| Pokhara University<br>Faculty of Science and Technology | |
|---|---|
| Course Code: WRE 340 (2-2-1) | Full Marks: 100 |
| Course Title: Engineering Hydrology | Pass Mark: 45 |
| Nature of the Course: Theory and Practical | Total Lectures: 30 hours |
| Level: Bachelor/ Year: III/ Semester: I | Program: Bachelor in Civil Engineering |

**1. Course Description:**

This course covers from fundamentals of hydrological cycle and water balance to measurement, estimation, and analysis of various water balance components such as precipitation, various types of losses, and runoff. In addition, it also covers various techniques for hydrograph analysis, including derivation and application of unit hydrographs. Finally, this course introduces flood hydrology with specific focus on various techniques for flood frequency analysis for design flood estimation purpose.

**2. General Objectives:**

At the end of the course, the students are expected to strengthen knowledge and skill on

- Drainage basin delineation and characterization
- Precipitation analysis – data quality assessment and filling missing data; station-average and watershed-average annual and seasonal rainfall estimation
- Measurement and estimation of runoff at gauged and un-gauged rivers
- Flood frequency analysis for design flood estimation
- Hydrological analysis for a water-infrastructure project

**3. Methods of Instructions:**

Lecture, Tutorial, Discussion, Readings and Practical works

**4. Course Contents**

| Specific objectives | Contents |
|---|---|
| • Recognize significance, and potential applications of engineering hydrology in civil engineering | **Unit 1: Introduction (2 hrs)**<br>1.1 Scope and application of engineering hydrology<br>1.2 Hydrologic cycle and water balance<br>1.3 Hydro-meteorological data<br>1.4 Catchment and its characteristics, catchment delineation |
| | |
| • Explain precipitation formation process and various types<br>• Describe various methods and instruments used for measuring precipitation | **Unit 2: Precipitation: Measurement and Analysis (5 hrs)**<br>2.1 Causes, forms, and types of precipitation; rainfall measurement (types and adequacy of rain gauges) |

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|---|---|
| • Describe techniques for estimating missing precipitation data and ensuring data accuracy | 2.2 Data quality assessment and missing data filling: various aspects of data quality assessment (e.g., hyetograph plots, single and double mass curves for consistency testing); estimation of missing rainfall data<br>2.3 Presentation of rainfall data: rainfall characteristics at a station (long-term average annual and seasonal values, plots of hyetograph, mass curve, annual rainfall); estimation of mean precipitation over a catchment<br>2.4 Rainfall intensity-duration-frequency (IDF) curve |
| | |
| • Explain various hydrological losses, including evaporation, transpiration, and infiltration<br>• Demonstrate factors affecting evaporation, transpiration, and infiltration rates<br>• Describe methods for measuring and estimating hydrological losses | **Unit 3: Hydrological Losses (5 hrs)**<br>3.1 Initial losses: interception and depression storage<br>3.2 Evaporation: estimation of evaporation losses (energy budget and mass transfer (Dalton's law) methods); observation of evaporation loss (evaporimeter).<br>3.3 Evapotranspiration: potential and actual evapotranspiration (AET, PET); estimation of PET (Penman's equation); observation of ET (Lysimeter).<br>3.4 Infiltration: measurement of infiltration (infiltrometers); estimation of infiltration (Horton, Philip, Green Ampt and Kostiakov); infiltration indices (Φ and W) |
| | |
| • Explain the processes of surface runoff generation and factors affecting surface runoff and streamflow<br>• Describe various methods and techniques for measuring and estimating streamflow | **Unit 4: Surface Runoff and Streamflows (5 hrs)**<br>4.1 Runoff process: factors affecting surface runoff; rainfall-runoff correlation<br>4.2 Stream gauging: purpose; site selection; types of gauges (manual and automatic)<br>4.3 Streamflow measurement by velocity-area method (current meters, floats, velocity rods, dilution techniques); slope-area method<br>4.4 Development of rating curve and its uses |
| | |
| • Explain key components of a hydrograph and various factors affecting shape of hydrographs | **Unit 5: Hydrograph Analysis (8 hrs)**<br>5.1 Storm hydrograph: components; factors affecting hydrograph (shape, size, slope of basin, |

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|---|---|
| • Explain various techniques for separating baseflow<br>• Introduce methods for constructing and interpreting hydrographs for different storm events | drainage density, and land use/cover); baseflow separation.<br>5.2 Unit hydrographs (UH): definition, applications, limitations, duration of UH<br>5.3 Derivation of UHs from isolated and complex storms.<br>5.4 Derivation of UHs of different durations: superposition and S-curve methods.<br>5.5 Synthetic unit hydrograph (Snyder) |
| | |
| • Explain the concept of flood hydrology and introduce key terminologies related to flood frequency analysis<br>• Describe statistical methods for estimating flood frequency<br>• Present commonly used methods for estimating flood frequency in Nepal | **Unit 6: Flood Hydrology (5 hrs)**<br>6.1 Design flood: risk and return period, statistical data and flood frequency, design floods (frequency-based flood, standard project flood, probable maximum flood)<br>6.2 Plotting position and frequency factors<br>6.3 Flood frequency analysis: Gumbel's Extreme Value Type I, Log-Pearson Type III, Log Normal; Regional Flood Frequency<br>6.4 Rational method, Regional Empirical methods (Dicken, WECS/DHM) |

| **5. List of Tutorials** | |
|---|---|
| SN | |
| 1 | Catchment area delineation and characterization |
| 1. | Precipitation analysis: test of inconsistencies and estimation of missing rainfall data; estimation of mean rainfall over a catchment using different methods |
| 2. | Hydrological losses: estimation of evaporation and potential evapotranspiration; infiltration indices; Horton's equation |
| 3. | Runoff and hydrograph analysis: discharge computation using velocity-area and slope-area methods; rating curve; derivation of unit hydrographs from isolated and complex storms; derivation of unit hydrographs of different durations |
| 4. | Design flood estimation: estimation of design frequency of a design flood; estimation of floods by different methods (plotting position, frequency analysis, Rational, empirical methods) |

| **6. List of Practical** | |
|---|---|
| SN | |
| 1. | Field visit to a meteorological station |
| 2. | Streamflow measurement: current meter, floats, dilution techniques |
| 3. | Rainfall-Runoff simulator |

**8. Prescribed Books and References**

**Text Books:**

1. Subramanya, K. (2008). *Engineering Hydrology*. New Delhi: Tata McGraw Hill Publishing Company.

**References:**

1. Elizabeth**,**S. M**.** *Hydrology in Practice***.** UK: Chapman and Hill.
2. Singh, V. P. *Elementary Hydrology*. New Delhi: Prentice Hall of India.
3. Linsley, R. K., Kohler, M. A., & Paulhus, J. L. H. *Hydrology for Engineers*. New Delhi: Tata McGraw Hill Publishing Company.
4. Chow, V.T., Midment, D. R., & Mays, L.W. *Applied Hydrology*. New Delhi: McGraw Hill International.
5. Varshney, R. S. *Engineering Hydrology*, Roorkee: Nem Chand & Bros.

**Pokhara University**
**Faculty of Science and Technology**

| | |
|---|---|
| Course No.: CVL 318 | Full Marks: 100 |
| Course Title: Estimating and Valuation (3-2-0) | Pass Marks: 45 |
| Nature of course: Theory and Tutorial | Total Lectures: 45 hours |
| Level: Bachelor | Program: BCE/BCRE |

## 1. Course Description

This course develops students' proficiency in cost estimation principles, techniques, and rate analysis for reliable project cost predictions. It covers property valuation methods, construction specifications, and various estimating techniques, including preliminary, detailed, and quantity surveying. Students will learn to prepare detailed estimates, understand property valuation, and apply these skills in practical situations. The course equips future engineers to make informed financial decisions and ensure project economic viability through lectures, tutorials, exercises, discussions, presentations, self-learning and tests.

