ARC 358 Building Technology (2 – 0 – 2)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

The main objective of this course is to make students familiar with building components, building services and finishing works. After completing this course students will also be able to prepare complete drawings of a building.

Course Contents:

1. Foundations and Basements — **3 hrs**

1.1 Types of foundations
1.2 Some common problems with existing foundations
1.3 Retaining properties and water proofing of basement
1.4 Earthquake effects on foundations
1.5 Damp-proof courses

2. Masonry — **3 hrs**

2.1 Brick and Block masonry
2.2 Bonds in brick work
2.3 Types of brick walls
2.4 Stone masonry
2.5 Classification of stone masonry
2.6 Composite masonry

3. Floors, Vertical Transportation and Roof — **4 hrs**

3.1 Floors and its types
3.2 Different means of vertical transportation
3.3 Elements of staircase
3.4 Types of staircases
3.5 Relationship between rise and tread in stairs
3.6 Types of roofs- shapes, material
3.7 Single and double timber roof: their types, comparative advantages and some construction details
3.8 Roof trusses
3.9 Roof coverings

4. Openings — **2 hrs**

4.1 Doors: types and details
4.2 Windows: types and details
4.3 Ventilators: types and details

4.4 Hardwares for doors, windows and ventilators
4.5 Arch and Lintels

5. Joints 3 hrs

5.1 Types of joints: construction and expansion joints
5.2 Treatment and detailing of joints at the roof level
5.3 Treatment and detailing of joints at the floor level
5.4 Treatment and joints in external walls
5.5 Treatment and joints in Shear wall

6. Temporary Construction 3 hrs

6.1 Scaffolding: single and double scaffolds
6.2 Formwork for excavations and trenches
6.3 Formworks for reinforced concrete construction
6.4 Shoring: horizontal, slant and vertical shores

7. Cladding and External Finishing 3 hrs

7.1 Cladding for load bearing and framed structures
7.2 Brick and stone facing
7.3 Cladding in concrete panels and their construction details
7.4 Plastering, punning and pointing
7.5 Properties and application of paints

8. Internal Finishing 2 hrs

8.1 Partitions: types, functions and methods of construction
8.2 Mobile partitions
8.3 Suspended and false ceilings: types, functions and methods of construction

9. Water Supply and Drainage 5 hrs

9.1 Mains of water supply: storage and distribution system
9.2 Hot water supply
9.3 Drainage of sewage and waste
9.4 Rainwater pipes and gutters
9.5 Septic tanks
9.6 Rainwater harvesting

10. Electrical Services 2 hrs

10.1 Residential and commercial requirements
10.2 General principles
10.3 Wiring system
10.4 Trunkings, busbars and ducts for electrical distribution
10.5 Safety precautions
10.6 Intake structures and provisions

Practical Works:

1. Plans, elevations and sections of a building
2. Trench plan and footing detail
3. Doors and window detail
4. Details of basements and shear wall
5. Construction details of roof
6. Water supply and drainage system

Note: The drawings for the practical works shall be produced with free-hand as well as CAD Tool

Text Books:

1. Chudley, R. (1987). *Construction Technology*. England: Longman Group UK Ltd.
2. Punmia, B.C., Jain, Ashok K. & Jain, Arun K. (2008). *Building Construction*. New Delhi: Laxmi Publications (P) Ltd.

References:

1. Reid, E. *Understanding Buildings*. MIT Press.
2. Olin, H.B. *Construction Principles, Methods and Materials.*
3. Ching, F.D.K. *Building Construction Illustrated.*
4. Kumar, S. (2010). *Building Construction*. New Delhi: Standard Publishers Distributors.
5. Singh G. (2010). *Building Construction*. New Delhi: Standard Book House.

