HYDRAULICS

Course Code: CE108

Lecturer: 4
Tutorial: 2
Practical: 1

Year: II
Part: II
Course Credit: 4

Course Objectives:

This course focuses on the fundamental principles and applications of hydraulic analysis in civil engineering. It covers the behavior and characteristics of fluid flow in both closed conduit systems (e.g., pipelines) and open channel systems (e.g., canals, spillways, weirs).The overall objective is to enable students to analyze and interpret flow characteristics in both pipe and open channel systems, thereby building a strong foundation in water resources engineering.

Course Contents:

Unit 1:Introduction to Pipe Flow (9hours)

1.1 Concept of pipe flow; Reynolds' experiment and classification of pipe flow based on Reynolds number

1.2 Laminar Flow in Circular Pipes: Expressions for shear stress, velocity, and head loss due to friction (Hagen–Poiseuille equation)

1.3 Turbulent Flow in Circular Pipes: Development of shear stress in turbulent flow; Prandtl's mixing length theory; Velocity distribution in turbulent flow; Head loss due to friction (Darcy–Weisbach equation)

1.4 Flow Resistance and Friction Factor: Hydrodynamically smooth and rough pipe boundaries; Nikuradse's experiments; Colebrook–White equation and use of Moody diagram

1.5 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);

1.6 Hydraulic Gradient Lines (HGL) and Total Energy Lines (TEL)

Unit 2:Three Reservoir and Pipe Flow Network Systems(10 hours)

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2.1 Introduction to three reservoir problems

2.2 Solution procedures for possible different cases.

2.3Introduction to piping system (fittings, bends, valves); Simple pipe flow problems and their solution

2.4 Pipes in series and parallel;Concept of equivalent pipe diameter in series

2.5 Siphons: Concept, applications, conditions required for continuous flow in a siphon system, problems, and solutions

2.6 Pipe network solution by Hardy-Cross method for single and double loops of pipe Networks

Unit 3:Unsteady flow and Water Hammer (6 hours)

3.1 Basic concepts of unsteady flow; definition, causes, and effects of water hammer in pipe systems

3.2 Pressure wave velocity; propagation of pressure waves; variation of pressure with time

3.3 Gradual and sudden closure of valve; derivation and application of pressure rise equations in rigid and elastic pipes

Unit 4:Introduction to Open Channel Flow (3 hours)

4.1Concept of open channel flow; Difference between open channel and pipe flows

4.2Types of open channel flows: steady & unsteady; uniform & non-uniform flows (Gradually and rapidly varied flows); Sub-critical, critical, and super-critical flows

4.3Classification of open channels (natural and artificial channels, prismatic and non-prismatic channel, rigid boundary, and mobile boundary channel);

4.4 Shapes and Geometric properties of open channels

Unit 5:Uniform Flow(8 hours)

5.1Conditions of uniform flow; shear stress and velocity distribution in open channel; mean velocity

5.2Fundamental equations of uniform flow: Manning's equation and Chezy's equation, relationship between Chezy's coefficients (C), Manning's and Darcy's-Weisbach coefficient

5.3Factors affecting manning's roughness coefficient.

5.4Conveyance, section factor and hydraulic exponent for uniform flow computation

5.5Determination of normal depth, velocity and slope

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5.6Design of economic channel sections (rectangular, triangular, trapezoidal, and circular)

Unit 6:Energy and Momentum Principles in Open Channel Flow (9hrs.)

6.1 Specific energy, specific energy diagram, Alternate depths; Computation of critical depths

6.2 Depth-discharge relationship; Applications in channel width reduction, rise in channel bed, venture flume and broad crested weir

6.3 Momentum principle, specific force, specific force curve, criteria for critical state of flow, conjugate depth

Unit 7:Gradually Varied Flows (8hrs.)