## 2. General Objectives

The general objectives of this course are to develop students …

- to prepare detailed cost estimate with analysing the rates and calculate the quantities of different items of works of building and other structures.
- to enhance the knowledge and skills of basic principles and methods of valuation of land and building structures and valuation report writing
- to develop systematic writing skills for preparation of specifications of different construction works.

## 3. Methods of Instruction

Lectures, tutorials, assignments, academic paper discussion, student-led presentations, field visit.

## 4. Contents in Detail

| Specific Objectives | Contents |
|---|---|
| Recognize the fundamental concepts of cost estimation, and units and software tools for effective estimation. | **Unit 1: Methods of Estimating (6 hrs.)**<br>1.1 Definition, importance and objectives of estimation<br>1.2 System of units<br>1.3 Units of measurement and payments for items of work and materials<br>1.4 Essentials of estimating<br>1.5 Methods of measurements of building and civil engineering works based on codes (NBC and Indian codes)<br>1.6 Subheads of various items of work<br>1.7 Multiple methods of taking out quantities: centre line method, long and short wall method, crossing |

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| | method<br>1.8 Abstracting bills of quantities<br>1.9 Software and digital tools |
| Explain the preliminary and detailed estimate methods with context of application and to use the mandatory rules of thumb for approximate cost-estimating of building resources and works. | **Unit 2: Types of Estimates (4 hrs.)**<br>2.1 Approximate estimates<br>2.2 Detailed estimates<br>2.3 Revised estimates<br>2.4 Supplementary estimates<br>2.5 Annual repair and maintenance estimates<br>2.6 Extension and improvement estimates<br>2.7 Complete estimates<br>2.8 Split up of cost of building works |
| Describe the purpose, importance, requisites, influencing factors, methods and format of rate analysis. | **Unit 3: Analysis of Rates (6 hrs.)**<br>3.1 Introduction<br>3.2 Purposes of rate analysis<br>3.3 Importance of rate analysis, cost of items, transportation cost, other expenses and overhead, contingency<br>3.4 Governmental norms and district rates<br>3.5 Requirements of rate analysis<br>3.6 Factors affecting the rate analysis<br>3.7 Procedure of rate analysis: for building works, for sanitary and water supply works, for road works, for irrigation works, for suspension bridge works |
| Clarify and develop skills to carry out a precise and comprehensive quantity estimate of the items of works and their costs associated with various infrastructures construction | **Unit 4: Detailed Estimate (14 hrs.)**<br>4.1 Estimate of single room building<br>4.2 Estimate of two room building (load bearing structure)<br>4.3 Estimate of framed structure building<br>4.4 Estimate of an aqueduct<br>4.5 Estimate of RCC slab and hume pipe culvert<br>4.6 Estimate of RCC T-beam decking<br>4.7 Estimate of septic tank and soak pit<br>4.8 Estimate of earthwork plain road<br>4.9 Estimate of earth work of hill road |
| Familiarize and describe the different methods and techniques to assess the monetary value of a property or construction project with skills for valuation report writing. | **Unit 5: Valuation (6 hrs.)**<br>5.1 Definition and terminologies<br>5.2 Purpose of valuation<br>5.3 Factors affecting valuation<br>5.4 Methods of determining value of property (depreciation, capitalized value, development methods)<br>5.5 Preparation of valuation report |

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|---|---|
| Explain requirements, characteristics, types and professional writing techniques of specifications for civil and allied works. | **Unit 6: Specifications (9 hrs.)**<br>6.1 Definition and importance<br>6.2 Prerequisite and characteristics of specifications<br>6.3 Types of specification: general and detailed; standard and restricted specifications<br>6.4 Specification writing technique<br>6.5 Specification writing: civil works, water supply and sanitary works and electrical works |

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

**5. List of Tutorials**

The following tutorial activities of 30 periods per group of maximum 24 students should be conducted to cover all the required contents of this course.

| S.N. | Tutorials |
|---|---|
| 1. | Estimate of a single room building (load bearing wall and framed structure) |
| 2. | Estimate of a two room building (load bearing wall and framed structure) |
| 3. | Estimate of earth work for plain road |
| 4. | Estimate of earthwork for hill road |
| 5. | Estimate of an aqueduct |
| 6. | Estimate of RCC slab culvert |
| 7. | Estimate of RCC T-beam decking |
| 8. | Estimate of septic tank and soak pit |
| 9. | Valuation report writing of land and building property |
| 10. | Specification writing of civil works, water supply and sanitary works and electrical works of building construction |

**Evaluation system and Students' Responsibilities**

**Evaluation System**

In addition to the formal exam(s) conducted by the Office of the Controller of Examination of Pokhara University, the internal evaluation of a student may consist of class attendance, class participation, quizzes, assignments, presentations, written exams etc. The tabular presentation of the evaluation system is as follows.

| External Evaluation | Marks | Internal Evaluation | Marks |
|---|---|---|---|
| Semester-End Examination | 50 | Class attendance and participation | 5 |
| | | Prepare a building estimate and writing a valuation report consulting with engineering experts and conducting a field visit | 5+5 |
| | | Quizzes/ assignments and presentations | 10 |
| | | Internal Term Exam | 25 |

| | | | |
|---|---|---|---|
| Total External | 50 | Total Internal | 50 |
| Full Marks 50+50 = 100 | | | |

**Students' Responsibilities**:
Each student must secure at least 45% marks in the internal evaluation with 80% attendance in the class to appear in the Semester End Examination. Failing to obtain such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear in the End-Term examinations. Students are advised to attend all the classes and complete all the assignments within the specified time period. If a student does not attend the class (es), it is his/her sole responsibility to cover the topic(s) taught during the period. If a student fails to attend a formal exam, quiz, test, etc. there won't be any provision for a re-exam.

## 6. Prescribed books and references:

**Text Books:**


1. Chakraborti, *Estimating, Costing, Specification and Valuation in Civil Engineering*
2. Dutta, B.N. *Estimating and Costing in Civil Engineering*, Delhi: USB Publishers distributers Limited


**References:**


1. Aggarwal, Amarjit, *Civil Estimating Quantity Surveying and Valuation*. Ludhiana: Katson Publishing House
2. Berger, Seymour & Godel, Jules B., *Estimating Project Management for Small Construction Firms*. New York: Van Nostrand Reinhold Publishing Company
3. Upadhya, A. K. *Civil Estimating & Costing Valuation Engineering.*
4. Patil, B.S. *Contract and Estimation*
5. Norms and Rate analysis of Government of Nepal
6. Standard Specification of Government of Nepal

| Pokhara University<br>Faculty of Science and Technology | |
|---|---|
| Course Code: GTE 310 (3 Credit) | Full Marks: 100 |
| Course Title: Foundation Engineering (3-2-1) | Pass Mark: 45 |
| Nature of the Course: Theory and Practice | Total Lectures: 45 hours |
| Level: Bachelor/ Year: III/ Semester: V | Program: BCE/BCRE |

| **1. Course Description:** |
|---|
| The course comprehensively covers all aspects of foundation engineering, ranging from the importance of the foundation, its types, design, and construction methods including soil improvements. |
| **2. General Objectives:** |
| • This course is to equip students with the knowledge and skills require for the design of foundation of various civil engineering structures. |
| **3. Methods of Instructions:** |
| Lecture, Tutorial, Discussion, Demonstration, Field and Laboratory tests. |

| **Specific Objectives** | **4. Course Contents** |
|---|---|
| | **Unit 1:Introduction to foundation and soil exploration (6 hrs)** |
| • Visualize the foundation, and methods of soil exploration | 1.1 Definition, types, and purposes of foundation<br>1.2 Factors affecting on selection of foundation<br>1.3 Soil Exploration<br>1.4 Planning of exploration program (i.e. Stages, vertical and lateral extent)<br>1.5 Soil sampling, types of soil sample, and types of soil sampler<br>1.6 Requirements of soil sampler, and points to be considered while sampling<br>1.7 Methods of boring for exploration<br>1.8 Field Test for soil investigation: Penetration tests (SPT, SCPT and DCPT)<br>1.9 Ground water observations<br>1.10 Borehole logs and site investigation report |
| | **Unit 2: Earth pressure theories and application (10 hrs)** |
| • Compute the lateral earth pressure using various theories | 2.1 Effect of wall movement on earth pressure<br>2.2 Earth pressure at rest<br>2.3 Rankine's theory of earth pressure for active and passive states<br>2.4 Coulomb's theory of earth pressure for active and passive state |

