COMMUNICATION ENGLISH

ENSH 251

Lecture : 3
Tutorial : 0
Practical : 1

Year : II
Part : II

Course Objectives:

The general objective of this course is to focus on English as a communication tool. Specifically, it emphasizes using English for professional communication for engineering works. It aims to increase English language ability to use appropriate research formats and methodology, develop concept papers, prepare research proposals and abstracts, set research questions, write a literature review, determine a research gap, link ideas, write technical proposals, prepare formal and informal reports and engage in project works, seminars/conferences.

1 Technical Communication **(2 hours)**

1.1 Definition, nature and scope of technical communication
1.2 Professional ethics in communication (Ethical issues, plagiarism and copyright concerns, honesty, transparency and clarity)

2 Writing Skills **(8 hours)**

2.1 Principles of effective technical writing (Clarity, conciseness and coherence)
2.2 Grammar (Pronoun and its antecedent, subject-verb agreement, non-finite verbs), sentence construction (Simple, compound, complex, and mixed sentences), error analysis and punctuation
2.3 Bias-free language guideline, reducing bias

3 Technical Writing **(15 hours)**

3.1 Technical proposals (Purpose, types, structure, key considerations and examples)
3.2 Research proposals and reports (Title page, table of contents, summary and abstract)
3.3 Technical reports (Progress, feasibility and case study)
3.4 Manuscript for journal (Structure, key considerations and examples)
3.5 Citation and referencing (In-text citation, direct quote citations, indent citation, indirect citation, citing from books and journals, citing multiple authors in a single text, citing multiple texts from the same author, using numerical, pagination, preparing a reference page

4 Business Correspondence **(10 hours)**

4.1 Writing formal letters (Applications, inquiries, complaints and orders)
4.2 E-mails (Structure, etiquette, and tone)
4.3 Notice, minutes and memos
4.4 Resume and cover letter
4.5 Press release/communique
4.6 Calling tender and responding to it

5 Listening and Oral Communication **(4 hours)**

5.1 Active listening (Barriers and strategies)
5.2 Effective speaking skills (Clarity, tone and pace)
5.3 Oral presentation skills (Structuring a presentation and handling questions)
5.4 Group discussions (Strategies and active participation)
5.5 Public speaking and speech delivery techniques

6 Use of Visual Aids in Communication **(6 hours)**

6.1 Tables
6.2 Graphs
6.3 Charts
6.4 Diagrams

Practical **(15 hours)**

1. Listening skill test
2. Visual skill test
3. Reading skill test
4. Oral communication test
5. Presentation skill test
6. Research proposals and project proposals
7. Team-based technical writing and presentations
8. Presentation on the prescribed texts
   - 8.1 "Which is More Important When Designing a Building: Beauty or Function?" from Unlock: Reading and Writing Skills by Chris Sowton
   - 8.2 On Being Modern-minded (Bertrand Russell)
   - 8.3 A Fable of Tomorrow" from The Silent Spring by Rachel Carson
   - 8.4 Religion and Science (From The World as I See It- Albert Einstein)
   - 8.5 "The Tamarisk Hunter" from Metatropolis by Paolo Bacigalupi
   - 8.6 Artificial Intelligence from The Art of Doing Science and Engineering by Richard W. Hamming
   - 8.7 Guglielmo Marconi and the History of Radio. Part II (Gerald A. Isted)
   - 8.8 Human-Centered Design (From The Design of Everyday Things- Don Norman)
   - 8.9 "The Paper Managerie" from The Paper Managerie and Other Stories by Ken Liu

8.10 "The Algorithm Will Save Us" from The New Voices of Fantasy by Sam J. Miller
8.11 "The Phantom Heart" by Laurence Yep
8.12 "Everyday Use" by Alice Walker

Final Exam

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

Chapter	Hours	Marks distribution*
1	2	5
2	8	10
3	15	20
4	10	10
5	4	10
6	6	5
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Markel, M. and Selber, S. A. (2018). Technical communication (12th edition). Bedford/St. Martln's.
2. Ingre, D. (2017). Engineering communication: A practical guide to workplace communications for engineers (2nd edition). Cengage Learning.
3. Weisman, H. M. (2000). Technical communication for engineers: A handbook for engineers, scientists, and technicians. Prentice Hall.
4. Stevenson, S. and Whitmore, S. (2002). Strategies for engineering communication. John Wiley & Sons.
5. Rothwell, E. J., Cloud, M. J. (2017). Engineering writing by design: Creating formal documents of lasting value. CRC Press.
6. Blake, G., Bly, R. W. (1993). The elements of technical writing. Macmillan.
7. Beer, D., Mc Murrey, D. (2013). A guide to writing as an engineer (4th edition). John Wiley and Sons.
8. Farhathullah, T. M. (2002). Communication skills for technical students. Orient Longman.
9. Lebrun, J. L. (2007). Scientific writing: A reader and writer's guide. World Scientific Publishing.
10. Ligawa. H. (2021). Communication skills notes. Siaya Institute of Technology.
11. Katz, M. J. (2009). From research to manuscript: A guide to scientific writing (2nd edition). Springer.
12. Swales, J. M., Feak, C. B. (2012). Academic writing for graduate students: Essential tasks and skills (3rd edition). University of Michigan Press.
13. Hofmann, A. H. (2014). Scientific writing and communication: Papers, proposals, and presentations (2nd edition). Oxford University Press.

PROBABILITY AND STATISTICS

ENSH 253

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 0

Course Objectives:

The objective of this course is to equip students with foundational knowledge in probability and statistics, focusing on core concepts essential for engineering applications. Students will develop essential skills in statistical data analysis, enabling them to apply various statistical techniques to address real-world engineering challenges. Additionally, the course emphasizes the interpretation and effective communication of statistical results, preparing students to make informed, data-driven decisions in their professional practice.

