ELX 110 Basic Electronics Engineering (2 – 1 – 2)

Evaluation:

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

Course Objectives:

This course aims to provide knowledge on principles of electronic devices and circuits, electro components, equipment and their use. Moreover, it provides fundamental skills on applications electronic devices, communication system, digital systems and their applications.

Course contents:

1. Semiconductor Diode **6 hrs**

1.1 Intrinsic and extrinsic semiconductor
1.2 P and N type semiconductors
1.3 Theory of P-N Junction, depletion region and barrier potential
1.4 Forward biasing and reverse biasing of diode
1.5 V-I characteristics curves of PN diode and temperature effects
1.6 Ideal and piecewise linear model of diode
1.7 Junction break down: zener breakdown and avalanche breakdown
1.8 DC regulated power supply, half wave and full wave rectifier (center tap and bridge) a filtering (shunt capacitor, LC filter and Pai filter)
1.9 Zener regulator, LED and Photo diode

2. Bipolar Junction Transistor **6 hrs**

2.1 Introduction of Bipolar Junction Transistor
2.2 Current flow mechanism in NPN and PNP transistors
2.3 Input and output characteristics of CB and CE transistor amplifiers
2.4 Transistor as a switch and as an amplifier
2.5 Need of biasing and various biasing circuits (fixed bias, collector to base bias and self bias circuit) and operating point
2.6 Comparison between BJT and FET

3. Operational Amplifier and Oscillators **5 hrs**

3.1 General characteristics (or advantages/disadvantages) of negative feedback amplifiers
3.2 Gain calculation for negative feedback amplifiers
3.3 Virtual ground concept, output offset voltage and CMRR of op –amp
3.4 Inverting and non-inverting amplifier
3.5 Application of an amplifier as an adder, subtractor, integrator and differentiator
3.6 Positive feedback and Barkhausen criteria for oscillations

4. Digital Electronics **5 hrs**

4.1 Significance of analog to digital and digital to analog conversion
4.2 Binary, hexadecimal, octal number system and conversion
4.3 Binary coded decimal (BCD)
4.4 Logic gates: OR, NOT, AND, NOR, NAND, XOR, XNOR gate and their truth tables.
4.5 De Morgan's theorem
4.6 Simplification of Boolean function using Karnaugh Maps

5. Communication System **4 hrs**

5.1 Basic blocks of communication system; Need of modulation
5.2 Fundamentals of frequency and phase modulation
5.3 Methods of generation and detection of AM/FM modulated signal
5.4 Concept of optical fiber communication

6. Electronic Instruments and their Applications in Civil Engineering **4 hrs**

6.1 Total station and its application
6.2 Use of EDM in surveying
6.3 Remote control sensing and robotics
6.4 Strain gauze load cell

Laboratories:

1. To verify the V-I characteristics of PN junction diode and zener diode
2. To rectify the AC signals into half wave and full wave rectified signals
3. To verify the input and output characteristics of CE and CB transistor amplifiers
4. To represent the functions of logic gates by means of truth table
5. To convert digital signal into analog signal and vice versa
6. To study AM and FM modulated signals

Text Books:

1. Bogart, T. F. *Electronic Devices and Circuits*. New Delhi: Pearson Education.2004.
2. Morris, M. M. *Digital logic and Computer Design*. New Delhi: Prentice Hall. 1995.
3. Lathi, B. P. *Modern Analog and Digital Communication Systems*. New Delhi: Oxford University Press, 1998.

References:

1. Mehata, V. K. *Principles of electronics* (5th ed.). New Delhi: S. Chand and Co. Ltd. 1993.
2. Coughlin, Robert F. & Desicoll, Fredrick F. *Operational Amplifiers and Linear Integrated Circuits* (4th ed.). New Delhi: Prentice Hall. 1996.
3. Bhandari, D. P. *Basic Electronics Engineering*, Kathmandu: Sukunda Pustak Bhawan. 2012.