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|---|---|
| | 2.5 Culmann's theory of earth pressure for active and passive state<br>2.6 Flexible retaining structure<br>2.6.1 Sheet pile wall and its classification<br>2.6.2 Analysis of sheet pile wall:<br>2.7 Bracing for open cuts: components; calculation of strut loads and bending moment on wales for the design of bracing components: Earth pressure against bracing in cuts<br>2.8 Proportioning of retaining walls<br>2.9 Stability analysis of retaining wall<br>2.10 Arching in soil, arching effect, and application |
| | **Unit 3: Bearing capacity and settlement (8 hrs)** |
| • Compute the bearing capacity and settlement for shallow foundation. | 3.1 Modes of failure on foundation soil<br>3.2 Terzaghi's bearing capacity theory<br>3.2.1 Terzaghi's bearing capacity theory<br>3.2.2 Extension of Terzaghi's theory (i.e. Meyerhof, Hansen and Vesic)<br>3.2.3 Skempton's bearing capacity theory for cohesion-less soil<br>3.3 Effect of water table on bearing capacity<br>3.4 Bearing capacity from in-situ tests:<br>3.4.1 Plate load test<br>3.4.2 SPT Value (N – Value)<br>3.5 Foundation settlement, types, analysis and its causes |
| | **Unit 4: Design of shallow foundation (5 hrs)** |
| • Analyze and design the shallow foundation | 4.1 Design loads on foundation<br>4.2 Factors governing the depth of foundation<br>4.3 Design and analysis of spread foundation, combined and strap beam footing<br>4.4 Mat Foundation: Types; bearing capacity; analysis and design by conventional approach<br>4.5 Proportioning of spread footing for equal settlement |
| | **Unit 5: Pile Foundation (7 hrs)** |
| • Analyze and design the Pile as a deep foundation. | 5.1 Classification of piles, their suitability and selection<br>5.2 Pile load capacity<br>5.2.1 Pile driving formulae (dynamic method)<br>5.2.2 Static method<br>5.2.3 Pile load test<br>5.3 Pile load capacity using SPT and CPT values<br>5.4 Group action of piles<br>5.4.1 Ultimate load capacity<br>5.4.2 Design of pile group |

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|---|---|
| | 5.4.3 Settlement of pile group in clay<br>5.5 Efficiency of pile group<br>5.6 Negative skin friction<br>5.7 Construction of pile foundation |
| | **Unit 6: Pier, caisson and coffer dam (6 hrs)** |
| • Analyze and design the pier and caisson | 6.1 Pier foundation and its suitability<br>6.2 Caisson and its types<br>6.3 Components of well foundation<br>6.4 Forces acting on well foundation<br>6.5 Design criteria of well foundation (shape, size, type and depth)<br>6.6 Construction and sinking of a caisson<br>6.7 Tilt and shift of well and rectification<br>6.8 Lateral stability of well foundation (Terzaghi)<br>6.9 Coffer dam, its purpose and types |
| | **Unit 7: Soil Improvement (3 hrs)** |
| • Recognize soil improvement methods. | 7.1 Need of soil improvement for foundation<br>7.2 Methods of Soil Improvement<br>7.2.1 Dynamic compaction<br>7.2.2 Preloading<br>7.2.3 Grouting<br>7.2.4 Use of admixtures<br>7.2.5 Sand compaction piles<br>7.2.6 Soil reinforcement<br>7.2.7 Geosynthetics |

| **5. Tutorials** | |
|---|---|
| SN | **Solution of Numerical Problems related to** |
| 1. | N Value correction in SPT tests results |
| 2. | Calculation of earth pressure by Rankine's Theory, Coulomb's Theory, and Culmann's Theory |
| 3. | Design and analysis of spread foundation, combined and strap beam footing |
| 4. | Design of Sheet Pile as a Flexible Retaining Structure (Cantilever by simplified method and Anchored Sheet Pile wall by free and fixed earth support methods) |
| 5. | Calculation of strut loads on braced cut and BM on wales |
| 6. | Stability Analysis of Retaining wall and its design |
| 7. | Calculation of bearing capacity and allowable pressure at various conditions using different bearing capacity theories |
| 8. | Soil Pressure calculation at the base of Mat Foundation by Conventional approach |
| 9. | Load bearing capacity of Pile using Dynamic and Static approach and correlations using SPT and CPT values. |
| 10. | Design of Pile group |
| 11. | Settlement of Pile group in clay |

| 6. Practical | |
|---|---|
| **SN** | **Name of Practical** |
| 1. | Methods of Boring (Auger or Wash or Percussion Boring) |
| 2. | Standard Penetration Test |
| 3. | Dynamic Cone Penetration Test |
| 4. | Static Cone Penetration Test (Demonstration) |
| 5. | Plate Load Test (Demonstration) |
| 6. | In-situ and Laboratory test of Permeability |

## 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. Ralph B. Peck, Walter E. Hanson, Thomash H. Thornburn, *FOUNDATION ENGINEERING*, (Second Edition), JOHN WILEY & SONS, New York
3. Joseph E. Bowles, P.E.,S.E., *FOUNDATION ANALYSIS AND DESIGN*, (Fifth Edition), The McGraw-Hill Companies, Inc., New York
4. T. William Lambe, *SOIL TESTING for Engineers*, John Wiley & Sons, Inc. New York
5. Dante Fratta, Jennifer Aguettant, Lynne Roussel-Smith (2007), *Introduction to Soil Mechanics Laboratory Testing*, CRC Press, New York
6. Braja M. Das (2002), *Principles of Geotechnical Engineering,* Thomson, Asia
7. Venkatramaiah, C. (Third Edition), *Geotechnical Engineering*, New Age International (P) Limited Publisher, India
8. Punmia, B.C, Jain, A.K.& Jain, Arun K. (Seventh Edition 2017). *Soil Mechanics and Foundation engineering,* Laxmi Publication Pvt. Ltd. India.

**Pokhara University**
**Faculty of Management Studies**

Course Code.: STR 314 (3 Credits)
Course title: **Structural Analysis II (3 – 2 – 1)**
Nature of the course: Theory/Practice/Theory & Practice
Year, Semester: 3rd, V
Level: Bachelor

Full marks: 100
Pass marks: 45
Time per period: 1 hour
Total periods: 45
Program: BE

## 1. Course Description

In this course, students will apply various methods of structural analysis and explore the fundamental theory and concepts operating and validating existing computer software used for the analysis of complex and indeterminate structural systems using analytical and graphical methods. Students will also apply a comprehensive knowledge of the theoretical framework underpinning linear-elastic analysis of various types of structures (e.g. statically indeterminate trusses, beams and frames) encountered in civil engineering design work. Students will be introduced to the principles of plastic analysis. The skills and knowledge gained in this course are essential for the design of indeterminate structures. All chapters consist of graphical methods for internal forces.