7.1Concept, reasons and examples of Gradual Varied Flow (GVF)

7.2Basic assumptions, governing equation and its physical meaning

7.3Classification of channel bed slopes (mild, critical, steep, horizontal and adverse) and Characteristics of flow profiles in prismatic channels

7.4Computation of GVF in prismatic channels by graphical integration, direct step and standard step methods

Unit 8:Hydraulic Jump (7 hours)

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; conjugate depth, height of jump and length of jump

8.3 Energy loss in jump

8.4 Classification of the jump based on the tail water level and Froude number

List of Tutorials

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

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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

List of Practicals

1. Study of Laminar and Turbulent Flow (Reynolds Experiment)
2. Determination of Major Head Loss in Pipes Flow
3. Determination of Minor Head Loss in PipesFlow
4. Demonstration of Hydraulic Jump in Open Channel Flow
5. Demonstration of Hump and Constricted Flow Analysis in Open Channel Flow
6. Introduction to Hydraulic Software Tools (e.g., HEC-RAS)

Reference 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.
4. Chow, V.T. Open Channel Hydraulics, New Delhi: McGraw-Hill.
5. K. G. Ranga Raju. Flow through Open Channel. New Delhi: Tata McGraw Hill Publishing Company Ltd.
6. Jain, A. K. Fluid Mechanics and Hydraulics. New Delhi: Khanna Publication.
7. Kumar, D.S. Fluid Mechanics and Fluid Power Engineering. Delhi: S.K. Kataria and Sons.
8. Rajput, R. K. Fluid Mechanics and Hydraulic Machines. New Delhi: S. Chand.
9. Sangraula, D. P. & Bhattarai, P. A text book of Hydraulics.

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Evaluation Schedule:

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 Pipe Flow	9	15
Unit 2	Three Reservoir and Pipe Flow Network Systems	10	17
Unit 3	Unsteady Flow and Water Hammer	6	10
Unit 4	Introduction to Open Channel Flow	3	5
Unit 5	Uniform Flowin Open Channel	8	13
Unit 6	Energy and Momentum Principles in Open Channel Flow	9	15
Unit 7	Gradual Varied Flows	8	13
Unit 8	Hydraulic Jump	7	12
	Total	**60**	**100**

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

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ENGINEERING SURVEY II

CE 109

Lecture:3 **Year:II**

Tutorial: 1 **Part: II**

Practical: 7

Course Objectives:

This course will provide advanced training in geospatial data collection, analysis, and applications for civil engineering projects, building upon foundational skills from Engineering Survey I. Students will master precision measurement techniques, 3D modeling, and specialized surveying methods through integrated theory and fieldwork.

Course Contents:

Unit 1: Geodetic Surveying **(6 hours)**

1.1 Earthgeometry: Ellipsoid, geoid, and datum (WGS84, NAD83)

1.2 Coordinate transformations: Grid-to-ground and vice versa

1.3 Map projections (UTM, State Plane) and scale factor corrections

1.4 GNSS for geodetic control: Static, RTK, and PPK methods

Unit 2: Hydrographic Surveying (8 hours)

2.1 Equipment: Single-beam vs multibeam echo sounders

2.2 Tidal corrections and datum reductions

2.3 River discharge measurement techniques

2.4 Bathymetric Surveying and Data Processing

Unit 3: Areas and Volumes (8 hours)

3.1 Method of measuring area of irregular boundaries (Mid ordinate, average ordinate, Simpsonrule)

3.2 Area of closed traverse (Double meridian distance method, coordinates method)

3.3 Volumes by cross-section method (Average end area, mean area, trapezoidal rule, prismoidal formula)

3.4 Volume from spot levels, contour plan

Unit 4: Route and Construction Surveying (7 hours)

4.1 Highway alignment: Horizontal and Vertical Curves

4.2 Mass haul diagrams for earthwork optimization

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4.3 Machine control systems for grading

Unit 5: Underground and Tunnel Surveying (7 hours)

5.1 Centerline alignment and breakthrough surveys

5.2 Gyrotheodolite applications for orientation

5.3 Monitoring convergence in tunneling

Unit 6: Mining and Industrial Surveying (7 hours)

6.1 Strike/dip measurements for ore body modeling

6.2 Stockpile volume calculations (conical and prismoidal methods)

6.3 Precision alignment for industrial installations

Unit 7: Aerial Surveying & LiDAR (6 hours)

7.1 UAV photogrammetry: Flight planning (GSD, overlap)

7.2 LiDAR point cloud processing and classification

7.3 DTM generation and volumetric analysis

Unit 8: Underground Utility surveying (5 hours)

8.1 Brief explanation of utility surveying (locating pipes, cables, etc.).

8.2 Importance of construction safety, preventing damage, and cost savings.

8.3Common methods: GPR (Ground Penetrating Radar), EMI (ElectromagneticInduction), and RFID.