WRE 211 Hydraulics (3 – 2 – 3)

Evaluation:

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

Course Objectives:

Student, at the end of the semester will have the abilities to analyze flow characteristics in pip flow as well as in open channel, which aims to impart the concept of water resources engineerin and their application in the field of civil engineering.

Course Contents:

1. Flow through Pipes **7 hr**

1.1 Introduction to pipe flow, Reynolds experiment and flow based on Reynolds' number.

1.2 Laminar flow (Steady-uniform-incompressible flow in a circular pipe, shear stress, and velocity distribution), laminar flow between parallel plates.

1.3 Major Head loss for laminar flow through pipe (Hagen Poisseuille equation).

1.4 Turbulent flow, difference between laminar & turbulent flow, shear stress development, Prandtl's mixing length theory, velocity distribution, Darcy-Weisbach equation, Nikuradse's experiment.

1.5 Resistance for commercial pipes, variation of friction factor with Reynold's number, Colebrook-White equation, use of Moody's diagram.

1.6 Minor head losses in pipes (losses in sudden enlargement, sudden contraction, exit loss, entry loss, losses due to sudden obstruction, losses in bends and losses due to different fittings).

1.7 HGL and TEL lines.

2. Simple Pipe Problems and Pipe Networks **6 hrs**

2.1 Three types of pipe flow problems and their solution procedure.

2.2 Pipe Line System (Pipes on series and parallel): Dupuit's equation, concept of equivalent pipe length /diameter in series and parallel.

2.3 Concept of economic diameter of pipes.

2.4 Siphons: definition, application, condition of continuous supply, different type of problem in siphon (simple and trial & error).

2.5 Pipe network solution procedure by Hardy-Cross method for single and double loops of pipe networks with examples.

2.6 Three reservoir problem and its solution for possible three different cases.

3. Unsteady Flow in Pipes **5 hrs**

3.1 Basic concept for unsteady flow: celerity, derivation of Euler's equation and continuity equation.

3.2 Water hammer and its causes & effects in pipes and penstock.
3.3 Variation of pressure and Water Hammer due to gradual and sudden closure of valve for the cases of rigid and elastic pipes: basic equation of water hammer, Rigid Water Column Theory, its limitations and Elastic Water Column Theory.
3.4 Propagation of hydraulic transient in rigid and elastic pipe
3.5 Relieving devices against action of water hammer: major functions and different types of surge tanks.

2 hrs

4. Introduction to Open Channel Flow

4.1 Introduction to open channel flow and its practical application, differences between open channel and pipe flows.
4.2 (a) Classification of open channel: natural and artificial channel, prismatic and non-prismatic channel, rigid boundary and mobile boundary channel.
(b) Types of open channel flow by time (steady & unsteady), space (uniform & non-uniform: gradually varied, rapidly varied and spatially varied flow) and hydraulic regime (based on Reynold's number: laminar, transition & turbulent; and Froude number: sub-critical, critical and super critical flow).
4.3 Geometric properties of open channels: depth, flow area, top width, wetted perimeter, hydraulic radius, hydraulic mean depth, bed slope, hydraulic or energy slope, water surface slope), Shapes of open channel.

6 hrs

5. Uniform Flow

5.1 Conditions of uniform flow in a prismatic channel, expression for shear stress on boundary of channel, velocity and shear stress distribution in open channel and mean velocity.
5.2 Fundamental equations of uniform flow: Manning's equation and Chezy's equation, relationship between Chezy's coefficients (C), Manning's and Darcy's-Weisbach co-efficient.
5.3 Factors affecting manning's roughness coefficient.
5.4 Conveyance, section factor and hydraulic exponent for uniform flow computation.
5.5 Determination of normal depth, velocity and slope.
5.6 Problems of uniform flow computation.
5.7 Design of best hydraulic channel sections (rectangular, triangular, trapezoidal and circular).
5.8 Choice of shape of channel section on plain and hill regions.