## 2. General Objectives

- To enhance the knowledge skills of the students to describe the behavior of indeterminate structures
-To make students able to analyze indeterminate trusses, beams, frames and arches with various analytical and graphical methods

– To acquaint the students with portray the plastic behavior of structures, apply Finite Element Method for analysis of structures, graphical methods and drawing of BMD and shear force

## 3. Contents in Detail

| Specific Objectives | Contents |
|---|---|
| • Identify complexity and number of degree of redundancy in both aspects for static as well as in kinematic indeterminancy. | **Unit 1: Indeterminate and complex Structures (2 hrs.)**<br><br>1.1 Types of indeterminate structure<br>1.1.1 Introduce various types of indeterminate structure applicable to real structure<br>1.1.2 Brief outline of various methods for various types of indeterminate structure.applying for analysis<br>1.2 Static (internal and external) and kinematic indeterminancy for 2D framed structure<br>1.3 Static (internal and external) and kinematic indeterminancy for 2D plate structure and 3D framed structure |

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|---|---|
| • Develop compietancy to analyse indeterminate structures using force method and draw internal force diagram.<br>• Classify all types of indeterminate and complex structure using consistent deformation method and validate analysis<br>. | **Unit 2: Consistent Deformation Method (8 hrs.)**<br><br>2.1 General Principle of Force , Virtual Work , Unit load Method<br>2.2 Appropriate method of creating primary ( determinate) scheme<br>2.3 Devloping Compatible flexibility equations for<br>2.3.1 Analyse for beams and trusses<br>2.3.2 Analyse for 2D frames<br>2.4 Effect of temperature, adjustment and settlement of supports<br>2.5 Derivation of three moment equation for continuos beam |

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|---|---|
| • Describe the concept of displacents occurred in beam by various loading rotational and translation effect in beam and frame.<br>• Solve the slope deflection equations<br>• validate analysis using various software and various methods other than Slope deflection method<br><br>. | **Unit 3: Displacement method;**<br>**Slope Deflection Method (5 hrs)**<br>3.1 Derivation of slope deflection equations<br>3.1.1 Using conjugate beam method<br>3.1.2 Using Force method<br>3.1.3 Fixed end moments due to loads, rotation and settlement of supports<br>3.2 Application of rotational and translation effect<br>3.3 Modification to slope deflection equation for fixed-pinned; pinned- pinned members<br>3.4 Application for continuous beam with necessary internal force diagram<br>3.5 Application for beams in elastic foundation<br>3.6 Effect of temperature and settlement of supports in continuous beam<br>3.7 Apllication in 2D portal frame |
| • Describe the concept of moment distribution method as displacement method<br>.<br>• validate analysis using various software and various methods other than Moment distribution method. | **Unit 4: Displacement method;**<br>**Moment Distribution Method (4 hrs)**<br>4.1 Application and principles of Moment distribution method<br>4.1.1 Carry over moments<br>4.1.2 Stiffness and distribution factors for beam and 2D frames<br>4.2 Application of rotational and translation effect<br>4.3 Modification to slope deflection equation for fixed-pinned; pinned- pinned members<br>4.4 Application for continuous beam including support settlements, rotational and temperature effects in continuous beams.<br>4.5 Application for 2D frames for non-sway frames<br>4.6 Application for 2D frames for side sway frames |

| | |
|---|---|
| • Describe the concept of stiffness matrix and modified displacement method<br>• Explain the concept of matrix formation of non sway and side -sway frames<br>• Apply direct stiffness method | **Unit 5: Displacement method;**<br>**Stiffness Matrix Method (9 hrs)**<br>5.1 Relation between flexibility and stiffness coefficients and matrix.<br>5.1.1 Degree of freedom and coordinates<br>5.1.2 Force – displacement realtion<br>5.2 Compatibility equation in matrix form<br>5.3 Application of Stiffness matrix method for beams and frames . with or without internal hinges.<br>5.4 Development of stiffness matrices for beam elements, shape functions for beam elements using direct stiffness , FDM and FEM approaches.<br>5.5 Derivation of Load vectors and assembling stiffness matrix<br>5.6 Boundary conditions and creating modified stiffness matrix as per support conditions.<br>5.7 Application of analysis in continuous and continuous overhang beam and frames. |
| • Describe the relation and use of force and stiffness matrix method<br>• Explain the concept of mixed method<br>• Classify of appropriate method between stiffness and force method | **Unit 6: Displacement method;**<br>**Mixed Method (4 hrs)**<br>6.1 Selection of Force and stiffness matrix method<br>(Degree of freedom and redundancies , translation and rotational movements of supports)<br>6.2 Application in the frames<br>6.3 Graphical method using mixed method in matrix form. |
| • Describe the relation of force method with integration as well graphical method in indeterminate arches.<br>• Explain the concept of temperature effect, rib shortening and yielding of supports. | **Unit 7: Indeterminate Arches (4 hrs)**<br>7.1 Analysis of two hinged arches ( parabolic and circular arches)<br>7.2 Effects of temperature change, support yielding and rib-shortening<br>7.3 Introductory analysis of hingless arches, elastic center<br>7.4 Analysis of tied parabolic arch |
| • Describe the similarities and differences of elastic and influence curves in continuous beams.<br>• Explain the concept of Muller-Breslau principle<br>• Selection of force method to determine Ordinate of ILD in continuos beam<br>• Validate analysis using software | **Unit 8: Influence Lines for Indeterminate in continuous Beams ( 5 hrs)**<br>8.1 Inluence line diagram using force method.<br>8.2 Muller-Breslau principle<br>Direct and approximate method of drawing influence line in continuous and both side overhanging continuous beams.<br><br>8.2 Drawing influence line diagram by Muller-Breslau principle<br>8.3. Drawing influence line diagram by influence |

| | |
|---|---|
| | coefficient method.<br>8.4. Introductory drawing of influence line diagram for 2D portal frame structure.<br>8.5. Introductory drawing of influence line diagram for indeterminate arches and two hinged stiffening girder |
| • Describe the elasto plastic and fully plastic structure and their analysis method.<br>• Explain and calculation of shape factor of various shaped structure in<br>• Identify the structure for number of collapse mechanisms<br>• Use elasto- plastic method for various design of structure | **Unit 9: Plastic Analysis (5 hrs)**<br>9.1 Introduction and necessity of plastic analysis<br>9.1.1 Elasto- plastic nature and analysis of structure used in various structural design<br>9.1.2 Plastic bending moment and plastic curvature, plastic hinge , length of plastic hinge.<br>9.2 Shape factor, Collapse load and Elastic and Plastic Modulus, Load factor<br>9.3 Types of collapse Mechanisms.<br>9.4. Upper bound ; lower bound and uniqueness theorems in plastic analysis.<br>9.5. Application to beams and frames |

## 4. Methods of Instruction

**List of Tutorials**

The following tutorial activities of 15 hours per group of maximum 24 students should be conducted to cover all the required contents of this course.

| S.N. | Tutorials |
|---|---|
| 1 | Indeterminancy of structure |
| 2 | Solving the problems related to slope deflection equation |
| 3 | Solving the problems related to Moment distribution methods |
| 4 | Solving the problems related to consistent deformation method |
| 5 | Solving the problems related to stiffness matrix and mixed method |
| 6 | Solving the problems related to related to influence line diagram in continuos beams |
| 7 | Solving the problems related to stiffnessmatrix method |
| 8 | Solving the problems related to indeterminate parabolic and circular arches |
| 9 | Validating all problems for tutorials using compatible software |
| 10 | Assignments on whole structure for individual students. |

## 5. Practical Works

| S.N. | Practical works |
|---|---|
| 1 | To determine ordinatess of the influence line diagram in continuous beam. |
| 2 | To determine the value of settlement of support and horizontal thrust in indeterminate arch.. |
| 3 | To determine the real displacement in indeterminate truss. |
| 4 | To determine sway force and value of sway in indeterminate frame structure. |
| 5 | Application of joint force and joint moment in frame structure. |
| 6 | Computer-simulation for analysis of indeterminate trusses |
| 7. | Computer-simulation for analysis of indeterminate beams and 2D, 3D-frames |

| | |
|---|---|
| 8. | Computer simulation for analysis of arches (two-hinged, single-hinged and fixed) |