WRE 350 Engineering Hydrology (2-2-1)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

After successful completion of this course, the students will be able to:

- use topographical maps for hydrological analyses
- estimate average rainfall from different methods and analyze the rainfall data
- analyze rainfall – runoff to estimate average monthly flow
- fill missing data in hydro-meteorological data series
- use double mass curve for estimating data consistency of rainfall and river flow
- develop intensity duration frequency curve from 24-hour maximum rainfall
- estimate flood flow of un-gauged and gauged rivers (WECS/DHM, MIP, Rational method, Modified Dickens, Gumbel, Log Person Type III, Log Normal)
- measure stream discharge using current meter, float and salt dilution methods.

Course Contents:

1. Introduction **2 hrs**

1.1. Scope and application of engineering hydrology
1.2. Hydrologic cycle and water balance
1.3. Hydro-meteorological data availability in Nepal

2. Physical Hydrology **6 hrs**

2.1 Causes, forms and types of precipitation
2.2 Measurement of rainfall (types and adequacy of rain gauges)
2.3 Estimation of missing rainfall data
2.4 Test for consistency of recorded rainfall data (double mass curve)
2.5 Mean precipitation over an area (Thessian and Isohyetal Methods)
2.6 Presentation of rainfall data (Mass curve, Hyetograph, Point Rainfall)
2.7 Development of Intensity-Duration-Frequency (IDF) Curve from 24-hour rainfall

3. Hydrological Losses **5 hrs**

3.1 Initial losses (Interception and Depression Storage)
3.2 Evaporation process: factors affecting evaporation (vapor pressure, radiation, temperature, humidity, wind, atmospheric pressure, soluble salts, heat storage in water bodies)
3.3 Evapotranspiration (AET, PET): evapotranspiration equations (Penman's Equation)

3.4 Infiltration
- 3.4.1 Measurement of infiltration (Flooding Type and Rainfall Simulator)
- 3.4.2 Infiltration indices (φ-Index, W-Index)

4. Surface Runoff and Flow Measurement **5 hrs**

4.1 Drainage basin and its quantitative characteristics
4.2 Factors affecting surface runoff
4.3 Rainfall-runoff correlation(Linear)
4.4 Stream gauging, selection of site, types of gauges and their selection
4.5 Stream flow measurement
- 4.5.1 Velocity area method, current meters, floats, velocity rods and dilution techniques
- 4.5.2 Slope area method

4.6 Development of rating curve and its uses

5. Hydrograph Analysis **6 hrs**

5.1 Storm hydrograph, factors affecting hydrograph (shape, size and slope of basin, drainage density, and land use)
5.2 Components of a flood hydrograph
5.3 Base flow separation, excess rainfall
5.4 Application and limitations of unit hydrograph (UH)
5.5 Derivation of UH from flood hydrograph, method of superposition and S-Curve

6. Engineering Applications **6 hrs**

6.1 Introduction to frequency and probability concept
6.2 High and low flow estimation, design flood and its estimation
6.3 Application of statistical and empirical methods of flood prediction
- 6.3.1 Return period, frequency and risk
- 6.3.2 Empirical methods (Modified Dickens, Rational), WECS/DHM, MIP method
- 6.3.3 Flood-Frequency Studies (Gumbel's Extreme Value Type I, Log-Pearson Type III and Log-normal)

Practical:

1. Measurement of Precipitation using Rain Gauges
2. Stream Discharge Measurement
   a. Current Meter (using Velocity Area method)
   b. Floats (using Velocity Area method)
   c. Dilution Techniques
3. Rainfall- Runoff Simulation:

3.1 Use of Topographical Maps to
   a. Locate project on topographical map and prepare hypsometric curve
   b. Catchment under different land use
   c. River Length

3.2 Estimate river discharge based on rainfall

Text Book:

1. Subramanya, K. (2008). *Engineering Hydrology*. New Delhi: Tata McGraw Hil 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 Hil International.
5. Varshney, R. S. *Engineering Hydrology*, Roorkee: Nem Chand & Bros.

GTE 320 Soil Mechanics (4 – 2 – 2)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

After completion of this course, the students will be able to:

- interpret various engineering properties of soil and their application to problems in civil engineering and classify the soil.
- describe the nature of the soil problems encountered in civil engineering with understanding of fundamentals and relevant principles of soil mechanics.