4 hrs

6. Energy and Momentum Principles in Open channel flow

6.1 Specific energy, specific energy diagram, critical depth of flow.
6.2 Critical depth computations for all kind of channel sections (prismatic) and criteria for critical state of flow.
6.3 Alternate depth, depth-discharge relationship.
6.4 Application of energy principle and critical depth concept: channel width reduction, rise in channel bed, venture flume and broad crested weir.
6.5 Momentum principle, specific force, specific force curve, criteria for critical state of flow, conjugate depth.

7. **Non-uniform Gradually Varied Flow (GVF)**

7.1 Introduction to GVF, reasons and examples of GVF.

7.2 Basic assumptions, governing /dynamic equation and its physical meaning.

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

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

8. **Hydraulic jump and its Analysis**

8.1 Characteristics of Rapidly Varied Flow (RVF).

8.2 Hydraulic jump and its uses as an energy dissipater: jumps in a horizon rectangular channel, jump variables (conjugate depth, height of jump, length jump).

8.3 Energy loss in jump.

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

8.5 Practical application of jump.

9. **Uniform Flow in mobile boundary channel**

9.1 Introduction to rigid and mobile boundary channel.

9.2 Definition of alluvial channel, shear stress distribution on the channel boundary.

9.3 Incipient motion condition, Introduction to tractive force approach.

9.4 Introduction to Shied diagram and its application for designing MBC.

9.5 Formation of river beds based on the shear stress.

10. **Similitude and Physical Modeling**

10.1 Introduction to similitude and physical modeling.

10.2 Necessity of model testing and its applications and limitations.

10.3 Types of similarities: geometric, kinematic and dynamic similarities.

10.4 Model Laws: Reynold's, Froude, Euler's, Weber's, Mach model laws.

10.5 Types of model: undistorted and distorted (geometrically, material an hydraulically distortion).

10.6 Scale effects in model study.

Laboratories:

1. Reynolds' experiment
2. Head loss in a pipeline
3. Flow through open sluice gate
4. Hydraulic jump analysis in open channel
5. Hump and constricted flow analysis: discharge measurement in open channel (channe width reduction, rise in channel bed and venture flume)
6. Computer program coding for simple problems: algorithm and coding for Hardy-cross with one loop pipe network and problem on siphon
7. Use of computer program for solution of simple flow problem: flow profile calculation for GVF using HEC-2 or other relevant computer program.

ext Books:

1. Modi, P. N. & Seth, S. M. *Fluid Mechanics and Hydraulics*. New Delhi: Standard Books. 2009.
2. Subramanya, K. *Flow in Open Channel.* New Delhi: Tata McGraw Hill.
3. Bansal, R. K. *A text book of Fluid Mechanics and Hydraulic Machines* (9th ed.). New Delhi: Laxmi Publications. 2010.

ferences:

1. Chow, V.T. *Open Channel Hydraulics*, New Delhi: McGraw-Hill. 1973.
2. Jagdish Lal. *Fluid Mechanics and Hydraulics*
3. K. G. Ranga Raju. *Flow through Open Channel.* New Delhi: Tata McGraw Hil Publishing Company Ltd.
4. Jain, A. K. *Fluid Mechanics and Hydraulics.* New Delhi: Khanna Publication. 2008.
5. Kumar, D.S. *Fluid Mechanics and Fluid Power Engineering* (6th ed.). Delhi: S.K Kataria and Sons. 2005.
6. Rajput, R. K. *Fluid Mechanics and Hydraulic Machines.* New Delhi: S. Chand. 2008.
7. Sangraula, D. P. & Bhattarai, P. *A text book of Hydraulics.*

MTH 230 Numerical Methods (3 – 1 – 3)

Evaluation:

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

Course Objectives:

1. To introduce numerical methods for interpolation, regressions, and root finding to the solution of problems.
2. To solve elementary matrix arithmetic problems analytically and numerically.
3. To find the solution of ordinary and partial differential equations.
4. To provide knowledge of relevant high-level programming language for computing implementing, solving, and testing of algorithms.

Course Contents:

1. **Solution of Nonlinear Equations** 10 hrs
   - 1.1 Review of calculus and Taylor's theorem
   - 1.2 Errors in numerical calculations
   - 1.3 Bracketing methods for locating a root, initial approximation and convergence criteria
   - 1.4 False position method, secant method and their convergence, Newton's method and fixed-point iteration and their convergence.