1 Descriptive Statistics and Basic Probability (6 hours)

1.1 Introduction to statistics and its importance in engineering
1.2 Measure of central tendency and measure of variation
1.3 Graphical representation of data: Histograms, box plots and scatter plots
1.4 Basic probability concepts, additive law, multiplicative law
1.5 Conditional probability and Bayes' theorem

2 Probability Distributions and Sampling Distribution (14 hours)

2.1 Random variables: Discrete and continuous
2.2 Expectation and variance of discrete and continuous random variables
2.3 Discrete probability distributions: Binomial, Poisson, negative Binomial
2.4 Continuous probability distributions: Normal, Gamma, Chi-Square
2.5 Population and sample
2.6 Sampling distribution of mean and proportion
2.7 Central limit theorem

3 Statistical Inference (14 hours)

3.1 Point estimations and properties of estimators
3.2 Confidence intervals for mean and proportions
3.3 Hypothesis testing, parametric and non-parametric tests, procedure of hypothesis
3.4 Hypothesis testing of mean (Single mean, two means, paired t-test and one-way)
3.5 Goodness of fit test and independence of attributes (Chi-square and Kolmogorov–Smirnov test)

4 Correlation and Regression **(6 hours)**

4.1 Correlation analysis and test of linear correlation
4.2 Simple regression analysis, the concept of explained, unexplained, and total
4.3 Multiple regression analysis

5 Statistical Quality Control **(5 hours)**

5.1 Quality control and its importance in engineering
5.2 Control charts for variables (X-bar, R-chart, P-chat)
5.3 Six sigma concepts

Tutorial **(15 hours)**

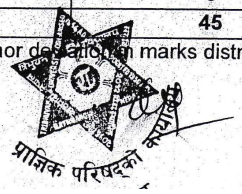
1. Visualize data, compute central tendency, and variance in engineering problems using computer software
2. Solve different engineering problems involving probability
3. Solve different engineering problems involving discrete probability distribution and its interpretation
4. Solve different engineering problems involving continuous probability distribution and its interpretation
5. Analyze numerical engineering datasets, perform normality tests, confidence intervals, significance tests of means, and ANOVA
6. Analyze categorical engineering datasets, perform crosstabulation, proportion tests, Chi-Square tests, and draw conclusions using computer software
7. Calculate the correlation coefficient and perform correlation tests on engineering data
8. Fit and interpret simple/multiple regression models on engineering data using computer software
9. Use control charts for process monitoring on sample engineering data.
10. Create control charts using computer software

Final Exam

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

Chapter	Hours	Marks distribution*
1	6	10
2	14	15
3	14	20
4	6	10
5	5	5
Total	**45**	**60**

* There may be minor deviation in marks distribution.



References

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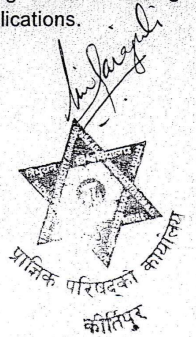
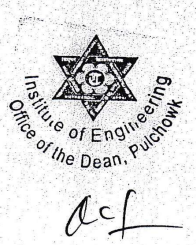
4. Jay L.D. (2012). Probability and Statistics for Engineering and Sciences. Boston: Thomson Brooks/Cole
5. Brian S.E., Ibrsten H. (2010). A Handbook of Statistical Analyses Using R (2nd edition). London: CRC Press Taylor & Francis Croup
6. Andy F. (2018). Discovering Statistics Using IBM SPSS Statistics (5th edition). London: SAGE Publications.





BUILDING TECHNOLOGY

ENCE 255

Lecture : 2 **Year : II**
Tutorial : 2 **Part : II**
Practical : 0

Course Objectives:
To introduce functional requirement of building, its component, special work, special treatment in building and sustainable building

1 Introduction (2 hours)

1.1 Built environment
1.2 History of building technology and Nepalese buildings
1.3 Classification of building based on occupancy, storey and height
1.4 Loads on building

2 Functional Requirement of Building (5 hours)

2.1 Orientation and planning of building (factors and site selection)
2.2 Lighting and thermal performance (daylight, artificial lighting, heat phenomena, thermal comfort and thermal performance)
2.3 Ventilation and air conditioning (functional requirement, natural and mechanical ventilation, air conditioning)
2.4 Sound and acoustic (characteristics, types, common defect)

3 Sub-structure and Superstructure Works (6 hours)

3.1 Sub-structure (Site exploration; foundation and its types; excavation of foundation on soft soil, hard rock, wetland and sloppy land; trenches for pipes and refiling works)
3.2 Load bearing structure
3.2.1 Stone masonry (Rubble and ashlar); composite, hollow block, autoclaved aerated cement block and compressed stabilized earthen block masonry; cavity wall; concrete 3D printing
3.2.2 Wall finishes (Tools, methods and defects in plastering; pointing types; painting on wooden, metal and masonry surface)
3.3 Frame Structure
3.3.1 Reinforced cement concrete structure (Precast and cast-in-situ construction; formwork for wall, slab, staircase, beam and column; slip formwork; timbering for trenches; partition and parapet wall)

3.3.2 Steel Construction (Advantage and disadvantage, steel section, bolted and welded connection)
3.3.3 Joint types (expansion, construction and seismic); location and sealing of joint

4 Building Components and services (7 hours)

4.1 Doors and windows (Location, shape, size, terminology and fixing process; types based on shutter and working mechanism; ventilators)
4.2 Horizontal and vertical circulation (Corridors; ladder and its types; stair types and planning; lift and escalator; ramps)
4.3 Flooring (Solid and suspended floor; flooring types)
4.4 Roof (Terminology; types of pitched roof; roof covering)
4.5 Building services
4.5.1 Plumbing (water distribution system, sanitary fittings, septic tank and soak pit)
4.5.2 Electrification (wiring systems, lightening arrester and safety precaution)