Unit 9: Engineering Survey ProjectManagement (6 hours)

9.1 Cost estimation for surveying projects

9.2 Quality assurance/quality control (QA/QC) procedures

9.3 Occupational health and safety in surveying

Tutorials (15 hours)

1. Coordinate transformation problems (3 hours)
2. Simpson's rule area calculations (2 hours)
3. Prismoidal volume computations (3 hours)
4. Vertical curve design (2 hours)
5. Stockpile volume estimations (3 hours)
6. Mass haul diagram preparation (2 hours)

Practical Work (35 hours)

1. GNSS control network establishment (5 hours)
2. UAV flight planning exercise (5 hours)

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3. Tunnel breakthrough simulation (5 hours)
4. Cross-section volume calculation (5 hours)
5. Bathymetric data processing (5 hours)
6. Mine stockpile measurement (5 hours)
7. Utility locating with GPR (5 hours)

Reference Books

1. Bannister, A. (2006). Surveying (Vol. 1). Pearson Education India.
2. Wolf, P. R., &Ghilani, C. D. (2002). Elementary surveying: An introduction to geomatics. (No Title).
3. Ghilani, C. D. (2017). Adjustment computations: spatial data analysis. John Wiley & Sons.
4. Adams, K. T. (1942). *Hydrographic manual*. US Government Printing Office.
5. Uren, J., & Price, B. (2018). Surveying for engineers. Bloomsbury Publishing.
6. Schofield, W., & Breach, M. (2007). *Engineering surveying*. CRC Press.
7. Kennie, T. J. (2014). Engineering surveying technology. CRC Press.
8. Schofield, W., & Breach, M. (2007). Engineering surveying. CRC Press.
9. Brinker, R. C., & Minnick, R. (2012). *The surveying handbook*. Springer Science & Business Media.
10. Kuesel, T. R., King, E. H., & Bickel, J. O. (2012). Tunnel engineering handbook. Springer Science & Business Media.
11. Wang, C., Yang, X., Xi, X., Nie, S., & Dong, P. (2024). Introduction to LiDAR remote sensing. CRC Press.
12. Darling, P. (Ed.). (2011). SME mining engineering handbook (Vol. 1). SME.
13. Daniels, D. J. (Ed.). (2004). Ground penetrating radar (Vol. 1). Iet.
14. Graham, R., & Koh, A. (2002). Digital aerial survey: theory and practice. CRC Press.
15. Ogundare, J. O. (2015). *Precision surveying: the principles and geomatics practice*. John Wiley & Sons.

Evaluation Schedule:

Unit	Title	Hours	Marks
1	Geodetic Surveying	6	6
2	Hydrographic Surveying	8	7
3	Areas and Volumes	8	7

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4	Route and Construction Surveying	7	7
5	Underground and Tunnel Surveying	7	7
6	Mining and Industrial Surveying	7	7
7	Aerial Surveying & LiDAR	6	7
8	Underground Utility Surveying	5	6
9	Engineering survey Project Management	6	6
Total		**60**	**60**

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

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SOIL MECHANICS

Course Code: CE110

Lecturer: 4
Tutorial: 2
Practical: 2

Year: II
Part: II
Course Credit: 4

Course Objectives:

The course on Soil Mechanics provide students with in-depth insights into soil parameters, their determination,and application in design and analysis, and exposure to analytical methods using standard guidelines, and construction practices.A thorough understanding of Soil Mechanics enables students to evaluate the strength of soil, consolidation settlement, and the factor of safety for slope stability as well. Moreover, this fundamental knowledge also serves as a gateway to exploring the multi-disciplinary aspects of Soil Mechanics across various civil engineering domains.

Course Contents:

Unit 1:Introduction (2 hours)

1.1 Definitions Rock and Soil

1.2 Definition of Soil Mechanics and its importance in Civil Engineering

1.3 Formation process of Soil

1.4 Residual and Transported Soils

1.5 Clay minerals: Montmorillonite, Kaolinite, and Illite

Unit 2:Solid-Water-Air relation, Index Properties, and Classification of Soil (10 hours)

2.1 Phase diagram of Soil, Basic definitions, and functional relationships

2.2 Index Properties of Soil, and their determination: Specific gravity, Relative density, Consistency Limits, Shape and Size of Soil grains.