2. **Interpolation and Approximation** 7 hrs
   - 2.1 Lagrangian's polynomials
   - 2.2 Newton's interpolation using difference and divided differences
   - 2.3 Cubic spline interpolation
   - 2.4 Curve fitting: least squares lines for linear and nonlinear data

3. **Numerical Differentiation and Integration** 5 hrs
   - 3.1 Newton's differentiation formulas
   - 3.2 Newton-Cote's, Quadrature formulas
   - 3.3 Trapezoidal and Simpson's Rules
   - 3.4 Gaussian integration algorithm
   - 3.5 Romberg integration formulas.

4. **Solution of Linear Algebraic Equations** 10 hrs
   - 4.1 Matrices and their properties
   - 4.2 Elimination methods, Gauss Jordan method, pivoting
   - 4.3 Method of factorization: Dolittle, Crout's and Cholesky's methods
   - 4.4 The inverse of a matrix
   - 4.5 Ill-Conditioned systems
   - 4.6 Iterative methods: Gauss Jacobi, Gauss Seidel, Relaxation methods

4.7 Power method.

5. Solution of Ordinary Differential Equations **8 hrs**

5.1 Overview of initial and boundary value problems
5.2 The Taylor's series method
5.3 The Euler Method and its modifications
5.4 Huen's method
5.5 Runge-Kutta methods
5.6 Solution of higher order equations
5.7 Boundary Value problems: Shooting method.

6. Solution of Partial Differential Equations **5 hrs**

6.1 Review of partial differential equations
6.2 Elliptical equations, parabolic equations, hyperbolic equations and their relevant examples.

Laboratory:
Use of Matlab/Math-CAD/C/C++or any other relevant high-level programming language for applied numerical analysis. The laboratory experiments will consist of program development and testing of:

1. Solution of nonlinear equations
2. Interpolation, extrapolation, and regression
3. Differentiation and integration
4. Linear systems of equations
5. Ordinary differential equations (ODEs)
6. Partial differential equations (PDEs)

Text Books:

1. Gerald, C. F. & Wheatly, P. O. *Applied Numerical Analysis* (7th edition). New York: Addison Wesley Publishing Company.
2. Guha, S. & Srivastava, R. *Numerical Methods: For Engineers and Scientists*. Oxford University Press.
3. Grewal, B. S. & Grewal, J. S. *Numerical Methods in Engineering & Science* (8thedition). New Delhi: Khanna publishers. 2010.
4. Balagurusamy, E. *Numerical Methods*. New Delhi: Tata McGraw Hill. 2010.

References:

1. Moin, Parviz. *Fundamentals of Engineering Numerical Analysis*. Cambridge University Press, 2001.
2. Lindfield, G. R. & Penny, J. E. T. *Numerical Methods: Using MATLAB*. Academic Press. 2012.
3. Schilling, J. & Harris, S.L. *Applied Numerical Methods for Engineers using MATLAB and C*. Thomson publishers, 2004.
4. Sastry, S. S. *Introductory Methods of Numerical Analysis* (3rd edition). New Delhi: Prentice Hall of India. 2002.

5. Rao, S. B. & Shantha, C. K. *Numerical Methods with Programs in Basic, Fortran and Pascal*. Hyderabad: Universities Press. 2000.
6. Pratap, Rudra. *Getting Started with MATLAB*. Oxford University Press. 2010.
7. Vedamurthy, V.N. & Lyengar, N. *Numerical Methods*. Noida: Vikash Publication House. 2009.

MTH 220 Probability and Statistics (3 – 2 – 0)

Evaluation:

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

Course Objective:

This course is designed to familiarize the students with basic knowledge about probability and statistics. After successful completion of this course students would be able to understand and apply the concept of presentation and summarization of data, probability and probability distributions, sampling and estimation, hypothesis testing, simple regression and correlation.