Course Contents:

1. Introduction — **1 hr**

1.1 Definition of soil and rock
1.2 Definition of soil mechanics and its importance in civil engineering
1.3 Formation process of soil and its major types.

2. Solid-Water-Air Relations and Index Properties of Soil — **6 hrs**

2.1 Phase Diagram, basic definitions & functional relationships
2.2 Index properties and their determination for coarse and fine-grained soil
  2.2.1 Specific gravity
  2.2.2 Relative density
  2.2.3 Consistency limit
  2.2.4 Shape and size of soil grain

3. Soil Identification and it's Classification — **4 hrs**

3.1 Purpose of soil classification
3.2 Field identification of soil
3.3 Soil classification systems- Particle size, Textural, ISCS, USCS and AASHTO soil classification system

4. Introduction to Clay Minerals — **2 hrs**

4.1 Clay Minerals
4.2 Types of Clay Minerals
4.3 Clay Particle interaction
4.4 Soil Structure

5. Compaction of Soil — **5 hrs**

5.1 Definition and purposes of compaction
5.2 Dry density and water content relationship
5.3 Laboratory test to obtain compaction characteristics

5.4 Factors affecting compaction
5.5 Effect of compaction on engineering behavior of fine grained soil
5.6 Methods of compaction and compaction control at field, relative compaction

Principle of Effective Stress, Capillarity and Permeability on Soil **7 hrs**

6.1 Concept of total stress, pore water pressure and effective stress
6.2 Effective stress equation and its physical interpretation
6.3 Surface tension and capillarity in soils
6.4 Computation of effective stresses in hydrostatic, uniform seepage, capillary and uniform surcharge conditions
6.5 Types of head, seepage pressure and quick sand conditions
6.6 Permeability and its determination- Laboratory and field method
6.7 Average permeability of stratified soil
6.8 Factors affecting permeability

Seepage Analysis Through Soils **6 hrs**

7.1 Two-dimensional flow – Laplace equation
7.2 Flow nets, their characteristics and applications
7.3 Seepage through earth dam on an impervious base and construction of phreatic line on earth dam
7.4 Rate of seepage, uplift pressure and exit gradient
7.5 Failure due to piping& it's prevention – Protective filter
7.6 Analysis of seepage discharge
7.7 Seepage through anisotropic condition

Vertical Stresses Below Applied Load **5 hrs**

8.1 Concept of stress distribution on soil
8.2 Boussinesq's and Westergaard's theory
8.3 Approximate method of vertical stress distribution
8.4 Pressure bulb concept
8.5 Vertical stress distribution diagrams
8.6 Vertical stress distribution beneath loaded areas (line load, strip, circular load &rectangular load)
8.7 Newmarks's and Fadum's Influence chart to compute vertical stress.

Compressibility and Consolidation of Soil **8 hrs**

9.1 Fundamentals of consolidation and it's type
9.2 One-dimensional consolidation test
9.3 Void ratio – pressure relationships
9.4 Compressibility parameters (compression Index, coefficient of compressibility, recompression index and swell index)
9.5 Normally consolidated and over consolidated clay, determination of over-consolidation pressure
9.6 Effect of disturbance on void ratio – pressure relationship
9.7 Calculation of consolidation settlement
9.8 Time rate of consolidation

9.9 Coefficient of consolidation and its determination by
- 9.9.1 Square root of time fitting and
- 9.9.2 Logarithm of time fitting method

10. Shear Strength of Soil **9 hr**

10.1 Concept of shear strength.
10.2 Mohr Circle, normal, shear and principal stresses
10.3 Mohr-Coulomb failure criterion
10.4 Relation between principle stresses at failure
10.5 Laboratory test for the determination of shear strength parameters
- 10.5.1 Direct Shear Test
- 10.5.2 Triaxial Test
  - 10.5.2.1 Consolidated Drained (CD) Test
  - 10.5.2.2 Consolidated Undrained (CU) Test
  - 10.5.2.3 Unconsolidated Undrained (UU) Test
- 10.5.3 Unconfined Compression Test on saturated clay
- 10.5.4 Vane Shear Test