5 Special Works on Building (7 hours)

5.1 Shoring, scaffolding and underpinning
5.2 Fire Protection (Fire resistant walls and columns, floors and roof, openings; fire extinguishing equipment)
5.3 Moisture movement, damp proofing methods and materials
5.4 Termite types and anti-termite treatment process
5.5 Thermal insulation (Insulating material; insulation of roofs, exposed walls, door and windows)
5.6 Sound insulation (Sound absorption and absorbents; insulating material; wall and floor insulation)
5.7 Seismic safety requirements (Building configuration; size and location of openings; earthquake resisting elements)
5.8 Repair and restrengthening (Structural and non-structural cracks; repair of cracks; retrofitting techniques for masonry and reinforced cement concrete structures)
5.9 Demolition of structures (steps before demolition and methods)

6 Sustainable Building (3 hours)

6.1 Concept and principles; rating system
6.2 Sustainable building construction methods (techniques and strategies)

Tutorial (30 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. Site plan, trench plan, floor plan and elevation
2. Foundation structure

3. Brick bonds (1 and 1-1/2 brick) and tools for masonry structures
4. Parapet wall and cavity wall detail
5. Timbering of trenches
6. Formwork and its components for slab, column beam and staircase
7. Detailing of door frames and shutters
8. Staircase plan, section and layout
9. Isometric view, plan and sections of lift and escalators
10. Isometric view, plan and section of scaffolding, shoring and underpinning
11. Pipe layout, septic tank and soak pit
12. Plumbing and electrical network
13. Case study on sustainable building

Final Exam

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

Chapter	Hours	Mark distribution*
1	2	2
2	5	5
3	6	6
4	7	6
5	7	7
6	3	4
Total	**30**	**30**

* There may be minor deviation in marks distribution.

References

1. McKay, W. B., McKay, J. K. (1961). Building Construction. United Kingdom: Longmans.
2. Chudley, R., Greeno, R. (2016). Building Construction Handbook. United Kingdom: CRC Press.
3. Reid, E. (2013). Understanding Buildings a Multidisciplinary Approach. United Kingdom: CRC Press.
4. Punmia, B. C. (2008). Building Construction. India: Laxmi Publications Pvt Limited.
5. Kumar, S. (2006). Building Construction. India: Standard Publishers Distributors.
6. Kubba, S. (2012). Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes. Netherlands: Elsevier Science.
7. Kibert, C. J. (2016). Sustainable Construction: Green Building Design and Delivery. United Kingdom: Wiley.
8. Building Codes

HYDRAULICS

ENCE 251

Lecture : 4 **Year : II**
Tutorial : 2 **Part : I**
Practical : 2/2

Course Objectives:

The objective of this course is to provide knowledge of hydraulics to impart the concept of water resources engineering and their application in the field of civil engineering. It equips students the skills to analyze and solve fluid flow problems in closed conduits and open channels. It also aims to teach practical applications through laboratory experiments and software tools.

1 Pipe Flow Regimes (8 hours)

1.1 Concept, scope and importance of pipe flow
1.2 Reynolds experiment (Laminar, transition and turbulent flows)
1.3 Steady laminar flow in circular pipes (Shear stress, velocity distribution and head loss - Hagen Poiseuille law)
1.4 Examples and characteristics of turbulent flow
1.5 Shear stress in turbulent flow (Boussinesq's, Reynold's and Prandtl's mixing length theories)
1.6 Hydrodynamically smooth and rough boundaries; Velocity distribution for turbulent flow in pipes; Nikuradse's experiments
1.7 Darcy-Weisbach equation, friction factor for turbulent flow in smooth and rough pipes; Colebrook white equation, Moody chart, introduction to Hazen-Williams equation

2 Pipe Flow Problems (10 hours)

2.1 Minor head losses in pipes (Losses due to sudden enlargement, sudden contraction, entry, exit, obstruction, gradual contraction or enlargement, bends and fittings)
2.2 Hydraulic gradient line and total energy line
2.3 Pipes in series and parallel
2.4 Siphons (Working principle and applications)
2.5 Three reservoir problems
2.6 Pipe network problems (Hardy-Cross method)

3 Unsteady Flow in Pipes (6 hours)

3.1 Concept and equations of unsteady flow
3.2 Water hammer phenomenon and effects

3.3 Velocity and magnitude of pressure waves, equation for water hammer pressure (Gradual and rapid valve closures)
3.4 Pressure variation due to sudden closure of valve (With and without head loss)

4 Uniform Flow in Open Channels (8 hours)

4.1 Classification of open channel and geometric properties
4.2 Conditions for uniform flow (Expression for shear stress on the channel boundary)
4.3 Flow resistance equations (Chezy, Manning and Darcy-Weisbach equations and their relationships; Bazin and Kutter equations)
4.4 Manning's roughness coefficient (Determination and factors affecting roughness)
4.5 Velocity distribution and profiles (Velocity distribution in rectangular, triangular, trapezoidal, and circular channel sections; velocity distribution coefficients)
4.6 Best hydraulic channel sections (Dimensions for rectangular, triangular, trapezoidal and circular sections)
4.7 Uniform flow computation (Conveyance, section factor, normal depth)

5 Energy and Momentum Principles in Open Channel Flow (12 hours)

5.1 Introduction to non-uniform flow in open channel
5.2 Energy principle (Specific energy, specific energy curve, alternate depths, and criteria for critical flow)
5.3 Critical depth computations in prismatic channel sections (Rectangular, triangular, circular and trapezoidal sections)
5.4 Depth-discharge relationship
5.5 Application of energy principle (Channel with hump; transition with a change in width; chocking; venturi flume; broad crested weir)
5.6 Momentum principle (Specific force; specific force curve; initial and sequent depths; conjugate depths; criteria for critical flow)
5.7 Application of momentum principle (Stilling basin; force on sluice gates; force on baffle blocks in stilling basin)