Course Contents:

1. Introduction of Statistics and Presentation of Data **4 hrs**

- 1.1 Introduction of statistics
- 1.2 Application of statistics in engineering
- 1.3 Variables, types of variable: numerical and categorical variable
- 1.4 Sources of data: primary and secondary source
- 1.5 Presentation and classification of data: stem- and-leaf displays
- 1.6 Frequency distribution
- 1.7 Diagrammatic and graphical presentation of data: Pareto diagram
- 1.8 Pie-diagram, histogram, frequency curve and frequency polygon
- 1.9 Cumulative frequency curve or ogive curve

2. Summarizing and Describing the Numerical Data **4 hrs**

- 2.1 Measure of central tendency (mean, median, mode), partition values
- 2.2 Measure of variation: range, inter-quartile range, standard deviation
- 2.3 Coefficient of variation
- 2.4 Box and whisker plot

3. Probability **5 hrs**

- 3.1 Random experiment, sample space, event and types of events, counting rule
- 3.2 Various approaches to probability
- 3.3 Laws of probability-additive, multiplicative
- 3.4 Conditional-probability and independence
- 3.5 Baye's theorem

4. Random Variable and Probability Distribution **12 hrs**

- 4.1 Random variable: discrete and continuous random variable
- 4.2 Probability mass function
- 4.3 Expectation, laws of expectation (addition and product law)
- 4.4 Discrete probability distribution: Binomial distribution, Poisson distribution, Hyper Geometric distribution and Negative binomial distribution

4.5 Probability density function, cumulative distribution functions, expected values of continuous random variables

4.6 Continuous probability distribution: rectangular distribution, exponential distribution, Gamma distribution, Beta distribution, Normal distribution, Log-Normal distribution

5. Bi-variate Random Variables and Joint Probability Distribution **3 hrs**

5.1 Joint probability mass function, joint probability density function, joint probability distribution function

5.2 Marginal probability mass function, marginal probability density function, conditional probability mass function

5.3 Sums and average of random variables

6. Sampling and Estimation **5 hrs**

6.1 Population and samples

6.2 Sampling distribution of mean

6.3 Types of sampling: probability and non-probability sampling

6.4 Determination of sample size

6.5 Central limit theorem and its application

6.6 Estimation: concept of point and interval estimation, criteria of good estimator, interval estimation, maximum likelihood estimation

6.7 Confidence interval for population mean and population proportion

7. Testing of Hypothesis **7 hrs**

7.1 Null and alternative hypothesis, level of significance, type I and type II error, critical value, P-value, one and two tailed tests, steps involved in hypothesis testing

7.2 One Sample test for mean and proportion

7.3 Two sample test for mean (independent and dependent) and proportion

8. Simple Linear Regression and Correlation **5 hrs**

8.1 Simple correlation and its properties

8.2 Concept of simple regression analysis, estimation of regression coefficient by using least square estimation method

8.3 Standard error, coefficient of determination.

Text Book:

Johnson, Richard A. *Probability and Statistics for Engineers* (8th edition). New Delhi: PHI learning private limited. 2011.

References:

1. Devore, Jay L. *Probability and Statistics for Engineering and the Sciences* (8th edition). New Delhi: Cengage learning.
2. Sheldom, M. Ross. *Probability and Statistics for Engineers and Scientist* (4th edition). New Delhi: Cengage Learning.
3. Shrestha, Hridya B. *Statistics and Probability* (2nd edition). Kathmandu: Ekata Books Distributer Pvt. Ltd.

STR 212 Structural Analysis I (3 – 2 – 1)

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 structural analysis. After completing this course students will be able to analyze statically determinate rigid frames, beams, and arches. Students will also get basic knowledge of space trusses and cables of suspension bridges.

