of central tendency, location and Measures of variability	1 hr.
II	Probability	2.1 Basic probability, additive law, multiplicative law and Bayes' theorem	2 hr.
		2.2 Random variables (Discrete and Continuous) and probability distribution function,	1 hr.
		2.3 Mathematical expectation of random variables	1 hr.
III	Discrete Probability Distributions	3.5 Binomial distribution,	1 hr.
		3.6 Poisson distribution	1 hr.
		3.7 Negative Binomial distribution	1 hr.
		3.8 Hyper geometric distribution	1 hr.
IV	Continuous Probability Distributions	4.1 Rectangular or uniform distribution	1 hr.
		4.2 Normal distribution	2 hr.
		4.3 Gamma and Beta distributions	2 hr.
		4.4 Exponential distribution	2 hr.
V	Bivariate Random Variables and Joint Probability Distribution	5.1 Joint probability mass function, Marginal probability mass function,	1 hr.
		5.2 Joint probability density function, Marginal probability density function	2 hr.
VI	Sampling Distribution and Estimation	6.1 Sampling distribution of mean and standard error	1 hr.
		6.2 Central limit theorem	1 hr.
		6.3 Concept of point and interval estimation and Sample size determination	1 hr.
		6.4 Confidence interval for single mean and difference of two population means and population proportion	1 hr.
VII	Hypothesis Testing	7.1 One sample test for mean and proportion	1 hr.
		7.2 Two sample test for mean and proportions	1 hr.
		7.3 Paired t – test	1 hr.
		7.4 Chi-square test of independence	1 hr.
VIII	Correlation and Regression	8.1 Simple correlation and its properties	1 hr.
		8.2 Simple linear regression	1 hr.

6. Evaluation system and Students' Responsibilities

Evaluation System

In addition to the formal exam(s), the internal evaluation of a student may consist of quizzes, assignments, project work, class participation, etc. The tabular presentation of the internal evaluation is as follows.

Internal Evaluation	Weight	Marks	External Evaluation	Marks
Attendance & Class Participation	10%	50	Semester-End Examination	50
Assignments	20%			
Presentations/Quizzes	10%			
Term Exam	60%			
Total Internal				
Full Marks: 50 + 50 = 100				

Student's Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

7. Prescribed Books and References

Prescribed Books

1. Johnson, R. A. (2018). *Probability and Statistics for Engineers*. New Delhi: Pearson Education Limited.

Reference Books

1. Devore, J. L.(2010). *Probability and Statistics for Engineering and Sciences*. New Delhi: Cengage learning.
2. Sheldom, M. R. (2014). Probability *and Statistics for Engineers and Scientist*. New Delhi: Cengage learning.
3. Gupta, S.C & V.K. Kapoor. (2000). *Fundamentals of Mathematical Statistics: A Modern Approach*. Sultan Chand & Sons Educational Publishers.

Pokhara University Faculty of Science and Technology	
Course Code: CLV 252 (3 Credit)	Full Marks: 100
Course Title: Surveying II (3-1-3)	Pass Mark: 45
Nature of the Course: Theory and Practical	Total Lectures: 45 hours
Level: Bachelor/ Year: II/ Semester: II	Program: Civil

1. Course Description:

This course is designed for specific applications of theoretical aspects of the previous course of Surveying-I. Furthermore, it includes the topics of advanced mapping techniques, spatial data analysis, remote sensing applications, and Geographic Information Systems (GIS). The course is developed for the application of modern survey and mapping techniques in civil infrastructure projects.
Surveying-I is the prerequisite of this course.

2. General Objectives:

General objectives of the course are:

- To enable students to solve, describe and analyze the various aspects of surveying in civil engineering project.
- To acquaint the students with modern techniques in the surveying and other mapping techniques and software.