## 6. Evaluation system and Students' Responsibilities

**Evaluation System**

In addition to the formal exam(s) conducted by the Office of the Controller of Examination of Pokhara University, the internal evaluation of a student may consist of class attendance, class participation, quizzes, assignments, presentations, written exams, etc. The tabular presentation of the evaluation system is as follows.

| **External Evaluation** | **Marks** | **Internal Evaluation** | **Marks** |
|---|---|---|---|
| Semester-End Examination | 50 | Class attendance and participation | 5 |
| | | Lab report | 5 |
| | | Quizzes/assignments and presentations | 10 |
| | | Internal Term Exam | 30 |
| Total External | 50 | Total Internal | 50 |
| Full Marks 50+50 = 100 | | | |

**Students' Responsibilities**:

Each student must secure at least 45% marks in the internal evaluation with 80% attendance in the class to appear in the Semester End Examination. Failing to obtain such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear in the End-Term examinations. Students are advised to attend all the classes and complete all the assignments within the specified time period. If a student does not attend the class(es), it is his/her sole responsibility to cover the topic(s) taught during the period. If a student fails to attend a formal exam, quiz, test, etc. there won't be any provision for a re-exam.

## 7. Prescribed Books and References

**Text Book**


1. Wang, Chu-Kin. Intermediate Structural Analysis, New York: McGraw-Hill
2. Reddy, C. S. Basic Structural Analysis. Tata McGraw-Hill


**Reference Books**


1. Hibbeler, R.C., Hwee, Tan Kiang (2009). Structural Analysis. Prentice Hall Education.
2. Norris, C.H., Wilbur,J.B. & Utku, S. Elementary Structural Analysis, New York: McGrawHill.
3. Bhavikatti, S.S. Structural AnalysisII, Vikas Publishing House Pvt. Ltd., New Delhi

Darkov A. & Kuznetsov V.R. Structural Mechanics.

4. Weaver,William& Gere,James M. MatrixAnalysis ofFrames Structures,India:CBS Publishers and Distributers.
5. Igor A. Karnovsky , Olga Lebedadvance method of structural analysis Springer New York Dordrecht Heidelberg London

**Pokhara University**
**Faculty of Science and Technology**

**Program: Civil Engineering**

Course Code.: TPR 310 (3 Credits) | Full marks: 100
Course title: **Transportation Engineering-I (3-1-1)** | Pass marks: 45
Nature of the course: Theory/Practical | Time per period: 1 hour
Year, Semester: III/I | Total periods: 45
Level: Bachelor

## 1. Course Description

The purpose of this course is to equip civil engineering students with the knowledge in transportation engineering. It consists of the foundational description of transportation system components, planning processes, and engineering aspects. The selection of highway alignment, design of geometric elements, drainage system and suitability of highway materials are major part of this course. This course is focused on the knowledge and skill enhancement by applying theoretical knowledge with the use of standards design and specifications of the road agencies. Furthermore, course covers the issues of the emerging technologies in the transport sectors.

## 2. General Objectives

The course is designed with the following general objectives:

- To identify the issues of transportation sector planning and engineering,
- To develop competence on the highway alignment selection, geometric design and drainage systems.
- To enhance the knowledge on the suitability of the materials used for the road construction,
- To visualize the emerging issues in the transportation sector.

## 3. Contents in Detail

| Specific objectives | Content | Teaching hours |
|---|---|---|
| • identify and recognize the major aspects of transportation system planning and engineering | **Unit 1: Introduction to Transportation System and Engineering**<br>1.1 Transportation System<br>1.1.1 Definition, scope, modes and role<br>1.1.2 Components, characteristics and classification<br>1.1.3 Transportation planning process<br>1.1.4 Comparison of different modes<br>1.2 Transportation Engineering<br>1.2.1 Hierarchy of movement<br>1.2.2 Mobility and accessibility<br>1.2.3 Airport engineering<br>1.2.4 Railway engineering<br>1.2.5 Water transportation<br>1.2.6 Ropeway engineering<br>1.2.7 Non-motorized transport systems | 10 hrs. |
| • categorize the roads and | **Unit 2: Highway Development and Road Alignment** | 5 hrs. |

| Specific objectives | Content | Teaching hours |
|---|---|---|
| recognize the major aspects of highway alignment | 2.1 History of road development<br>2.2 Highway engineering and scope<br>2.3 Classification of roads in Nepal<br>2.4 Road survey and selection of alignment<br>2.4.1 Requirements<br>2.4.2 Controlling factors<br>2.4.3 Engineering survey<br>2.4.4 Special considerations for design and construction of hill roads | |
| • design the geometric elements of the roads by considering safety | **Unit 3: Geometric Design of Highway**<br>3.1 Factors controlling geometric design of highway<br>3.2 Cross-sectional elements<br>3.2.1 Typical cross section highways (urban and hill roads)<br>3.2.2 Camber<br>3.2.3 Superelevation<br>3.2.4 Extra-widening<br>3.3 Horizontal alignment<br>3.3.1 Tangents<br>3.3.2 Curves including transition curves<br>3.3.3 Hair pin bends<br>3.4 Sight distance<br>3.4.1 Definition and tyypes<br>3.4.2 Setback requirement considering sight distance<br>3.5 Vertical Alignment<br>3.5.1 Gradients<br>3.5.2 Grade compensation<br>3.5.3 Vertical curves<br>3.6 Combination of horizontal and vertical alignment<br>3.7 Safety by road design | 8 hrs. |
| • categorize, synthesize and design of the drainage systems | **Unit 4: Highway Drainage Systems**<br>4.1 Introduction and importance<br>4.2 Requirements analysis<br>4.3 Causes of moisture variation in subgrade Soil<br>4.4 Design principles of highway drainage<br>4.4.1 Surface drainage<br>4.4.2 Subsurface drainage<br>4.4.3 Cross drainage<br>4.5 Erosion control and energy dissipation measures<br>4.6 Types of drainage structures for hill, urban and plain areas | 7 hrs. |
| • classify and recognize the main properties of highway materials, and evaluate | **Unit 5: Highway Materials and Specifications**<br>5.1 Subgrade soil classifications<br>5.1.1 Properties of subgrade soil<br>5.1.2 Sub-grade soil strength and tests<br>5.2 Road aggregates | 10 hrs. |

| Specific objectives | Content | Teaching hours |
|---|---|---|
| suitability as per the specifications | 5.2.1 Properties of road aggregates<br>5.2.2 Tests on road aggregates<br>5.2.3 Gradation analysis<br>5.3 Bituminous Binders<br>5.3.1 Manufacturing methods and types<br>5.3.2 Tests on bitumen binders<br>5.4 Bituminous Mixes<br>5.4.1 Definitions and types<br>5.4.2 Bituminous concrete mix design (Marshall mix design) | |
| • visualize the emerging issues in transportation sector mainly socio-economic and environmental perspectives | **Unit 6: Sustainability in Transportation Sector**<br>6.1 Transport and socio-economic development<br>6.2 Transportation and environment<br>6.3 Resilient transport infrastructure | 5 hrs. |

## 4. Methods of Instruction

The lecture classes of the course are conducted for a group of 48 students. These lecture classes are mainly focused on the theoretical part for imparting the knowledge on the subject matter. The lecture classes are further strengthened by the conducting the tutorial classes for 24 students in a group. The tutorials are mainly concentrated on solving engineering problems and design for the specific component of the highway. The final outcomes of the tutorials may be a complete design report of highway. The practical classes are also focused on carrying out tests in laboratory and field observations. Laboratory or practical classes are intended to enhance students' hands-on practice for laboratory-based activities.