Course Contents:

1. Introduction **2 hrs**

1.1 Types of structural system
1.2 Linearity and non-linearity in structural analysis
1.3 Statically determinate and indeterminate structures
1.4 Degree of static indeterminacy

2. Strain Energy Method **6 hrs**

2.1 Strain energy and complementary strain energy, work and complementary work
2.2 Strain energy due to gradually and suddenly applied direct load: dynamic multipliers
2.3 Strain energy due to axial force, shear force, bending and torsion
2.4 Displacement of beams and trusses by strain energy method

3. Virtual Work Method **6 hrs**

3.1 Limitations of real work method
3.2 Principle of virtual work
3.3 Unit load method
3.4 Displacement of beams, frames and truss by unit load method
3.5 Effect of fabrication error (misfits) and temperature change in trusses

4. Displacement Theorems **3 hrs**

4.1 Betti's law
4.2 Maxwell's reciprocal theorem
4.3 Castigliano's theorems and application for beams and plane frames

5. Slope and Deflection of Beams **5 hrs**

5.1 Application of integration method for beams
5.2 Theorems on moment area method and its application for beams
5.3 Conjugate-beam method and its application for beams

Influence Line Diagrams for Simple Structures

6.1 Moving loads and influence lines **9 hrs**

6.2 Influence lines for statically determinate beams (support reactions, shear forces and bending moments)

6.3 Influence lines for statically determinate trusses (support reactions and member forces)

6.4 Influence line diagrams for the case of indirect load applications or panel loading (shear forces and bending moments)

6.5 Reactions and internal forces (shear forces and bending moments) from influence line diagrams due to different loadings: point load, uniformly distributed load, standard load trains

6.6 Maximum internal forces at a beam section and absolute maximum internal force on a beam span (shear forces and bending moments)

Statically Determinate Arches **5 hrs**

7.1 Types of arches

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

7.3 Determination of support reactions, shearing forces, normal forces and bending moments (circular and parabolic arches)

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

7.5 Influence line diagrams for reactions, bending moments, shearing forces and normal forces in three-hinged parabolic arches and determination of internal forces

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

Space Trusses **3 hrs**

8.1 Introduction to simple space truss

8.2 Types of supports

8.3 Analysis of space truss by tension coefficient methods

Cable Structures **6 hrs**

9.1 Introduction to cable

9.2 Catenary and parabolic cables

9.3 Elements of a simple suspension bridges

9.4 Analysis of parabolic cables

9.5 Analysis of three-hinged stiffening girder

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

9.7 Tower structures, wind cables and ties (introduction only)

Laboratories:

1. Deflection of beam
2. Influence lines for beams
3. Analysis of plane frame experimentally or by computer simulation
4. Influence lines for frames
5. Analysis of three-hinged arches under different loading arrangements
6. Analysis of suspension bridge under different loading arrangements
7. Analysis of space truss by computer simulation

Tutorials:

At least five assignments accommodating all chapters.

Note: Assignments shall be focused on analysis of problems requiring elongated time that are not possible to be included in final examination.

Text Books:

1. Norris, C. H., & Wilbur, J. B. (1960). *Elementary Structural Analysis.* McGraw-Hill.
2. Bhavikatti, S. S. (2011). *Structural Analysis I.* New Delhi: Vikas Publishing House Pvt. Ltd.

References:

1. Darkov, A. & Kuznetsov, V. *Structural Mechanics.* Moscow: Mir Publishers.
2. Reddy, C.S. (1999). *Basic Structural Analysis.* Tata McGraw-Hill Education.
3. Jain, A.K. *Strength of Materials and Structural Analysis.* Roorkee: Nem Chand & Bros.

CVL 221 Surveying I (3 – 1 – 4)

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 provide knowledge to civil engineering students on various techniques and instruments for measurements of distances, angles and elevations; topographic surveys, preparation of topographic maps, tacheometry and contouring.