6 Rapidly Varied Flow in Open Channels (6 hours)

6.1 Characteristics of rapidly varied flow
6.2 Hydraulic jump (Analysis of hydraulic jump with assumptions)
6.3 Hydraulic jump in rectangular channel: Relationship between hydraulic jump variables (Conjugate depth, height of jump, efficiency of jump and length of the jump); energy loss in jump
6.4 Classification of hydraulic jump based on tail water level and Froude number

7 Gradually Varied Flow in Open Channels (10 hours)

7.1 Characteristics of gradually varied flow
7.2 Analysis of gradually varied flow (Basic assumptions for analysis, dynamic equation, dynamic equation in wide rectangular channel and control section)
7.3 Channel bottom slope: Relation between water surface and channel bottom slopes; bottom slope characteristics (Mild, critical, steep, horizontal and adverse slopes)
7.4 Water surface profiles (Classification and characteristics of water surface profiles; practical examples of water surface profiles)
7.5 Computation of gradually varied flow in prismatic channels: Direct integration (Bresse method), direct step and standard step methods
7.6 Computation of location of hydraulic jump under different flow conditions

Tutorial (30 hours)

1. Calculation of the Reynolds number and classify the flow regime (Laminar, transition, or turbulent) in a given pipe
2. Determination of the velocity distribution, shear stress, and head loss for steady laminar flow in circular pipes using the Hagen-Poiseuille equation
3. Computation of the head loss for turbulent flow in pipes using the Darcy-Weisbach equation and appropriate friction factors
4. Use the Colebrook-White equation and Moody chart to find the friction factor for turbulent flow in smooth and rough pipes
5. Calculation of the head loss due to a sudden contraction, enlargement, bends, fittings and, other minor losses in a pipe system
6. Solution for the total head loss in a system where pipes are arranged in series with varying diameters and lengths
7. Calculation of the flow distribution and head loss for pipes arranged in parallel
8. Analysis of the flow rate and pressure variations in a siphon, including head losses and practical applications
9. Calculation of the flow rates between three interconnected reservoirs using energy principles
10. Solution of flow rates and head losses in a given pipe network using Hardy-Cross method
11. Calculation of the pressure rise in a pipe due to sudden and gradual closure of a valve using the water hammer equation
12. Computation of the speed of pressure waves in pipes of different materials during transient flow conditions
13. Calculation of the flow velocity and discharge in open channels with given roughness coefficients using Manning's and Chezy's equations
14. Determination of the most efficient channel dimensions for rectangular, trapezoidal, and circular sections based on specific flow rates

15. Computation of the specific energy and critical depth in various channel shapes (Rectangular, trapezoidal, and triangular channels)
16. Solution of flow characteristics over a channel with a hump, transition with width change, through a Venturi flume and, broad-crested weir
17. Calculation of forces on sluice gates, baffle blocks, and stilling basins using the momentum principle
18. Determination of conjugate depths, energy loss, and jump efficiency for hydraulic jumps in rectangular channels
19. Calculation of the water surface profile for prismatic channels using direct integration, direct step and, standard step methods
20. Computation of the location of a hydraulic jump in an open channel under varying flow conditions

Assignment

Practical problem-solving for pipe flow and open channel flow using appropriate modeling tools.

Practical **(15 hours)**

1. Reynolds' experiment
2. Head loss in pipes
3. Determination of Manning's coefficient for different surfaces
4. Flow through open sluice gates
5. Hump and constricted flow analysis
6. Hydraulic jump analysis

Final Exam

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

Chapter	Hours	Mark distribution*
1	8	8
2	10	10
3	6	6
4	8	8
5	12	12
6	6	6
7	10	10
Total	60	60

* There may be minor deviation in marks distribution.

References

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2. Chaudhry, M.H. (2014). Applied hydraulic transients (3rd edition). Springer.
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9. Sangroula, D.P., Bhattarai, P.K. (2017). A textbook of hydraulics: Fundamentals and applications (2nd edition). Green Books.

SOIL MECHANICS
ENCE 253

Lecture	**: 4**	**Year : II**
Tutorial	**: 2**	**Part : II**
Practical	**: 2**	

Course Objectives:

The main objective of this course is to introduce the fundamental concepts of soil, including its index and engineering properties. Additionally, the course aims to provide knowledge of the mechanical behavior of soil under both static and dynamic loading conditions. By the end of the course, students will be able to quantify key soil properties and apply this knowledge to solve various soil engineering problems.

1 Introduction (6 hours)

- 1.1 Historical development of soil mechanics
- 1.2 Scope and application of soil mechanics
- 1.3 Soil formation and soil types
- 1.4 Soil structures and clay minerals

2 Phase Relationship, Index Property and Soil Classification (12 hours)

- 2.1 Basic definitions
- 2.2 Phase relationships: Volume-volume, mass-volume, weight-volume and mass-mass relationships
- 2.3 Soil index properties: Index properties of coarse and fine grained soils
- 2.4 Soil classification systems (MIT, USCS, IS, BS)
- 2.5 Field identification of soil

3 Soil Water, Permeability and Seepage Analysis (8 Hours)

- 3.1 Soil water and capillarity
- 3.2 Soil permeability (Darcy's law and its validity, coefficient of permeability from laboratory and field tests and their significance)
- 3.3 Factors affecting soil permeability
- 3.4 Permeability in stratified soil
- 3.5 Two dimensional flow (Laplace equation)
- 3.6 Flow net, flow net construction and applications
- 3.7 Seepage through an earthen dam (with and without horizontal filter)
- 3.8 Seepage through anisotropic soil condition
- 3.9 Piping failure and its mitigation measures

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4 Soil Stresses (8 hours)