3. Methods of Instructions:

Lectures. Tutorials, Discussion and Practical works

4. Course Contents

Specific Objective	Contents
To determine the position of unknown points by using Theodolite & Total station.	**Unit 1: Orienteering (4 hrs)** 1.1. Introduction, Uses and Importance 1.2. Analytical Intersection 1.3. Analytical Resection-Three point problem: Collin`s point Method, Tienstra Method and (ϕ-45) degree method
To identify the various parameters of the curves and visualize the procedure for setting out the curves in the field.	**Unit 2: Setting the Curves** (9 hrs) 2.1 Introduction, Designation ,Types, Uses and Importance 2.2 Elements of Simple Circular Curve and their computation 2.3 Setting out of Simple Circular Curve by Ordinate from Long Chord, Offset from Tangent and Deflection angle Method 2.4 Computation of Elements and Setting out of Transition Curves 2.5 Computation of Elements and Setting out of Vertical Curves 2.6 Field survey protocol
To determine the horizontal and vertical controls of points & taking the knowledge of measurement of large water bodies	**Unit 3: Hydrographic Survey** (4hrs) 3.1 Introduction and Basic Terms 3.2 Vertical and Horizontal Control 3.3 Sounding- Definition, Equipment used and Methods. 3.4 Preparation of bathymetric maps 3.5 Field survey protocol

To describe the advance surveying methods without physical contact to the objects and respective procedures.	**Unit 4: Photogrammetry and Remote Sensing (8 hrs)** 4.1 Introduction and Uses of Photogrammetry 4.2 Scale of Vertical Photograph 4.3 Relief Displacement 4.4 Introduction, Types, Uses and Basic Process of Remote Sensin 4.5 Interaction of Electromagnetic Radiation with Earth Surface Features
To recognize the modern methods of surveying and mapping techniques.	**Unit 5 : Field Astronomy, GPS and GIS (9 hrs)** 5.1 Basic Terms in Field Astronomy 5.2 Latitude, Longitude, Azimuth, Distance and Time 5.3 Uses of Astronomy in Surveying and Mapping 5.4 Introduction and uses of GPS 5.5 GPS accuracy, precision and error sources 5.6 Application of GIS
To illustrate and apply computer software in mapping	**Unit 6 : Mapping Software (2 hrs)** 6.1 Introduction 6.2 Advantages and Disadvantages of Manual Plotting and Computerized Plotting
To apply survey techniques for civil infrastructure projects.	**Unit 7: Project Survey (9 hrs)** 7.1 Basics of project survey 7.2 Laying out, progress monitoring of infrastructure projects 7.3 Alignment Survey of linear infrastructure

5. Evaluation System and Students' Responsibilities

Evaluation System

The internal evaluation of a student may consist of assignments, attendance, term-exams, lab reports and projects etc. The tabular presentation of the internal evaluation is as follows:

Internal Evaluation	Weight	Marks	External Evaluation	Marks
Theory		**30**		**50**
Attendance & Class Participation	10%			
Assignments	20%			
Presentations/Quizzes	10%			
Internal Assessment	60%			
Practical		**20**	**Semester End**	
Attendance & Class Participation	10%			
Lab Report/Project Report	20%			
Practical Exam/Project Work	40%			
Viva	30%			
Total Internal		**50**		
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) to appear the Semester-End Examinations. Students are

advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

6. List of Tutorials	
SN	
1.	Solving the problems related to intersection and resection to determine the co-ordinate of unknown points
2.	Calculation of different elements of curves (circular, transition and vertical curves) & computation of necessary data to set out the curves by linear and angular methods
3.	Problems related to the photogrammetry i.e calculation of scale of the vertical photograph, Relief displacement and flying height of the aircraft and altitude of the terrain.
4.	Solving the problems related to the time and distance with reference to the latitude & longitude of any location

7. List of Practicals	
SN	
1.	Determination of co-ordinates of an unknown point by analytical intersection and analytical resection methods.
2.	Setting out of simple circular curve by Offsets from Long Chord, Offsets from Tangent and Rankine Method of Deflection Angles.
3.	Setting out of transition curve by Deflection Angle Method.
4	Laying out of a Building.
5	Demonstration and use of GPS instrument to determine co-ordinates of a point.
6	Introduction to GIS software.

8. Prescribed Books and References
Text Books: 1. Punmia, B.C., Jain Ashok K & Jain Arun K(2005). Surveying (Vol. I,II,III). New Delhi: Laxmi Publications. 2. Duggal, S. K. Surveying(vol I, II). New Delhi: Tata McGraw-Hill Publishing Company Limited.
References: 1. Bannister, A &Raymond, S (1997) Surveying. London: ELBS 2. Kanetkar, T.P& Kulkarmi, S.V Surveying & leveling.