10.6 Stress Path
10.7 Shear Strength of unsaturated cohesive soil
10.8 Shear strength of sands

11. Stability of Slopes **7 hr**

11.1 Causes of instability in slopes, modes of failure and it's remedial measures
11.2 Finite and infinite slopes.
11.3 Stability analysis of infinite slopes, Taylor stability number
11.4 Stability Analysis of finite slopes
- 11.4.1 $\varphi = 0$ Analysis (Total stress analysis)
- 11.4.2 $c - \varphi$ Analysis (Slice method)
- 11.4.3 Friction circle method

11.5 Location of most critical circles
11.6 Use of Stability Coefficients

ractical:

1. Particle size distribution test
   - 1.1 Sieve Analysis for coarse grained soil
   - 1.2 Hydrometer Analysis for fine grained soil
2. Determination of Atterberg's Limit of soil (LL, PL, SL)
3. Determination of OMC and maximum dry density
4. Determination of in-situ density by
   - 4.1 Core cutter method
   - 4.2 Sand replacement method
5. Direct Shear Test
6. Permeability test
   - 6.1 constant heat test for coarse grained soil
   - 6.2 falling head test for fine grained soil
7. Consolidation Test.

Text Books:

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

References:

1. Terzaghi, Karl, Peck, R.B. & John, Wiley (1967). *Soil Mechanics in Engineering Practi* New York.
2. Das,Braja M. *Principles of Geotechnical Engineering*. California State Univers Sacramento: Thomson/Brookscole Publication.
3. Das, Braja M. *Advanced Soil Mechanics* (2008). New York: Taylor and Francies Group
4. Punmia, B.C, Jain, A.K.& Jain, Arun K. (2005). *Soil Mechanics and Foundati engineering*. India: Laxmi Publication Pvt. Ltd.
5. Arora, K.R. (2008). *Soil Mechanics and Foundation Engineering*. Delhi: Standa Publisher Distribution.
6. Lambe, T. William. *Soil Testing for Engineers*. USA: Wiley Eastern Limited.
7. Venkatramaiah, C. *Geotechnical Engineering*. India: New Age International (P) Limi Publisher.

STR 312 Structural Analysis II (3 – 2 – 1)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

After completion of this course, students will be able to:

- describe the behavior of indeterminate structures
- analyze indeterminate trusses, beams, frames and arches selecting appropriate methods
- portray the plastic behavior of structures
- apply matrix-method for analysis of structures

Course Contents:

1. Indeterminate Structures — **2 hrs**

1.1 Types of indeterminate structures
1.2 Static and Kinematic Indeterminacy (2D and 3D structures)

2. Consistent Deformation Method — **7 hrs**

2.1 General Principle
2.2 Appropriate choice of redundant
2.3 Compatible equations
2.4 Application to statically indeterminate beams, frames and trusses
2.5 Effect of temperature and adjustments

3. Slope Deflection Method — **5 hrs**

3.1 Derivation of slope-deflection equation
3.2 Fixed end effects
3.3 Rotational and translational effects
3.4 Modification to slope deflection equation for fixed-pinned members
3.5 Application to continuous beams
3.6 Effects due to support settlement in continuous beams

4. Moment Distribution Method — **5 hrs**

4.1 Principle of Moment Distribution Method
4.2 Fixed-end moments
4.3 Carry over, stiffness and distribution factors
4.4 Application to continuous beam including support settlements
4.5 Application to portal frames with and without side sway

5. Influence Lines for Indeterminate Beams — **3 hrs**

5.1 Direct method of drawing influence line diagram
5.2 Muller-Breslau principle

5.3 Drawing influence line diagram by Muller-Breslau principle

6. Indeterminate Arches 4 hrs

6.1 Elastic Center
6.2 Analysis of two-hinged Parabolic Arches
6.3 Effects of temperature change, support yielding and rib-shortening
6.4 Introduction to single-hinged and fixed Arches