## 5. List of Tutorials

The tutorials have been developed on the following theme of the course. These tutorials are prepared as the component of a complete road design or solving a particular engineering problem.

| S.N. | Tutorials |
|---|---|
| 1 | Alignment selection in the topographic map and geometric design of plan, profile and cross section. (six number of students will work in a group to prepare a report and presentation) |
| 2 | Review of material test report of the road agencies and prepare report. |
| 3 | Bituminous mix design previous tutorial |

## 6. Practical and laboratory works

| S.N. | Practical |
|---|---|
| 1 | Sub-grade soil testing: Standard CBR test (moisture content and density parameters) |

| S.N. | Practical |
|---|---|
| 2 | Tests on the road aggregates as mentioned on the Standard Specification. LA abrasion test, Crushing test, Impact test, Elongation and Flakiness Index tests |
| 3 | Tests on bituminous binders (as mentioned in the specifications) |
| 4 | Tests on bituminous mixes (Bituminous concretes)<br>Marshall mix design, core cutting for bitumen extraction and aggregate gradation |
| 5 | Field observation to the project site and report preparation (group of five students). |

**7. Evaluation system**

In addition to the formal exam(s) conducted by the Office of the Controller of Examination of Pokhara University, the internal evaluation of a student may consist of class attendance, class participation, quizzes, assignments, presentations, written exams, etc. The tabular presentation of the evaluation system is as follows.

| External Evaluation | Marks | Internal Evaluation | Marks |
|---|---|---|---|
| Semester-End Examination | 50 | Class attendance and participation | 5 |
| | | Field visit and field report | 5+5 |
| | | Tutorials/assignments and presentations | 10 |
| | | Internal Term Exam | 25 |
| Total External | 50 | Total Internal | 50 |
| Full Marks 50+50 = 100 | | | |

**8. Students' Responsibilities:**

Each student must secure at least 45% marks in the internal evaluation with 80% attendance in the class to appear in the Semester End Examination. Failing to obtain such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear in the End-Term examinations. Students are advised to attend all the classes and complete all the assignments within the specified period. If a student does not attend the class(es), it is his/her sole responsibility to cover the topic(s) taught during the period. If a student fails to attend a formal exam, quiz, test, etc. there won't be any provision for a re-exam.

**9. Prescribed Books and References**


- Dr. S.K. Sharma (2019). Principles, Practice and Design of Highway Engineering. S. Chand and Company Limited, New Delhi
- Dr. S.K. Khanna and Dr. C.E.G. Justo (2021). Highway Engineering. Nem Chand & Bros Roorkee (U.P.)
- C.A. Flaherty (2002). Highway Engineering. Edward Arnold Publishers Ltd.
- Recent DoR publications on design and Standard Specification for roads and allied works
- Shrestha, D. K. and Marsani, A. (2020), Transportation Engineering II, 4th Ed, Heritage Publisher and Distributors, Kathmandu
- Khanna, S. K., Justo, C. and Veeraragavan A (2013). Highway Materials and Pavement Testing, Nem Chand & Bros Roorkee (U.P.), India.

**Pokhara University**
**Faculty of Science and Technology**

| | | |
|---|---|---|
| Course Code: ENV 310 | | Full Marks: 100 |
| Course title: Water Supply Engineering (3-2-1) | | Pass Marks: 45 |
| Nature of the Course: Theory & Practical | | Total Lectures: 45 hours |
| Level: Bachelor | | Program: BCE/BCRE |

1. **Course Description**
   The course is designed to provide students with a comprehensive understanding of the technical and practical aspects related to the design, construction, and maintenance of water supply systems by covering topics such as hydraulic principles, water quality analysis, treatment processes, pump design, and water distribution system design.

2. **General Objectives**
   The general objective of this course is to provide students with a comprehensive knowledge of the principles, design, construction, operation, and maintenance of water supply systems. This course aims to equip students with the knowledge, skills to plan, organize, design, and implement safe, sustainable, and efficient water supply systems for communities and industries. Additionally, the course enhance the capacity of students to analyze the latest technology, regulatory frameworks related to water supply systems while implementing in the field.

3. **Methods of Instruction**
   Lecture, Tutorial, Discussion, Readings and Practical works

4. **Contents in Detail**

| Specific Objectives | Contents |
|---|---|
| - Define the water supply system and identify its impact on community<br>- List the component of water supply system and also recognize the flow measurement techniques<br>- Interpret the Guideline and Standard | **Unit I: Water Supply System (4 hrs)**<br>1.1 Needs and importance of drinking water<br>1.2 Contaminated water, wholesome water and pure water<br>1.3 Components of water supply system<br>1.4 Impact of water supply system on Socio-economic environment<br>1.5 National Drinking Water Quality Standard, WHO Guidelines for Drinking Water Quality |
| - Identify and characterize the sources of water and explain the discharge measurement from different sources | **Unit II: Sources and Collection of Water (6 hrs)**<br>2.1 Surface sources: Lakes, ponds, streams, rivers, impounded reservoirs<br>2.2 Underground sources: Springs, wells, infiltration galleries<br>2.3 Rainwater harvesting system<br>2.4 Measurement of yield from different sources (springs, streams, wells)<br>2.5 Selection of source for water supply system |

| | |
|---|---|
| | 2.6 Intake works: Components (spring intake and river intake) and selection of site |
| - Calculate the water demand based on national guideline<br>- Analyze the variation of water demand in different scenarios<br>- Solve the relevant numerical and design the water demand for the rural, semi-urban and urban area | **Unit III: Quantity of Water (5 hrs)**<br>3.1 Water demand: domestic, livestock, commercial, industrial, municipal, fire-fighting, losses and wastage as per National Guideline<br>3.2 Per-capita demand and affecting factors<br>3.3 Variation in water demand: seasonal, monthly, daily and hourly variations<br>3.4 Methods of population forecasting: arithmetic increase, geometrical increase, incremental increase, graphical, master plan and logistic methods |
| - Identify the possible impurities in water and examine the water quality | **Unit IV: Quality of Water (5 hrs)**<br>4.1 Impurities in water: suspended, colloidal and dissolved impurities<br>4.2 Hardness and alkalinity of water and their relationship<br>4.3 Living micro-organisms in water: virus, algae, worms and indicator organisms<br>4.4 Water borne diseases: water borne, water washed, water based diseases and water related vectors<br>4.5 Fecal-oral transmission route and preventive measures<br>4.6 Physical, chemical and biological examination of water |
| - Interpret the water treatment process and distinguish the appropriate treatment process<br>- Design the different water treatment plan | **Unit V: Water Treatment (10 hrs)**<br>5.1 Objectives and components<br>5.2 Treatment processes and typical layout of water treatment plant<br>5.3 Screening: objectives and types<br>5.4 Plain sedimentation: theory of settlement (Newton's law and Stoke's law), types, components and design<br>5.5 Sedimentation with coagulation: purpose, stages, types of coagulants with chemical equations, principle of coagulation and flocculation, optimum dose of coagulant by jar test<br>5.6 Filtration: Mechanism of filtration, design and operation of slow sand, rapid sand and pressure filters<br>5.7 Disinfection: necessity and methods, chlorination, forms of chlorination, dose, application and test of chlorine, disinfection of byproducts<br>5.8 Softening: definition and types of hardness, removal of temporary and permanent hardness of water |