2.3 Soil Identification and Classifications: Particle size, Textural, USCS, ISCS, AASHTO

Unit 3:Compaction of Soil (5 hours)

3.1 Definition, and purpose of Compaction

3.2 Dry density and moisture content relationship

3.3 Laboratory Compaction Tests

3.4 Factors affecting compaction of soil

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3.5 Effects of compaction on the engineering behavior of soil

3.6Methods of Field Compaction

3.7 Determination of field density: Core Cutter method, Sand Cone method, Rubber balloon method, Water displacement method

3.8 Relative Compaction

Unit 4:Principle of Effective Stresses, Capillarity and Flow in Soils (7 hours)

4.1 Concept of Total Stress, Pore water pressure, and effective stress: Effective Stress Equation

4.2 Types of head: Total head, Pressure head, Elevation head, and Velocity head

4.3 Quick Sand Condition

4.4Surface tension and Capillary rise of water in soil

4.5Definition: Permeability of Soil, Darcy's law

4.6Laboratory and field determination of Permeability

4.7Equivalent permeability in stratified Soil

4.8Factors affecting Permeability of Soil

Unit 5:Seepage Analysisthrough Soil (6 hours)

5.1 Definition of Seepage, and Laplace equation for two-dimensional flow

5.2 Introduction to Flow Net, their characteristics, applications

5.3 Analysis of seepage discharge

5.4 Seepage through Earthen Dam: Concept and construction of Phreatic Line, expression for seepage discharge

5.5 Piping and its Preventive Measures

Unit 6:Stress Distribution on Soil below the Applied Vertical Load (6hrs)

6.1 Concept of Stress Distribution on Soil,

6.2 Boussinesq's and Westergaard's Theory

6.3 Concept of Pressure Bulb and its construction

6.4 Vertical Stress Distribution on horizontal & vertical plane

6.5 Vertical Stress Distribution beneath the loaded area (Line load, Strip load, circular area, and Rectangular area), Use of Newmarks and Fadum's chart

6.6Approximate Method of Stress Distribution

Unit 7:Compressibility and Consolidation of Soil (9hrs)

7.1 Definition, Principles of consolidation, its type

7.2 Terzaghi's spring analogy model

7.3 One-Dimensional Consolidation theory

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7.4 Consolidation test

7.5Void ratio pressure relationships: Compressibility Characteristics (i.e. Compression Index, Coefficient of Compressibility, Recompression Index, Swelling Index, Coefficient of Volume change, etc.)

7.6 Types of Consolidated Clay

7.7 Determination of Over Consolidation (i.e. Pre-consolidation) Pressure

7.8 Determination of Consolidation Settlement

7.9 Determination of Coefficient of Consolidation: Square root and Logarithm of time fitting method

Unit 8:Shear Strength Soil (8 hours)

8.1 Concept of shear strength of soil

8.2 Principle planes, Principle stresses, Plane of Failure, Normal Stress, Shear Stress - Mohr Circle

8.3 Mohr-Coulomb's Failure Criteria

8.4 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

8.5 Shear Strength of Clay and Sand

Unit 9:Stability of Earth slopes (7 hours)

9.1 Introduction, Finite and Infinite Slopes

9.2 Cause of Instability of Slopes, Modes of failure of Slopes and its Remedial Measures

9.3 Stability Analysis of Infinite Slopes

9.4 Stability Analysis of Finite Slopes: $\varphi = 0$ Analysis (Total Stress Analysis), $c - \varphi$ Analysis (Slice Method)

9.5 Location of most critical circle

List of Tutorials

There shall be related tutorials exercised in class and given as regular homework exercise. Tutorial can be as following for each specified chapters

1. Solid-Water-Air relation, Functional relationships, Index Properties, and Classification of Soil
2. Compaction Properties of Soil
3. Effective stresses computation on hydrostatic, uniform seepage, Capillary, and uniform surcharge condition

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4. Determination of permeability of soil
5. Computation of pore pressure at any point of flow net and Calculation of Seepage discharge through soil
6. Computation of vertical stresses due to applied load (point load, line load, strip load, and UDL on circular Rectangular area)
7. Use of Newmark and Fadum's chart to compute vertical stress
8. Consolidation Settlement and Time Rate of Consolidation
9. Shear strength of soil (c, φ, τ, principal planes, principal stresses, etc.)
10. Stability Analysis of Earth Soil