7. Elementary Plastic Analysis 6 hrs

7.1 Introduction to plastic analysis
7.2 Plastic bending and Moment curvature
7.3 Plastic hinge and Plastic moment
7.4 Shape factor, Collapse load and Plastic Modulus
7.5 Application to statically determinate beams and frames
7.6 Application to simple statically indeterminate beams and frames

8. Matrix Method of Analysis 9 hrs

8.1 Force-deformation relationships
8.2 Flexibility and Stiffness coefficients
8.3 Degree of freedoms and Coordinates
8.4 Flexibility Matrix and Stiffness matrix
8.5 Compatibility and Equilibrium equations in matrix form
8.6 Application of Stiffness matrix method for beams and frames
8.7 Energy principle and its application to simple structures

9. Direct-Stiffness Method 4 hrs

9.1 Development of stiffness matrices for beam elements
9.2 Element load vectors
9.3 Global stiffness matrices and load vectors
9.4 Boundary Conditions
9.5 Application to analysis of continuous beams

Laboratories:

7. Analysis of indeterminate plane frame
8. Analysis of two-hinged arches
9. Computer-simulation for analysis of indeterminate trusses
10. Computer-simulation for analysis of indeterminate beams and 3D-frames
11. Computer simulation for analysis of arches (two-hinged, one-hinged and fixed)

Tutorials:

1. At least five assignments (covering all chapters)
2. One mini-project on structural Analysis of 2D frame or 2D truss
3. One mini-project on structural Analysis of 3D frames (using standard software package)

Text Book:

1. Wang, Chu-Kin. *Intermediate Structural Analysis*, New York: McGraw-Hill.

eferences:

3. Reddy, C. S. *Basic Structural Analysis.* Tata McGraw-Hill.
4. Hibbeler, R.C., Hwee, Tan Kiang (2009). *Structural Analysis*. Prentice Hall Education.
5. Norris, C.H., Wilbur, J.B. & Utku, S. *Elementary Structural Analysis*, New York: McGraw-Hill.
6. Bhavikatti, S.S. *Structural Analysis II,* Vikas Publishing House Pvt. Ltd., New Delhi
7. Darkov A. & Kuznetsov V.R. *Structural Mechanics*.
8. Weaver, William & Gere, James M. *Matrix Analysis of Frames Structures*, India: CBS Publishers and Distributers.

CVL 321 Surveying II (3-1-4)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

After completion of this course, students will be able to:

- set up orientation and set out different types of curves
- perform hydrographic and photogrammetric survey
- handle GPS device and analyze the GIS data
- carryout laying-out of civil-engineering works.

Course Contents:

1. Orientation — **3 hrs**

- 1.1 Introduction, Uses and Importance
- 1.2 Analytical Intersection
- 1.3 Analytical Resection - Three Point Problem – (F – 45) Degree Method and Collin's Point Method
- 1.4 Instruction on Field Works

2. Curves — **10 hrs**

- 2.1 Introduction, Designation of Curves, Uses and Importance
- 2.2 Types of Curves
- 2.3 Computation of Elements of Simple Circular Curve
- 2.4 Setting Out of Simple Circular Curve by Linear and Angular Methods
- 2.5 Computation of Elements and Setting Out of Transition Curves
- 2.6 Computation of Elements and Setting Out of Vertical Curves
- 2.7 Instruction on Field Works

3. Hydrographic Survey — **5 hrs**

- 3.1 Introduction, Definitions of Basic Terms
- 3.2 Vertical and Horizontal Controls
- 3.3 Equipment and Methods of Sounding
- 3.4 Measurement of Cross-section
- 3.5 Measurement of Velocity and Flow
- 3.6 Instruction on Field Works

4. Photogrammetry — **5 hrs**

- 4.1 Introduction and Basic Terms of Photogrammetry
- 4.2 Uses and Importance of Photogrammetry
- 4.3 Types of Photogrammetry