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|---|---|
| | 5.9 Reverse osmosis, membrane technology, UV, ozone and activated carbon treatment |
| - Recall the different components of water distribution system<br>- Solve the different hydraulic consideration of pipe flow<br>- Design the water distribution system and plan the pipe layout system | **Unit VI: Reservoir, Distribution System (5 hrs)**<br>6.1 Types of distribution system<br>6.2 Component of distribution system<br>6.3 Hydraulic consideration of pipe flow<br>6.4 Method of water distribution system<br>6.5 Layout of distribution system; dead end, tree, radial and ring systems standards<br>6.6 Design of distribution system: pipe hydraulics, design criteria, pipe network analysis |
| - Identify and choose the appropriate water conveyance appurtenances<br>- Visualize the construction of pipe line | **Unit VII: Water Conveyance and Appurtenances (5 hrs)**<br>7.1 Construction of pipe lines: planning, setting out, alignment and gradient, excavation, laying and joining, testing and backfilling<br>7.2 Pipe materials: CI, GI, DI, Steel, Concrete, AC, PVC, HDPE, PPR, CPVC pipes and their joints<br>7.3 Valves: sluice valve, reflux valve, globe valve, scour valve, air valve, fire hydrants<br>7.4 Fittings: stop cock, water meter, water tap, sockets, bends, elbows |
| .<br>- Describe the gravity flow water supply system and relate associated hydraulic theories<br>- Compare the different practical technologies and choose the appropriate technology<br>- Apply the computer software for designing water supply | **Unit VIII: Gravity Flow Water Supply System (5 hrs)**<br>8.1 Introduction and typical layout of water supply system<br>8.2 Collection chamber, Interruption chamber break, pressure tank, Public stand post<br>8.3 Practical technologies: anchoring pipes, stream and river crossings, barbed wire fencing, protection of pipe lines and structures<br>8.4 Hydraulic design and use of computer software |

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

## 5. List of Tutorials

| Chapters | Tutorials |
|---|---|
| 2 | Discharge calculation of wells and capacity determination of impounded reservoirs by analytical and graphical methods |
| 3 | Population forecasting and water demand for rural area, semi-urban area, and urban area |
| 4 | Alkalinity, pH of water |
| 5 | Design of sedimentation tank, slow sand filter and rapid sand filter |
| 6 | Calculation of capacity of balancing reservoir by analytical and graphical |

| | |
|---|---|
| | methods, water supply pipe line design of simple networks |
| 8 | Practice of computer software for designing water supply system |
| | Field Visit: Field demonstration of the water supply system and submit the report. |

## 6. Practical Works

| S.N. | Practical works |
|---|---|
| 1 | Determination of total solids and dissolved solids of water sample. |
| 2 | Determination of turbidity of water sample. |
| 3 | Determination of pH of water sample. |
| 4 | Determination of chlorine in water sample by Starch Iodide method. |
| 5 | Determination of dissolved oxygen of water sample from Winkler's method. |
| 6 | Determination of optimum dose of coagulant in water sample by using Jar test. |
| 7 | Determination of Coliform bacteria / Escherichia coli (E-Coli.) of water sample. |

## 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. Punmia, B.C., Jain, A.K. and Jain, A.K. *Environmental Engineering – I: Water Supply Engineering.* Jodhpur: Arahant Publications.

**References**

1 Modi, P.N. *Environmental Engineering, Volume – I: Water Supply Engineering.* Rajsons Publication Pvt. Ltd., Standard Book House.
2 Garg, S.K., *Environmental Engineering (Vol. I): Water Supply Engineering.* Delhi: Khanna Publishers.
3 Davis, M.L. and Masten S.J., *Principle of Environmental Engineering and Science.* Mc Graw Hill.
4 UNICEF. *Guidelines for Gravity Flow Water Supply System.* Nepal: UNICEF.

| Pokhara University<br>Faculty of Science and Technology | |
|---|---|
| Course Code: STR 214 (3 Credits) | Full Marks: 100 |
| Course Title: Concrete Technology and Masonry Structure (3-2-2) | Pass Mark: 45 |
| Nature of the Course: Theory and Practice | Total Lectures: 45 hours |
| Level: Bachelor/ Year: III/ Semester: V | Program: BE Civil/Civil and Rural |

**1. Course Description:**

The purpose of this course is to provide the concept, knowledge and skill on concrete technology and masonry structural elements. The course focuses on various properties of concrete ingredients and will also be able to design concrete mix of different grades using different methods. This course explores the tools and techniques of quality control in different stages of construction by using concrete and masonry units. This course also helps to analyze and design of masonry structures for gravity and lateral loads using codal provisions.

**2. General Objectives:**

- Familiarize with ingredients of concrete and masonry materials
- Carry out mix design of concrete
- Test various properties of fresh and hardened concrete
- Conduct tests on masonry units and masonry structures
- Analyze and design simple masonry structure

**3. Methods of Instructions:**

Lecture, Tutorial, Discussion, Readings and Practical works

| | **4. Course Contents** |
|---|---|
| | **Part I: Concrete Technology** |
| **Specific Objectives:** | **Unit 1: Introduction to Plain Cement Concrete and its Constituents (5 hours)** |
| Understand the properties of concrete constituents and familiarization with the various construction aspects of civil engineering. | 1.1 Use of Concrete in Structure and Types of Concrete<br>1.2 Constituents of concrete material<br>1.2.1 Cement - Manufacturing of cement, Compound composition of Portland Cement and its role in Concrete, Hydration of cement<br>1.2.2 Sand and Aggregates – Types, Properties, Gradation and their effects in concrete strength<br>1.2.3 Water- Quality of water used in concrete, Effect of water-cement ratio on concrete performance (Abram's law)<br>1.2.4 Admixtures – Types and their Functions |
| | **Unit 2: Mix Design of Concrete and Properties of Fresh Concrete (10 hours)** |

| | |
|---|---|
| Understand the different tests of concrete (lab and site based) including its quality check, and to learn various mix design methods for producing durable, high-performance concrete. | 2.1 Workability and its test (Slump Test, Compaction Factor Test, Flow Test and Vee-Be Test)<br>2.2 Manufacturing of Concrete and its Quality Control (Batching, Mixing, Transporting, placing (manual, lift and pumping), Finishing (Compaction) and Curing of Concrete<br>2.3 Segregation and Bleeding Effect<br>2.4 Concreting in Extreme Temperature<br>2.5 Mix Design<br>2.5.1 Nominal Mix Design<br>2.5.2 Probabilistic Concept in Mix Design Approach<br>2.5.3 Mix Design by DOE, ACI and IS Method |
| | **Unit 3: Properties of Hardened Concrete (7 hours)** |
| learn key factors affecting the strength of concrete. | 3.1 Strength of Hardened Concrete and Factor Influencing Strength (Compressive Strength, Tensile Strength, Flexural Strength, Shear and Bond Strength)<br>3.2 Deformation of Hardened Concrete: Moduli of Elasticity, Poisson's Ratio<br>3.3 Shrinkage and Creep<br>3.4 Fatigue, Impact and Cyclic Loading<br>3.5 Thermal Properties<br>3.6 Effect of Porosity, and Gel-Space Ratio<br>3.7 Durability of Concrete and Factors Affecting It<br>3.8 Concrete Deterioration, Defects and their Preventive Measure |
| | **Unit 4: Testing of Hardened Concrete and Quality Control (5 hours)** |
| Evaluate the different methods of testing of concrete strength. | 4.1 Compressive Strength Test, Direct Tensile Strength Test, Flexural Strength Test, Bond Strength<br>4.2 Non-Destructing Tests of Concrete<br>4.3 Variability of Concrete Strength and Acceptance Criteria as per Codal Provisions<br>4.4 Quality Control and Statistical Approach of Quality Assurance |
| | **Unit 5: Special Types of Concrete (3 hours)** |
| Identify different types of concrete. | 5.1 Light Weight Concrete<br>5.2 Polymer Concrete<br>5.3 Porous Concrete<br>5.4 Plum Concrete<br>5.5 High Density/Roller compacted Concrete<br>5.6 Fiber Reinforced Concrete<br>5.7 Self-Compacting Concrete<br>5.8 High strength concrete |