List of Practicals

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 density of soil: Core Cutter Method, Sand Cone Method
4. Consistency Limits Test for fine-grained soil (i.e. LL, PL, and SL)
5. Compaction Test
6. Permeability Test: Constant and Falling head Method
7. Direct Shear Test
8. Triaxial Test (Demonstration)
9. Unconfined Compression Test
10. Vane Shear Test
11. Consolidation Test (Demonstration)
11. Visual Classification Test of Soil (Demonstration)
12. Experimental demonstration of water effect on sandcastle

Reference 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.
3. Braja M. Das (2002), *Principles of Geotechnical Engineering, Eighth Edition,* Cengage Learning 2016, 2012
4. Venkatramaiah, C. (Revised Third Edition), *Geotechnical Engineering,* New Age International (P) Limited Publisher, India

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5. Punmia, B.C., Jain, A.K.& Jain, Arun K. (Seventh Edition 2017). *Soil Mechanics and Foundation engineering*. Laxmi Publication Pvt. Ltd. India.
6. Terzaghi, Karl, Peck, R.B. & John, Wiley (1967). *Soil Mechanics in Engineering Practice*, New York.
7. T. William Lambe, Robert V. Whitman (1969), *Soil Mechanics*, JOHN WILEY & SONS, New York
8. T. William Lambe, *SOIL TESTING for Engineers*, John Wiley & Sons, Inc. New York
9. Muni Budhu, (Third Edition), *Soil Mechanics and Foundations*, John Wiley & Sons, Inc
10. Holtz, R.D. and Kovacs, W.D., (1981), *An Introduction to Geotechnial Engineering*, Prentice Hall
11. Adhikari P.B., Thapa H.J. A Text Book of Soil Mechanics, (2023), SanskritiPrakashan, Kathmandu, Nepal

Evaluation Schedule:

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	2	
Unit 2	Solid-Water-Air relation, Index Properties, and Classification of Soil (10 hours)	10	
Unit 3	Compaction of Soil	5	
Unit 4	Principle of Effective Stresses, Capillarity and Flow in Soils	7	
Unit 5	Seepage Analysis through Soil	6	
Unit 6	Stress Distribution on Soil below the Applied Vertical Load	6	
Unit 7	Compressibility and Consolidation of Soil	8	
Unit 8	Shear Strength Soil	9	
Unit 9	Stability of Earth slopes	7	
	Total	**60**	

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

Vice-Chancellor

BACHELOR DEGREE IN CIVIL ENGINEERING

STRUCTURAL ANALYSIS I

Course Code: CE 111

Lecturer: 3

Tutorial: 2

Practical: 1

Year: II

Part: II

Course Credit: 3

Course Objectives:

This course will help to provide the basic concept and knowledge of structural analysis of statically determinate structure. After completing this course, it is expected that the students will be able to analyze statically determinate beam, frame, truss, arch and cable both by manual calculation as well as computer application.

Course Contents:

Unit 1: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

Unit 2:Energy Methods(4 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 using strain energy method

Unit 3:Virtual Work Method(6 hrs)

3.1 Limitations of real work method

3.2 Principle of virtual work method

3.3 Unit load method

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3.4 Displacement of beams, frames and truss by the method of virtual work

3.5 Displacements in beam due to temperature effects

3.6 Displacement of truss due to misfit and temperature effects and combination of different effects

Unit 4:Displacement Theorems(2 hrs)

4.1 Betti's law

4.2 Maxwell's law of reciprocal displacement

4.3 Castigliano's theorems and application for beams and plane frames

Unit 5:Slope and Deflection of Beams(6 hrs)

5.1 Double Integration method

5.2 Macaulay's method

5.3 Conjugate beam method and its application for beams

5.4 Moment area method and its application for beams

Unit 6:Influence Lines For Simple Structures(9 hrs)

6.1 Influence lines for statically determinate beams

6.2 Influence lines for statically determinate trusses

6.3 Influence lines for girders with floor systems

6.4 Response at a particular location due to a single moving concentrated load

6.5 Response at a particular location due to a uniformly distributed live load

6.6 Response at a particular location due to a series of moving concentrated loads

6.7 Absolute maximum response

Unit 7:Statically Determinate Arches(6 hrs)