4.4 Types of Photographs
4.5 Scale of Vertical Photograph
4.6 Relief Displacement
4.7 Instruction on Field Works

5. Remote Sensing and GIS **8 hrs**

5.1 Introduction to Remote Sensing
5.2 Uses of Remote Sensing
5.3 Types of Remote Sensing
5.4 Interaction of Electromagnetic Energy with Earth Surface Features
5.5 Introduction to GIS
5.6 Components of GIS
5.7 Uses of GIS in Civil Engineering
5.8 Instruction on Field Works

6. Field Astronomy and GPS **6 hrs**

6.1 Introduction and Definition of Basic Terms in Field Astronomy
6.2 Determination of Latitude, Longitude, Time and Azimuth
6.3 Introduction to Global Positioning System (GPS)
6.4 Components of GPS
6.5 Working Principles and Uses of GPS
6.6 Instruction on Field Works

7. Project Survey **6 hrs**

7.1 Introduction to Surveying in Civil Engineering Projects
7.2 Establishment of Horizontal and Vertical Control using Traditional Methods and Modern Method (GPS)
7.3 Laying out of Buildings
7.4 Laying out of Water Supply Line / Sewer Lines / Canal
7.5 Alignment Survey of High Transmission Lines
7.6 Instruction on Field Works

8. Computer Software Uses in Surveying **2 hrs**

8.1 Introduction to Mapping Softwares
8.2 Advantages and Disadvantages of Manual Plotting and Computerized Plotting

Practical:

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

Practical Group:

1. Each practical group should consist of 4 – 6 members.
2. Practical report should be prepared individually.

Text Books:

1. Punmia, B.C., Jain Ashok K. & Jain, Arun K. (2005). *Surveying (Vol. I, II, III)*. New Delhi: Laxmi Publications (P) ltd.
2. Duggal, S. K. *Surveying (Vol. I, II)*. New Delhi: Tata McGraw-Hill Publishing Company Limited.

References:

1. Clark, David (2004). *Plane and Geodetic Surveying for Engineers*. CBS Publishers & Distributors.
2. Bannister, A & Raymod, S. (1997) *Surveying*. London: ELBS
3. Kanetkar, T. P. & Kulkarmi, S. V. *Surveying and leveling*. Pune: Pune Vidarthi Griha Prakashan.

ENV 330 Water Supply Engineering (3 – 2 – 1)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

After completion of this course, students will be able to:

- appreciate and describe with the basic chemistry and micro-biology of water, components of water supply system, water treatment technology, gravity flow water supply system and water analysis.
- design the water supply system, maintain the water supply system and perform the general duties of a water supply engineer.

Course Contents:

1. Introduction **3 hrs**

1.1 History of water supply system
1.2 Objectives of water supply system
1.3 Immediate, long term and negative impacts of water supply system
1.4 Components of water supply systems in rural and urban areas
1.5 Definition of terms: contaminated water, wholesome water, pure water
1.6 Duties of water supply engineer
1.7 Water Resource Act in Nepal, policies on water supply in Nepal

2. Sources and Collection of Water **5 hrs**

2.1 Global perspectives of water sources
2.2 Surface sources: lakes, ponds, streams, rivers, impounded reservoirs
2.3 Underground sources: springs, wells, infiltration galleries
2.4 Rainwater harvesting system
2.5 Measurement of yield from different sources (springs, streams, wells)
2.6 Selection of source for water supply system
2.7 Intake works: definition, classification and selection of site for an intake
2.8 Characteristics of spring intake and river intake
2.9 Discharge calculation of wells and capacity determination of impounded reservoirs by analytical and graphical methods.