- 4.1 Effective stress principle
- 4.2 Effective stress (Hydrostatic, one dimensional flow and uniform surcharge)
- 4.3 Quick sand condition, problems and mitigation
- 4.4 Stress due to applied load (Boussinesq's solution and its extension; Westergaard's solution)
- 4.5 Newmark's influence chart
- 4.6 Equivalent point load and approximate stress distribution for loaded areas

5 Consolidation (8 hours)

- 5.1 Consolidation process (Spring analogy)
- 5.2 One-dimensional consolidation theory
- 5.3 Oedometer test (Compression, swelling and recompression indices; compressibility, volume change and consolidation coefficients; pre-consolidation pressure)
- 5.4 Secondary consolidation
- 5.5 Normally consolidated and over consolidated clay
- 5.6 Settlement calculation
- 5.7 Accelerating consolidation (Preloading, vertical and horizontal drains)

6 Shear Strength (12 hours)

- 6.1 Shear strength, Mohr circle and Mohr-Coulomb failure theory
- 6.2 Shear strength of soil
  - 6.2.1 Direct shear test
  - 6.2.2 Uniaxial compression test
  - 6.2.3 Triaxial compression tests (stress-strain behavior, stress path)
  - 6.2.4 Vane shear test
- 6.3 Factors affecting shear strength
- 6.4 Cyclic shear strength (Cyclic triaxial test, stress-strain behavior, hysteresis loop, shear modulus, cyclic strength envelope)
- 6.5 Critical state framework

7 Soil Compaction (6 hours)

- 7.1 Importance of soil compaction
- 7.2 Compaction tests and results interpretation (Standard and modified Proctor tests, Harvard miniature compaction test)
- 7.3 Factors affecting compaction
- 7.4 Structure and engineering behavior of compacted soils
- 7.5 Compaction specification and field control

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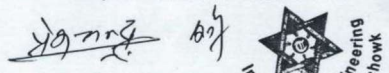
Tutorials **(30 hours)**

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

1. Computation of different soil parameters and their interrelationship (Phase relationships): Tutorial on calculating void ratio, porosity, water content, and degree of saturation; Examples demonstrating the relationship between bulk density, dry density, and unit weight
2. Index properties and soil classification: Tutorial on determining particle size distribution, Atterberg limits, and consistency indices; Soil classification exercises using the Unified Soil Classification System (USCS)
3. Problems Related to Soil Capillarity, Permeability, and Seepage: Exercises on computing capillary rise and pore water pressure; Solving problems related to Darcy's law for permeability; Tutorials on flow nets for seepage analysis in soil
4. Determination of Effective Stress for Different Conditions: Problems on effective stress computation for submerged soils and layered soils for different scenarios; Examples of vertical stress analysis under various applied loads
5. Computation from 1-D consolidation test and settlement calculations: Tutorial on interpreting laboratory consolidation test results; Exercises on calculating compression index, settlement, and rate of consolidation
6. Failure criterion and soil strength for different soils: Tutorials on Mohr-Coulomb failure criterion and shear strength parameters; Exercises on direct shear test, triaxial test (monotonic and cyclic), and undrained shear strength analysis
7. Problems on determining maximum dry density and optimum moisture content using standard Proctor test results

Practical **(30 hours)**

1. Determination of moisture content and specific gravity
2. Determination of field density using core cutter and sand replacement method
3. Sieve analysis and hydrometer analysis
4. Determination of Liquid limit and Plastic limit
5. Permeability test using falling head and constant head
6. Oedometer test
7. Direct shear test on sand
8. Unconfined compression test on undisturbed sample
9. Triaxial test- unconsolidated undrained
10. Compaction test of natural soils



Final Exam

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

Chapter	Hours	Mark distribution*
1	6	6
2	12	12
3	8	8
4	8	8
5	8	8
6	12	12
7	6	6
Total	**60**	**60**

* There may be minor deviation in marks distribution.

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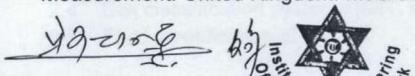

SURVEY CAMP

ENCE 256

Duration: 10 days **Year: II** **Part: II**

Course Objectives:

The primary objective of the survey camp is to equip students with the practical experience and skills needed to apply their theoretical knowledge of Engineering Surveying in real-world conditions. Through hands-on fieldwork, students will gain exposure to various surveying methods, modern instruments, computational techniques, and best practices for presenting their findings in a professional report. By the end of the course, students will be able to effectively implement surveying techniques to address practical challenges in the field.

1 Establishment of Horizontal Control for Major Traverse (2 days)

1.1 Reconnaissance, stations selection and pegging of major traverse: Closed traverse at least 1.5 km perimeter (15-20 stations) controlled with reference to national grid system
1.2 Measurement of major traverse angles and distances by Total Station/DGPS
1.3 Level transfer using Auto level/DGPS
1.4 Computation of coordinates (NEZ)

2 Minor Traverse and Topographic Survey (5 days)

2.1 Reconnaissance, stations selection and pegging of minor traverse: Link traverse (5-7 stations) controlled with reference to major traverse
2.2 Measurement of minor traverse angles and distances by Total Station/DGPS
2.3 Level transfer using Auto level/DGPS
2.4 Computation of coordinates (NEZ)
2.5 Plotting of major and minor traverse
2.6 Detailed topographic survey from major and minor control points: Semi built up area around 4 to 6 hectares of land using Total Station/Drone
2.7 Digital data recording and plotting by CAD software

3 Bridge Site Survey (1.5 days)

3.1 Detailed topographic survey of suitable bridge site area (At least 200m x 120m)
3.2 Detailing by using total station; Vertical control for control points using auto level/DGPS
3.3 Preparation of topographic map, L-section and X-section to standard scale

4 Road Alignment Survey (1.5 days)

4.1 Topographic survey of road alignment (Corridor at least 650m x 30m)
4.2 Preparation of topographic map of the corridor
4.3 Preparation of Plan, L-section and X-section (Right of Way 20 m) to standard scale including selection of grades and formation levels

Evaluation Criteria

Internal Assessment (50 marks)

Attendance of 10 days weighted 10 marks but if anybody absent more than 3 days' camp should be repeated. Regular evaluation throughout the 10 days as well as viva for computation and plotting of major traverse, minor traverse, viva for road and bridge site survey and traverse orientation check should be taken

Final Exam

Standard reports shall be prepared group wise. During compilation of the report, data shall be submitted content wise and all the reference sketches and standard drawings shall be compiled in A3 size and all the original data and drawings shall be presented during final exam. In the final examination there will be viva and instrumentation as per following weightage.