Course Contents:

1. Introduction to Surveying **4 hrs**

1.1 Definition of Surveying
1.2 Plane and Geodetic Surveying
1.3 Classification of Surveying
1.4 Principles of Surveying
1.5 Scales, Maps and Plans
1.6 Units of Measurement (Length, Area and Volume) and Conversions
1.7 Accuracy and Error

2. Compass Survey **5 hrs**

2.1 Introduction, Uses and Importance
2.2 Meridians, Bearings and Angles
2.3 Designation of Bearings - Whole Circle and Quadrantal System and Conversions
2.4 Fore Bearing and Back Bearing
2.5 Types of Compass
2.6 Magnetic Declination
2.7 Local Attraction
2.8 Closing Error and Adjustments (Graphical and Analytical)
2.9 Instruction on Field Works

3. Levelling **10 hrs**

3.1 Levelling - Basic Definitions and Importance
3.2 Types of Levelling – Spirit, Trigonometrical and Barometric
3.3 Spirit Levelling - Basic Definitions and Types
3.4 Methods of Reducing Levels - HI and Rise & Fall Method, Arithmetic Checks
3.5 Effect of Curvature and Refraction
3.6 Reciprocal Levelling
3.7 Permissible Error in Levelling
3.8 Sources of Error in Levelling

3.9 Trigonometrical Levelling – Problems of Height and Distances
3.10 Practical Cases in Levelling
3.11 Instruction on Field Works

4. Introduction to EDM, Theodolite and Total Station **4 hrs**

4.1 Principle of Electronic Distance Measurement and Use of EDM
4.2 Types of Theodolite and its components
4.3 Principle of Theodolite
4.4 Uses of Theodolite - Measurement of Horizontal & Vertical Angles and Bearings
4.5 Components of Total Station
4.6 Electronic Data Recording
4.7 Uses of Total Station

5. Theodolite Traversing **10 hrs**

5.1 Traverse – Definition, Types and Uses
5.2 Checks in Closed and Open Traverse
5.3 Consecutive and Independent Co-ordinates; and its Computation
5.4 Closing Error in Closed Traverse, its computation and Balancing
5.5 Degree of Accuracy in Traversing
5.6 Plotting of Theodolite Traverse
5.7 Omitted Measurements
5.8 Instruction on Field Works

6. Tacheometry **5 hrs**

6.1 Introduction, Uses and Importance
6.2 Principles of Optical Distance Measurement
6.3 Systems of Tacheometry - Stadia System and Tangential System
6.4 Distance Measurement using Vertical Staff
6.5 Instruction on Field Works

7. Contouring **4 hrs**

7.1 Basic definitions in Contouring
7.2 Contour Interval
7.3 Characteristics of Contours
7.4 Methods of Contouring
7.5 Interpolation of Contours
7.6 Uses of Contour Maps
7.7 Instruction on Field Works

8. Trilateration and Triangulation **3 hrs**

8.1 Principle of Trilateration
8.2 Principles and Classification of Triangulation Systems
8.3 Strength of Figure
8.4 Satellite Stations and Inter-visibility of Triangulation Stations
8.5 Instruction on Field Works

Practical:

1. Preparation of a detailed survey map by "using tapes and compass", with concepts of ranging, offsets, booking methods, measurement on sloping ground and use of abney level or clinometer.
2. Transfer of RL from BM to a point by Fly Levelling.
3. Preparation of L-section and X-sections of a road alignment.
4. Demonstration of Theodolite and Total Station and traverse survey using theodolite or Total Station.
5. Preparation of a detailed topographic map by traversing using theodolite or Total Station, with distances and elevations computed by tacheometry and contours drawn after arithmetic interpolation.
6. Determination of elevation of accessible and inaccessible points by Trigonometrical Leveling.
7. Measurement of a plot of land by trilateration and computation of area in various systems (Ropani, Bigha, Hectare etc.) and demonstration of EDM.

Text Books:

1. Punmia, B. C., Jain Ashok K. & Jain, Arun K. *Surveying Vol. I, II, III*. New Delhi: Laxmi Publications. 2005.
2. Clark, D. *Plane and Geodetic Surveying for Engineers Vol. 1, II.* Michigan: Constable Limited. 1923.
3. Bannister, A., Raymod, S. & Baker, Raymond. *Surveying* (7th edition). New Delhi: Pearson education.
4. Kanetkar, T.P. *Surveying.*
5. Basak, N.N. *Surveying and Levelling.* New Delhi: Tata McGraw Hill. 2010.