7.1 Types of arches

7.2 Three-hinged arches with support at same and different level

7.3 Determination of support reactions, normal thrust, radial shear and bending moment of circular and parabolic arches

7.4 Axial force, shear force and bending moment diagrams in three hinged parabolic arch

7.5 Influence line diagrams for reactions, bending moments, radial shear, normal thrust

7.6 Maximum internal forces (axial force, shear force and bending moment) in three hinged parabolic arches

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Unit 8:Cable Structures(6 hrs)

8.1 Introduction to cable structures

8.2 Elements of a simple suspension bridges

8.3 Analysis of parabolic cables

8.4 Analysis of three-hinged stiffening girder

8.5 Influence line diagrams and determination of shear forces and bending moments for three-hinged stiffening girder

Unit 9:Statically Determinate Space Trusses (3 hrs)

9.1 Introduction to simple space trusses

9.2 Types of supports

9.3 Determinacy and stability

9.4 Analysis of space truss by tension coefficient method

List of Tutorials (30 hours)

There shall be related tutorials exercised in class and given as regular homework exercise. The assignment shall be focused on analysis of problem requiring elongated time that are not possible to be included in final examination.Tutorial can be as following for each specified chapter.

1. Introduction(2hrs)
2. Energy Methods (3hrs)
3. Virtual Work Method (4hrs)
4. Displacement Theorems (1hrs)
5. Slope and Deflection of Beam (4hrs)
6. Influence Lines For Simple Structures (6hrs)
7. Statically Determinate Arches (4hrs)
8. Cable Structures (4hrs)
9. Statically Determinate Space Trusses(2hrs)

List of Practical (15 hours)

1. Deflection of beam experimentally and by computer simulation (2 hrs)
2. Deflection of frame experimentally and by computer simulation (2 hrs)

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3. Influence lines for beam experimentally and by computer simulation (3 hrs)
4. Horizontal thrust of three-hinged arch experimentally and by computer simulation (3 hrs)
5. Tension in cable of suspension bridge by experimentally and computer simulation (3 hrs)
6. Analysis of space truss by computer simulation (2 hrs)

Reference Books

Kassimali, A. (2009). Structural Analysis. Cengage Learning.

Norris, C. H., & Wilbur, J. B. (1960). Elementary Structural Analysis. McGraw-Hill.

Bhavikatti, S. S. (2011). Structural Analysis I. New Delhi: Vikas Publishing House Pvt. Ltd.

Darkov, A. &Kuznetsov, V. Structural Mechanics, Moscow: Mir Publishers.

Hibbeler, R.C (2009). Structural Analysis. Pearson.

Jain, A.K. Strength of Materials and Structural Analysis (2012). Roorkee: Nem Chand & Bros.

Reddy, C.S. (1999). Basic Structural Analysis. Tata McGraw-Hill Education.

Evaluation Schedule:

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	3	5
Unit 2	Energy Methods	4	9
Unit 3	Virtual Work Method	6	15
Unit 4	Displacement Theorems	2	3
Unit 5	Slope and Deflection of Beam	6	15
Unit 6	Influence Lines For Simple Structures	9	18
Unit 7	Statically Determinate Arches	6	15
Unit 8	Cable Structures	6	15
Unit 9	Statically Determinate Space Trusses	3	5
	Total	**45**	**100**

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

Vice-Chancellor

BUILDING DRAWING

Course Code: CE112

Lecture: 1
Tutorial:0
Practical: 3

Year: II
Part: II
Course Credit: 1

Course Objectives:

This course will help to introduce the fundamental terminology, components, elements and structural systems of buildings. It also provides concept and knowledge to develop primary skills in manual building drawing and computer-aided drafting (CAD) and familiarises students with building planning concepts, building by-laws and professional drawing practices including municipality submission and working drawings.