| | |
|---|---|
| | 5.9 Shotcrete |
| | **Part II: Masonry Structures** |
| | **Unit 6: Constituents of Masonry Structures (2 hours)** |
| Recognize masonry materials and masonry typology. | 6.1 Types of Masonry Units: Bricks, Stones, Adobes, Concrete Blocks, ACC Block, CSE Block<br>6.2 Uses of Masonry Structures<br>6.3 Types of Brick Masonry Bond: - English Bond, Flemish Bond, Rat-Trap Bond<br>6.4 Types of Masonry Structures<br>6.3.1 Load Bearing and Non-Load Bearing Masonry<br>6.3.2 Reinforced and Unreinforced Masonry<br>6.5 Mortar<br>6.5.1Ingredients and properties of Wet Mortar<br>6.5.2 Strength of Mortar |
| | **Unit 7: Design of Masonry Walls For Gravity Loads (8 hours)** |
| Analyze and design of masonry wall for gravity loads. | 7.1 Introduction to Codal Provisions (NBC109) and Guidelines (NBC202)<br>7.2 Analysis and Design Example for Gravity Loads for Solid wall, wall with Openings, Walls with Eccentric Loadings and Walls Acting as Columns<br>7.3 Design and Detailing of Reinforced Masonry Structures (Lintel Band) |
| | **Unit 8: Masonry Structure under lateral loads (3 hours)** |
| Discuss of masonry structure under lateral loads. | 8.1 Traditional and Modern Methods: Use of Bond Stones, Types of Bands Used in Masonry Structures in order to Resist Lateral Load<br>8.2 Failure Behavior of Masonry Structures in Lateral Loads<br>8.3 Introduction of Composite Masonry<br>8.3.1 Infill Walls in Reinforced Concrete Frames<br>8.3.2 Uses of Bamboo in Masonry Structures |
| | **Unit 9: Testing of Masonry Elements (2 hours)** |
| Evaluate the different methods of testing of masonry walls. | 9.1 Compressive Strength of Bricks and Walls<br>9.2 Diagonal Shear Test<br>9.3 Non-Destructive Tests – Schmidt hammer, Elastic Wave Tomography, Flat-Jack, Push Shear Test |

| **5. List of Tutorials** | |
|---|---|
| SN | |
| 1. | Calculation of theoretical compressive strength w.r.t gel space ratio and rate of hydration, porosity. |

| | |
|---|---|
| 2. | Design concrete mix by using different design methods, like DOE, IS and ACI |
| 3. | Calculate standard deviation, mean target strength, Coefficient of Variance of given sample of concrete cube. |
| 4. | Design and detailing of lintel beam in masonry structure. |
| 5. | Design of different types of masonry wall under gravity loads. |
| 6. | List out the different techniques used for resisting lateral load in masonry structure. |

| **6. List of Practicals /Project works** | |
|---|---|
| SN | Description |
| 1. | Workability test for fresh concrete. |
| 2. | Compressive strength test for hardened concrete by using destructive method. |
| 3. | Indirect tensile test for hardened concrete by using destructive method. |
| 4. | Compressive strength test of hardened concrete by using nondestructive test. |
| 5. | Determination of strength of cement mortar. |
| 6. | Determination of strength of masonry units. |
| 7. | Demonstration of Non-destructive test in masonry wall. |
| 8. | Tests in masonry wall. |

## 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 | 30% | | | |
| 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

**Text Books:**


1. M. S. Shetty, Concrete Technology: Theory and Practice, S. Chand, New Delhi, 2005
2. A.S. Arya, Masonry and Timber Structures including earthquake resistant Design, Nem Chandra and Bros, Roorkee, 1987 5.


**References:**


1. P.K. Mehta, Paulo j. M. Monteiro, Concrete, Microstructure, Properties and Materials, University of California, Berkley (Indian Edition)
2. A.W. handry, B.P. Sinha, S.R. Davies, An Introduction to Load Bearing Brick Design, University of Edinburgh, 1981
3. P. Dayaratnam, Brick and Reinforced Brick Structures, Oxford and IBH Publishing Co. Pvt. Ltd. 1987)
4. A.M. Neville, J.J. Brook, Concrete Technology, International Students' Edition
5. IS 456, 2000- Plain and reinforced Concrete – Code of Practice
6. DUDBC.NBC 109, 1994 Masonry; Unreinforced
7. DUDBC. NBC 202- Load Bearing Masonry
8. IS 1905- 1987
9. IS: 383 – 1970
10. SP 20: 1991

| Pokhara University<br>Faculty of Science and Technology | |
|---|---|
| Course Code: CVL 322 | Full Marks: 100 |
| Course Title: Survey Field Project (0-0-2) | Pass Mark: 45 |
| Nature of the Course: Field Based Practical | Total Hours: |
| Level: Bachelor | Program: BCE/BCRE |

**1. Course Description:**

This course is designed to implement theoretical knowledge of surveying in the real field.

**2. General Objectives:**

The general objectives of this course are;

- To enable students independently carryout the civil engineering field survey
- To develop analytic skills of field survey data and drawing
- To enhance the skill for data and report presentation

**3. Methods of Instructions:**

Field based lectures, group discussions and field works.

| **4. Contents in Details** | |
|---|---|
| **Specific Objective** | **Contents** |
| Develop the skills for establishment of traverse stations and collect the data for topographical map | 1. **Topographical survey by using survey instruments**<br>1.1 Horizontal and vertical control for large area : Major traverse<br>- Control of Easting and Northing coordinate by total station and elevation by Auto level (fly levelling)<br>1.2 Horizontal and vertical control inside the Major traverse: Minor Traversing<br>-- Control of Easting and Northing coordinate by total station and elevation by Auto level (fly levelling)<br>1.3 Fly leveling for Establishing Temporary Bench Mark (BM) - two peg test<br>1.4 Computation, Plotting and Detailing<br>- Computation For major and minor traverse for horizontal and vertical coordinate in proper format.<br>- Reference sketch preparation of survey site |

| | |
|---|---|
| Conduct the road alignment survey and draw the formation level | **2. Road alignment survey**<br>2.1 Topographical map, longitudinal profile, cross section of road alignment.<br>2.2 Draw formation level. |
| Conduct the bridge site survey and draw the topographical map | **3.Bridge site survey**<br>3.1 Triangulation method<br>3.2 Reciprocal levelling<br>3.3 Draw the bridge site's topographical map, longitudinal section and cross section. |
| Conduct the photogrammetry and GNSS survey | **4.Topographical survey By using UAV and GNSS**<br>4.1 Topographical survey by UAV of same periphery and Taking sample detailing By RTK method of same location. |

**5. Evaluation System and Students' Responsibilities**

**Evaluation System**

The internal evaluation of a student at the closed camp.

| **External Evaluation** | | **Marks** | **Internal Evaluation** | **Marks** |
|---|---|---|---|---|
| Presentation, Viva and Final Report Evaluation by External Evaluator:<br>-Final Report(Drawing shall be prepared by using software)<br><br>-Final Viva | | 20<br><br><br>10 | Evaluation at the camp:<br>- Field performance<br>- Field Book and Field Drawings, Draft Report<br>- Field Viva | 35<br>20<br><br>15 |
| **Total Internal** | | **30** | | **70** |
| **Full Marks: 70+ 30 = 100** | | | | |

**Notes:**

Unit1- The survey should cover minimum of 15 stations for major traverse, 3 minor stations, 1 km loop distance for fly leveling. ( 6 days)

Unit 2- Minimum 500 m chainage (1.5 days)

Unit 3- Coverage 150 m upstream and 50 m downstream (1.5 day)

Unit 4- UAV and GNSS survey ( 1 day)

The Number of students in each group should be 4 to 6.