The evaluation scheme will be as indicated in the table below:

Evaluation Method	Mark distribution*	Remarks
Viva / Report Presentation	30	
Instrumentation	20	Should pass individually
Total	**50**	

* There may be minor deviation in marks distribution.

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THEORY OF STRUCTURES II

ENCE 252

Lecture	**: 4**	**Year : II**
Tutorial	**: 2**	**Part : II**
Practical	**: 2/2**	

Course Objectives:

The course is designed to introduce key terminology and concepts related to displacements, stresses, strains, stiffness, and other parameters essential for understanding indeterminate systems. It provides practical examples to illustrate the fundamental concepts and theorems concerning static equilibrium, geometrical compatibility, and physical conditions such as forces, stiffness, and displacements within these systems. Additionally, the course equips students with the necessary skills for more advanced structural mechanics courses by introducing analytical tools, including the matrix method, force method, displacement method, and plastic analysis.

1 Introduction (4 hours)

- 1.1 Types of indeterminate structures
- 1.2 Boundary conditions and degree of freedoms
- 1.3 Static and kinematic indeterminacy
- 1.4 Structure idealization, local and global coordinate systems, deformations and their sign conventions
- 1.5 Determination of degree of static indeterminacy of a system: Use of formula, necessity of visual checking for plane systems in the form of beam, frame, truss and arch
- 1.6 Degree of kinematic indeterminacy of a system and its determination: Use of formula, necessity of visual checking for plane systems in the form of beam, frame, truss and arch
- 1.7 Definitions and explanations of force and displacement, flexibility and stiffness and their relationship

2 Theorem of Displacements (6 hours)

- 2.1 Force and displacements as cause and effects
- 2.2 Castigliano's theorems and their applications
- 2.3 Analyses of simple systems like beam, frame and truss
- 2.4 Bending moment, shear force and normal thrust diagrams for beam, truss and frames

3 Force Method (10 hours)

- 3.1 Definitions and explanations; Specialties of force method and its limitations
- 3.2 Consistent deformation systems; Compatibility equations, primary structures, choice of redundant
- 3.3 Flexibility method: Use in beam, frame and trusses; Yielding of supports in beam, truss and frames; Temperature effects and misfits in truss
- 3.4 Flexibility matrix method
- 3.5 Graph multiplication approach for simple cases
- 3.6 Three moment theorem and its application
- 3.7 Introduction to focal point method

4 Analysis of Indeterminate Arches (6 hours)

- 4.1 Use of arches in modern constructions
- 4.2 Horizontal reaction for parabolic and circular two-hinged and fixed arches
- 4.3 Bending moment, shear force and normal thrust diagrams
- 4.4 Yielding of supports, temperature effect and rib shortening
- 4.5 Influence line diagrams for horizontal thrust, bending moment at span, normal thrust and radial shear for two hinged arches

5 Slope Deflection Method (5 hours)

- 5.1 Introduction and sign conventions
- 5.2 Formulation of slope deflection equation
- 5.3 Fixed end moments
- 5.4 Application in beam and frames with support settlements and rotations
- 5.5 Bending moment, shear force and normal thrust diagrams for beam and frames

6 Moment Distribution Method (5 hours)

- 6.1 Introduction, terminology and development of method
- 6.2 Distribution factors
- 6.3 Carry over moments
- 6.4 Application in beam and frames: Symmetry and anti-symmetry, sway conditions and support yielding
- 6.5 Bending moment, shear force and normal thrust diagrams for beam and frames

7 Stiffness Matrix Method (12 hours)

- 7.1 Definition of stiffness, choice of redundant and degree of freedoms
- 7.2 Member stiffness matrix for spring, bar, truss and beam elements
- 7.3 Rotation matrices
- 7.4 Analysis of multiple spring connected systems, bar and string combinations, simple two-dimensional trusses

7.5 Applications to beams and two-dimensional frames, effects of settlement of support and temperature
7.6 Application in space/three-dimensional truss
7.7 Bending moment, shear force and normal thrust diagrams for beam and frames
7.8 Introduction to structural engineering related software

8 Influence Line for Indeterminate Beams (6 hours)

8.1 Necessity of influence line diagrams
8.2 Muller Breslau principle, its physical meaning and use
8.3 Influence line diagrams for reactions, bending moment and shear force in various sections of continuous beams (Two to three spans only)
8.4 Use of influence line diagrams to calculate reactions, shear forces and bending moments for concentrated force, couple and distributed load

9 Introduction to Plastic Analysis (6 hours)

9.1 Definitions and explanations
9.2 Plastic analysis of bending members
9.3 Plastic hinge and its length
9.4 Load factor, shape factor and plastic modulus
9.5 Basic theorems on methods of limit analysis
9.6 Collapse loads: partial collapse, complete collapse
9.7 Collapse with tied loads for simple cases of statically indeterminate beams (Not more than three spans) and frames (Only portal frames)

Tutorial (30 hours)

1. Theorem of displacements on computation of bending moment, shear force and normal thrust, truss and frames
2. Analysis of beam, frame and trusses using force method
3. Analysis of beam and frame using slope deflection method
4. Application of moment distribution method on analysis of beams and two-dimensional frames
5. Stiffness matrix method
6. Influence line for indeterminate beams
7. Plastic analysis of statically indeterminate beams and frames

Practical (15 hours)

Determination of redundant reaction components and their comparative studies in the following four experiments and three project works.