	Teaching Schedule Hours/Week			Evaluation Scheme				
				Internal Evaluation		Final Evaluation		Total
	Lecture	Tutorial	Practical	Theory	Practical	Theory	Practical	
Cr	1	0	3	-	60	-	40	

Course Contents:

Unit 1: Introduction to Building Drawing (3 hours)

1.1. Structural system and anatomy of buildings
1.2. Elementsof buildings
1.3. Scales used in building drawings
1.4. Introduction to basic building by-laws
1.5. Local architectures (e.g. Mithila architecture) in building drawing

Unit 2: Symbols, Conventions, and Introduction to CAD (2 hours)

2.1. Standard symbols for doors, windows, materials, plumbing and electrical fittings
2.2. Line types, hatching patterns, dimensioning standards and lettering

Unit 3: Standard Views in Building Drawing (4 hours)

3.1. Location plan and Site plan
3.2. Floor plans
3.3. Elevations (front, back and sides)
3.4. Cross-sections
3.5. Detail drawings (staircases, doors, windows)

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Unit 4: Types of Building Drawings(4 hours)

4.1. Concept drawings and Presentation drawings

4.2. Municipality submission drawings (with reference to building by-laws)

4.3. Measured drawings (documentation of existing buildings)

4.4. Working drawings: Architectural, Structural, Service (Electrical and Plumbing) drawings

4.5. As-built drawings

Unit 5: Practical Building Drafting and CAD Application (2 hours)

5.1. Plan-reading and interpretation exercises

5.2. Drawing simple public buildings (e.g.small school, office)

5.3. Introduction to combining manual and CAD practices for competent output

List of Tutorial(0 hours)

List of Practical(45 hours@ 3 hours per week)

Unit	Description of Drawing Sheet	No. of Sheets	Mode (Manual/CAD)	Hours Allocated
Unit 1	1. Scale exercises (scale conversion): Symbols, elements, and line types.	1 sheet	Manual	3 hours
Unit 2	2. Basic drafting practice: Simple room plan with standard symbols (doors, windows, furniture)	1 sheet	Manual	3 hours
Unit 3	3. Floor plan of simple residential building.	1 sheet	Manual	6 hours
	4. Elevation and cross-section of the same building.	1 sheet	Manual	6 hours
	5. Detail drawings (staircase plus door and window combined in one sheet).	1 sheet	Manual	6 hours
Unit 4	6. Municipality drawing (site plan, floor plan, elevation).	1 sheet	CAD	6 hours
	7. Measured drawing of an existing small building (simple house/room)	1 sheet	CAD/manual (choice)	3 hours
Unit 5	8. Working drawings: Architectural plan	1 sheet	CAD	3 hours
	9. Working drawings: Structural plan (column layout, footing plan)	1 sheet	CAD	3 hours
	10. Working drawings: Electrical layout (lights, switches, power points)	1 sheet	CAD	3 hours
	11. Working drawings: Plumbing and sanitary layout	1 sheet	CAD	3 hours

Reference Books

1. Shah, M., Kale, C. M., & Patki, S. Y. (2019). *Building Drawing: With an Integrated Approach to Built Environment*. Tata McGraw Hill Education
2. Bindra, S. P., & Arora, S. P. (2022). *Building Construction: Planning Techniques and Methods* (Revised ed.). Dhanpat Rai Publications.
3. *NBC 206:2015 – Nepal National Building Code: Architectural Design Requirements*. Government of Nepal.
4. Ching, F. D. K. (2015). *Architectural Graphics* (6th ed.). Wiley.
5. Gautam, D. (2016). *Building Drawing and Drafting (in Nepali Context)*. Heritage Publishers & Distributors.
6. NBC Codes and Local Building Bye-laws.
7. Suraj Singh.*Civil Engineering Building Practice.*
8. William J. Hornung.*Architectural Construction Drafting and Design Fundamentals*
9. John Molnar.*Building Construction Drafting and Design*
10. Brian W. Boughton.*Building and Civil Engineering Construction*
11. Thomas Marvin L.*Architectural Working Drawing*

Evaluation Schedule:

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

Units	Unit Title	Scheduled Hours (Th+Pr)	Marks*
Unit 1	Introduction to Building Drawing	6	4
Unit 2	Symbols, Conventions and Introduction to CAD	5	3 to 4
Unit 3	Standard Views in Building Drawing	22	14 to 15
Unit 4	Types of Building Drawings	13	8 to 9
Unit 5	Practical Building Drafting and CAD Application	14	9 to 10
	Total	**60**	**40**

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

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NUMERICAL METHOD

Course Code: SH109

Lecturer: 3 **Year: II**

Tutorial: 1 **Part: II**

Practical: 2 **Course Credit: 3**

Course Objectives:

This course aims to provide students with a comprehensive understanding of numerical methods, emphasizing their use in obtaining approximate solutions to complex mathematical problems frequently found in science and engineering. It fosters the development of algorithm development, programming, and visualization techniques, allowing students to successfully apply computational methods and their problem-solving skills in real-world situations.