3. Quantity of Water **4 hrs**

3.1 Water demand: domestic, livestock, commercial, industrial, municipal, fire-fighting, losses and wastage as per National Building Code
3.2 Per-capita demand of water and factors affecting per capita demand
3.3 Variation in water demand: seasonal, monthly, daily and hourly variations
3.4 Base period and design period, selection basis of design period
3.5 Population forecasting: necessity

3.6 Methods of population forecasting: arithmetic increase method, geometrical increase method, incremental increase method, decrease rate of growth method, graphical extension method and master planning method

3.7 Numerical exercises on population forecasting and water demand for rural area and urban area using arithmetic, geometrical and incremental increase method.

4. Quality of Water

4 hrs

4.1 Impurities in water: suspended, colloidal and dissolved impurities

4.2 Hardness and alkalinity of water and their relationship

4.3 Living micro-organisms in water: bacteria, virus, algae, worms and indicator organisms

4.4 Water borne diseases: water borne, water washed, water based diseases and water related vectors.

4.5 Fecal-oral transmission route and preventive measures

4.6 Physical examination of water (tests for temperature, color and turbidity), chemical examination of water (tests for pH, total solids, dissolved and suspended solids, chlorine, dissolved oxygen), biological examination of water (membrane filter technique, multiple tube fermentation technique)

4.7 Nepal National Drinking Water Quality Standard, WHO Guidelines for Drinking Water Quality

4.8 Numerical exercises on alkalinity, pH of water

5. Water Treatment

15 hrs

5.1 Objectives of water treatment

5.2 Treatment processes and typical layout of water treatment plant

5.3 Screening: objectives and types

5.4 Plain sedimentation: theory of settlement, Newton's law and Stoke's law, types of sedimentation tanks, design criteria of sedimentation tank

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

5.6 Filtration: theory of filtration, construction and operation of slow sand filter, rapid sand filter and pressure filter, introduction of bio-sand filters

5.7 Disinfection: necessity and methods, chlorination, forms of chlorination, dose of chlorination, application and test of chlorine, disinfection by products, introduction of emergency disinfection methods

5.8 Softening: definition and types of hardness, removal of temporary and permanent hardness of water

5.9 Membrane technology in water treatment: introduction, methods and suitability

5.10 Miscellaneous treatments: purpose of aeration and its types, removal of iron and manganese, removal of color, odor and taste, solar disinfection (SODIS)

5.11 Numerical exercises on design of sedimentation tank, slow sand filter and rapid sand filter

Reservoir and Distribution System

5 hrs

6.1 Systems of water supply: continuous and intermittent

6.2 Methods of water distribution: gravity, dual and pumping
6.3 Layouts of distribution system: dead end, tree, radial and ring systems
6.4 Service reservoir and its types
6.5 Balancing reservoir, capacity determination of balancing reservoir by analytical and graphical methods
6.6 Design of distribution system: pipe hydraulics, design criteria, pipe network analysis
6.7 Numerical exercises on calculation of capacity of balancing reservoir by analytical and graphical methods, water supply pipe line design of simple networks

7. Conveyance of Water **2 hrs**

7.1 Pipe materials: CI, GI, Steel, Concrete, AC, PVC, HDPE, PPR, CPVC pipes
7.2 Pipe joints and their types
7.3 Construction of pipe lines: planning, setting out, alignment and gradient, excavation, laying and joining, testing and backfilling

8. Pipe Appurtenances, Valves and Fittings **2 hrs**

8.1 Valves: Sluice valve, reflux valve, globe valve, scour valve, air valve, fire hydrants
8.2 Fittings: Stop cock, water meter, water tap, sockets, bends, elbows

9. Gravity Flow Water Supply System **5 hrs**

9.1 Introduction and typical layout
9.2 Prefeasibility study and its report preparation
9.3 Detail engineering survey
9.4 Hydraulic theory, U profile
9.5 Public stand post, break pressure tank
9.6 Practical technology in gravity flow water supply system: anchoring pipes, stream and river crossings, barbed wire fencing, protection of pipe lines and structures
9.7 Introduction to computer software for designing gravity flow water supply system

Field Visit:

One local field visit at components of water supply system including intake and treatment works.

Tutorials:

Minimum 3 tutorials to be submitted by students covering major theoretical and numerical exercises in the course.