1 Continuous beams (propped cantilever, two spanned beams with various end conditions)
2 Two hinged arch
3 Symmetrical portal frame
4 Unsymmetrical portal frame
5 Analysis of two-dimensional truss of at least 4 degree of redundancy, solve by flexibility matrix method and calculate axial forces
6 Analysis of two-dimensional truss of at least 4 degree of redundancy, solve by stiffness matrix method and calculate axial forces
7 Analysis of two-dimensional frame of at least 4 degree of redundancy, solve by stiffness matrix method and draw bending moment diagram, shear force diagram and axial force diagram

Students should submit individual report of both lab test and project works

Final Exam

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

Chapter	Hours	Mark distribution*
1	4	4
2	6	6
3	10	10
4	6	6
5	5	5
6	5	5
7	12	12
8	6	6
9	6	6
Total	**60**	**60**

* There may be minor deviation in marks distribution.

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WATER SUPPLY ENGINEERING

ENCE 254

Lecture : 3 **Year : II**
Tutorial : 2 **Part : II**
Practical : 2/2

Course Objectives:

This course is designed to offer a comprehensive understanding of Water Supply Engineering. It covers fundamental theories, principles, design considerations, and practical knowledge in the field. Topics include various drinking water requirements and quantity estimation, sources and their selection, water examination (physical, chemical and biological) methods, quality requirements, engineering design of the conveyance networks, treatment plant components, reservoirs, distribution networks, construction, operation, and maintenance of water supply system. It also covers brief introduction to advanced water treatment methods. The course places strong emphasis on hands-on learning through examples and experiments, which are considered highly effective for helping students grasp and apply the course material.

1 Introduction (2 hours)

- 1.1 Importance of water, including water sanitation and hygiene (WASH) aspects
- 1.2 Historical development of water supply systems (Global to National context)
- 1.3 Pure and impure water; potable and wholesome water; polluted and contaminated water
- 1.4 Objectives and importance of water supply system
- 1.5 Types of water supply systems (Gravity, pumped, and combined); planning, typical components, and their functions
- 1.6 Schematic diagram of typical water supply systems

2 Sources of Water (4 hours)

- 2.1 Distribution of earth's water, water cycle (Hydrological cycle)
- 2.2 Climate change and water availability
- 2.3 Classification of water sources
  - 2.3.1 Surface water sources: Rivers, streams, lakes, ponds, and impounded reservoirs (capacity of reservoirs using mass curve and analytical methods)
  - 2.3.2 Groundwater sources (Confined aquifer and unconfined aquifer, springs, wells, infiltration galleries, sump wells), jack wells
  - 2.3.3 Alternative sources: Rainwater harvesting, reclaimed water sources
- 2.4 Yield of surface sources and wells (Practical approach)
- 2.5 Selection of sources: Technical and legal considerations
- 2.6 Conservation of drinking water sources

3 Quantity of Water (5 hours)

- 3.1 Water quantity estimation
  - 3.1.1 Per capita demand
  - 3.1.2 Design and base periods and selection criteria
  - 3.1.3 Demographic trends and forecasting (Arithmetical increase method, geometrical increase method, incremental increase method and decrease rate of growth method, zoning method, numerical on population forecasting)
- 3.2 Types of water demand (Domestic, livestock, commercial, public/municipal, Industrial, firefighting, loss/wastage, and total demand)
- 3.3 Variation in water demand, peak factors and its significances
- 3.4 Factors affecting water demand

4 Quality of Water (5 hours)

- 4.1 Types of impurities (Suspended, colloidal and dissolved) and their effects
- 4.2 Living organisms in water (Algae, bacteria, viruses, worms)
- 4.3 Water-related diseases (Water borne, water washed, water based, and water vector disease) causes and effects, their transmission routes, and preventive measures (Primary and secondary barriers)
- 4.4 Physical water qualities and their significance
  - 4.4.1 Solids (Suspended and dissolved)
  - 4.4.2 Turbidity
  - 4.4.3 Color
  - 4.4.4 Taste and odor
  - 4.4.5 Temperature
  - 4.4.6 Health, environment, and engineering significance
- 4.5 Chemical water qualities
  - 4.5.1 Chemistry of solutions: pH, solubility and pH dependence
  - 4.5.2 Hardness and alkalinity (Lime incrustation in pipeline and customer meter)
  - 4.5.3 Metals: Toxic and non-toxic metals
  - 4.5.4 Pollutants of emerging concerns
  - 4.5.5 Health, environment, and engineering significance
- 4.6 Biological water qualities
  - 4.6.1 Microorganisms in water and their classification (Oxygen requirement, temperature, disease-causing, life process, and shapes)

4.6.2 Health, environment, and engineering significance
4.6.3 Pathogen's indicators and their tests (Multiple tubes, membrane fermentation, and standard plate count method), the most probable number

4.7 Standard methods of water quality examination: US- Environmental Protection Agency (EPA), American Public Health Association (APHA) methods

4.8 Water quality standard for drinking purposes (World Health Organization and National)

5 Intakes (3 hours)

5.1 Type of intakes and their components
5.2 Factors considered for site selection of an intake
5.3 Characteristics of intake (River intake, reservoir intake, spring intake, well intake)
5.4 Design considerations for intake