Course Contents:

Unit 1:Introduction (2 hours)

1.1 Introduction, History &Importance of Numerical methods
1.2 Approximation and Errors in computations
1.3 Analog and Numeric Data
1.4 Floating point representation and errors-Normalized floating-point forms, Errors in representing numbers
1.5 Floating point machine number and machine epsilon

Unit 2:Solution of Non-Linear Equations (6 hours)

2.1 Bisection method

2.2 RegulaFalsi method and secant method

2.3 Newton-Raphson method

2.4 Fixed point iteration method

2.5 Solution of non-linear simultaneous equations using Newton Raphson method

Unit 3:Solution of Algebraic Equations (8 hours)

3.1 Matrix inversion method, Gauss elimination method, and Gauss-Jordan method

3.2 Jacobi's method, and Gauss-Seidal method

3.3 Factorization (or Decomposition) Method,

3.4 Determination of eigenvalues by using power method

Unit 4:Interpolations and Approximation (8 hours)

4.1 Finite differences (Forward, backward, central and divided differences)

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4.2 Newton's forward and backward difference interpolation, and Bessel's central difference interpolation

4.3 Newton's divided difference interpolation, Lagrange interpolation

4.4 Least square method of curve fitting for linear and non-linear form

4.5 Cubic spline interpolation

Unit 5:Numerical Differentiation and Integration (6 hours)

5.1 Differentiation formulae for equally spaced intervals

5.2 Local maxima and minima of a tabulated function

5.3 Newton Cote's general quadrature formula

5.4 Trapezoidal rule, Simpson's 1/3 and 3/8 rules

5.5 Romberg integration

5.6 Gauss-Legendre integration (up to 3-point formula)

Unit 6:Solution of Ordinary Differential Equations (8 hours)

6.1 Initial value problem, Picard's, Taylor series method,

6.2 Runge-Kutta first, second and fourth order methods

6.3 Solution of system of first and second order by Runge-Kutta methods

6.4 Solution of boundary value problems by shooting and finite difference method

Unit 7: Solution of Partial Differential Equations(7 hours)

7.1 Introduction and classification of partial differential equations

7.2 Solution of elliptic equations (Laplace and Poisson equation)

7.3 One-dimensional heat equation (Schmidt method)

7.4 Solution of wave 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 non-linear equations by all methods and its rate of convergence (2 hours)
2. Solution of system of linear algebraic equations(3 hours)
3. Solution of different interpolating polynomials, regression curve and cubic spline interpolation(2 hours)
4. Determination of the first and second order derivatives by difference method (1 hours)
5. Integration by Trapezoidal rule, Simpson's rule, Romberg method and Gaussian method (2 hours)

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6. Solution of ordinary differential equations (Initial value problems) (1 hours)
7. Solution of ordinary differential equations (Boundary value problems) (1 hours)
8. Solution of partial differential equations (3 hours)

List of practical's (30 hours)

Programming language to be used: MATLAB/C/C++, or any other relevant high level programming languages.

1. Basics of programming (any)
2. Solution of Non-linear equations
3. System of linear algebraic equations and power method
4. Interpolation and regression
5. Numerical Integration
6. Solution of Ordinary Differential Equations

Reference Books ***(order based on relevance/availability)***

1. B. S. Grewal, "Numerical Methods in Engineering & Science" (11th edition). India: Khanna Publishers.
2. E. Balagurusamy, "Numerical Method", New Delhi, Tata McGraw Hill, 2010.
3. S.S. Sastry, "Introductory Method of Numerical Analysis (4th edition)", Prentice-Hall of India, New Delhi, 2008.
4. C.F. Gerald and P.O. Wheatley, "Applied Numerical Analysis (7th edition)", New York.
5. S. C. Chopra and R.P. Canale, "*Numerical Methods for Engineers*", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.

Evaluation Schedule:

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	2	-
Unit 2	Solution of Non-Linear Equations	6	10
Unit 3	Solution of Algebraic Equations	8	10
Unit 4	Interpolations and Approximation	8	10
Unit 5	Numerical Differentiation and Integration	6	10

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Unit 6	Solution of Ordinary Differential Equations	8	10
Unit 7	Solution of Partial Differential Equations	7	10
	Total	**45**	**60**

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

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