Laboratories:

1. Determination of turbidity, pH, total solids and dissolved solids of water sample.
2. Determination of chlorine in water sample by Starch Iodide method.
3. Determination of dissolved oxygen of water from Winkler's Method.
4. Determination of optimum dose of coagulant in water by Jar Test.
5. Determination of Coliform bacteria/Escherichia coli (E. Coli) of water sample.

Text Book:

1. Punmia, B.C., Jain, Ashok K. & Jain, Arun K. *Environmental Engineering - I: Water Supply Engineering*. Jodhpur: Arihant Publications.

References:

1. S. K. Garg. *Environmental Engineering (Vol. I): Water Supply Engineering*. Delhi: Khanna Publishers.
2. G. S Birdie and J.S. *Water Supply and Sanitary Engineering including Environmental Engineering*. India: Dhanpat Rai & Sons publishers.
3. Steel Ernest W. *Water Supply and Sewerage*. New York: Mc Graw Hill publishers.
4. Thomas & Jordan Jr. *Hand Book of Gravity Flow, Surveying, designing and construction with special reference to such projects as implemented by Local Development Department of HMG*. Nepal
5. UNICEF. *Guidelines for Gravity Flow Water Supply System*. Nepal: UNICEF.

CVL 390 Project II (0 – 0 – 2)

Evaluation:

	Theory	Practical	Total
Sessional	-	50	50
Final	-	50	50
Total	-	100	100

Course Description:

Project II is a follow-up course of previous semester Project I. It is intended to enable the students to define project implementation approach, stakeholders' community, and impacts of the project on economy, society, environment, and technology. During the course of study, student should select a project (ongoing or completed) as a case study and conduct a meeting/discussion with stakeholders and prepare the report.

A course supervisor will be assigned for a group of six students (maximum) for case study and report preparation. However, the theoretical background and methodology of the course can be taught in lecture class for the whole section. At the end of the semester, student shall submit a hard copy report. Contribution of each member student in the chapters of the report should be well defined. Oral presentation of each student on the assigned sub-topic is compulsory. Evaluation scheme for project II is as: theoretical knowledge (10%), field work (20%), report (50%) and presentation (20%).

Course Objectives:

1. To enable students to summarize project proposals and formulate implementation steps,
2. To enable students to know the impact of civil engineering projects,
3. To enable students to communicate with stakeholders on project matters,
4. To impart skill for writing report on: ongoing or completed projects including the following theme
   a. project rationale
   b. indentification of stakeholders
   c. reponsibilities of stakeholders
   d. project impact on society, economy, technology, environment
5. To make students familiar with basic computer techniques for report writing and presentation,
6. To make students familiar to work in a team,
7. To develop the skills of oral presentation; make them able to prepare seminar papers, workshop papers and poster designing

Course Contents: **5 hrs**

1. **Theoritical Background**
   a. Review of project proposals
   b. Project implementation tools and approaches: Design, drawings, estimates, specifications, tendering and execution of projects

c. Introduction to Civil Egineering Projects: water resources, roads, buildings, bridges, geotechincal, environment, etc.
d. Project stakeholders and their responsibilities with examples
e. Impact of the Project on society, economy, technology, environment

2. Case Study (in the field) **10 hrs**

a. Site visit to the ongoing or completed project
b. Identification of project objectives
c. Identification of project execution methods (ongoing projects)
d. Understanding the operational and maintenace mechanism of the project (completed projects)
e. Interaction/discussion with stakeholders

3. Report Writing **10 hrs**

a. Project background
b. Project rationale
c. Project objectives
d. Projects execution method / operational mechanism / maintenace strategies
e. Roles of of stakeholders for the project sustainability
f. Impacts of project on the society, economy, technology and environment
g. Recommendations on the project

4. Report Presentation (indivdual) **5 hrs**

References

1. Kumar, Ranjit (2006). *Research Methodology*. Pearson Education
2. *Report writing for technicians & Engineers*