6 Water treatment (14 hours)

6.1 Overview of drinking water treatment unit operation and process
6.2 Objectives of water treatment: Treatment processes and impurity removal
6.3 Physical treatment: Impurities removal and operation mechanism; design considerations
6.3.1 Screenings: Types, head losses and design steps
6.3.2 Plain sedimentation, principle, mechanism, and design: Theory of particle settlement; Derivative of Stoke's law, Hazen's law and Newton's law; Temperature effect on settling; Ideal sedimentation; Types of sedimentation tank; Design of sedimentation tank
6.3.3 Filtration, operation mechanism, and design considerations: Theory of filtration, types of filters, slow and rapid sand filter, pressure filter and design consideration
6.3.4 Aeration: Purpose, mechanism and methods
6.4 Chemical Treatment
6.4.1 Coagulation and flocculation: Coagulation mechanism; coagulants (Types and their chemical reactions; Mixing devices (Purpose and types); flocculation tank and its design considerations; clarifiers; jar test
6.4.2 Disinfection: Purposes and significance of disinfection; physical methods (boiling and UV); chemical methods (Halogens, ozone, potassium permanganate, silver); chlorination (theory, chlorine demand, dose, residual chlorine and contact time); Kinetics (Chick's law; types of chlorine (Hypochlorites, chloramines, liquid/ gas chlorine, and their usage); forms of chlorination (Plain chlorination, pre-chlorination, post-chlorination, double chlorination, multiple chlorination, breakpoint chlorination, super chlorination, de-chlorination); factors affecting efficiency of chlorination
6.4.3 Softening: Purposes; removal of temporary hardness (Boiling and lime treatment); removal of permanent hardness (Lime soda, Zeolite); demineralization and deionization process

6.5 Advanced water treatment processes (Brief introduction, impurities removal, and removal mechanism)
6.5.1 Removal of heavy metals (Iron, Arsenic and Manganese)
6.5.2 Removal of color, odor, and taste
6.5.3 Advance oxidation processes (AOPs)
6.5.4 Membrane filters (Ultrafiltration, nanofiltration, reverse osmosis)
6.5.5 Desalination and electrodialysis
6.5.6 Ozonation
6.5.7 Adsorption: Activated carbon

7 Reservoirs and Distribution System (6 hours)

7.1 Water supply systems (Continuous and intermittent system)
7.2 Clear water reservoir
7.3 Service reservoir (Purpose, construction, types and design consideration)
7.4 Types of distribution system and layout (Tree, grid, ring and radial system)
7.5 Smart water distribution: Concept of district metering areas (DMAs) and supervisory control and data acquisition (SCADA)
7.6 Design of distribution system (Pipe hydraulics for branched and looped networks, design criteria and design steps)
7.7 Water supply systems for buildings (Hydraulic considerations)
7.8 Introduction to computer-aided design software: EPANET, WaterGems /WaterCADs, etc.

8 Conveyance of Water (2 hours)

8.1 Mode of conveyance: Open channel and pressure flow
8.2 Pipe materials
8.2.1 Requirements of good pipe material
8.2.2 Pipe corrosion: Corrosion mechanism and protection
8.2.3 Types of pipe material (CI, GI, Steel, PE, HDPE, PVC, PPR, DI)
8.3 Pipe joints: Purposes and types (Socket, spigot, flanged, collar, screwed socket joints, butt and electrofusion joints for PE and HDPE pipes)
8.4 Laying of pipes: Construction, operation and maintenance considerations

9 Pipe Appurtenances, Operation and Maintenance (4 hours)

9.1 Valves: Purposes and types (Sluice, reflux, safety, air valves, pressure relieve valves, pressure sustaining valves, butterfly valves, gate valves, and drain valves); typical schematic diagram of a valve (With all accessories required)

9.2 Fittings: Purpose and types (Bends, reducers, tees, mechanical couplings, expansion joints, dismantling joints, stop cocks and water taps)
9.3 Flushing arrangements (Reservoirs, transmission mains, and at distribution lines)
9.4 Propose and construction of break pressure tank
9.5 Public stand post (Purposes, location, flows, and construction)
9.6 Pumps: Type of pumps, purpose and uses; layouts of pumps; introduction to pump curves
9.7 Operation of water supply system
9.8 Maintenance: Necessity, types (Regular, preventive and emergency maintenance)
9.9 Roles and responsibilities of different organizations in water supply management (Federal, provincial, local government, and user's committee)

Tutorial **(30 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. Computation of capacity of impounded reservoir by mass curve and analytical method, yield and safe yield calculation for surface and ground water sources
2. Population forecasting by arithmetical increase method, geometrical increase method, incremental increase method and decrease rate of growth method, zoning method.
3. Water demands calculation for a settlement/community
4. Solution on hardness and alkalinity and water quality related numerical problems
5. Intakes: Numerical on design of intake (spring)
6. Water Treatment: Numerical on design of sedimentation tank, determination of size and number of filters, numerical on chlorine demand, chlorine dose and residual chlorine, disinfectant concentration and contact time, killing concentration, working mechanism on advanced water treatment methods
7. Reservoirs and Distribution System: Determination of service reservoir capacity, pipe hydraulic, design criteria of distribution systems, and equivalent pipe method for looped networks, hydraulic calculation for multistorey building
8. Conveyance of Water: Preparation of pipe layout diagram for urban water supply
9. Pipe appurtenances, operation & maintenance, and computer-aided tools
10. Schematic diagram of valves and fittings, flushings and urban household plumbing from water meter to tap, water supply management and tools (Introducing some software and optimizing tools for water supply schemes)

Practical

1. Determination of temperature, color, turbidity and pH
2. Determination of suspended, dissolved and total solids
3. Determination of dissolved oxygen by modified Winkler method
4. Determination of optimum dose of coagulant by jar test apparatus
5. Determination of residual chlorine in water
6. Microbial analysis of water for fecal contamination

Assignment

1. A complete design of water supply schemes for a community (Quantity estimation, treatment and conveyance with necessary drawings using computer-aided design software)
2. A case study report on a conventional water treatment unit of running water supply scheme

Final Exam

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

Chapter	Hours	Mark distribution*
1	2	3
2	4	5
3	5	7
4	5	7
5	3	4
6	14	18
7	6	8
8	2	3
9	4	5
Total	**45**	**60**

* There may be minor deviation in marks distribution.

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