First Year 'all common' Subjects for:

- Civil Engineering
- Civil & Rural Engineering
- Computer Engineering
- Electronics & Communication Engineering
- Electrical & Electronics Engineering

First Year 'Partial Common' subjects for:

- BEIT
- BE Software

Table of Contents

1. MEC 119.3 Applied Mechanics I (3-2-0)

Evaluation:

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

Course Objectives:

This course has been developed to provide the basic knowledge of engineering mechanics to the students of engineering so that it would be beneficial to understand structural engineering. The knowledge of mechanics can utilized in wide range of engineering applications using Newton's laws of motion and mechanical equilibrium of different force system. This course shall be considered as a basic for all branches of Engineering of Pokhara University in first year of undergraduate program.

Course Contents:

1. Introduction (2 hrs)

1.1 Definition and scope of Applied Mechanics
1.2 Concept of Statics and Dynamics
1.3 Concept of Particle
1.4 Concept of Rigid, Deformed and Fluid Bodies
1.5 Fundamental Concepts and Principles of Mechanics: Newtonian Mechanics
1.6 System of Units

2. Review of Coordinate System (2 hrs)

2.1 Cartesian Coordinate System
2.2 Polar Coordinate System
2.3 Cylindrical Coordinate System
2.4 Spherical Coordinate System
2.5 Review of Vector Algebra

3. Forces acting on particles and rigid body (7 hrs)

3.1 Types of Forces: Point Force, Transitional and Rotational Force- Relevant Examples
3.2 Resolution and Composition of Forces- Relevant Examples
3.3 Principle of Transmissibility and Equivalent Forces- Relevant Examples
3.4 Moments: Moment of a Force about a point and an axis- Relevant Examples
3.5 Theory of Couples:: Relevant Examples
3.6 Resolution of a Force into Forces and a Couple- Relevant Examples
3.7 Resultant of Force and Moment for a System of Force: Examples

4. Basic Concept of Static Equilibrium (2 hrs)

4.1 Concept of Load types, Load Estimation and Support Idealizations- Examples and Standard Symbols
4.2 Free Body Diagram- Relevant Examples
4.3 Physical Meaning of Equilibrium and its essence in structural application
4.4 Equation of Equilibrium in Two/Three Dimensions

5. Friction Forces (3 hrs)

5.1 Introduction
5.2 Types of Friction and its Coefficients: Static and Dynamic
5.3 Laws of Friction
5.4 Angle of Friction

5.5 Engineering Examples of usage of Friction

6. Center of Gravity, Centroid and Moment of Inertia (6 hrs)

6.1 Concept and Calculation of Centre of Gravity and Centroid of Line/Area /Volume – Examples
6.2 Concept and Calculation of Second Moment of Area/ Moment of Inertia and Radius of Gyration- Relevant Examples
6.3 Use of Parallel Axis Theorem: Relevant Examples

7. Analysis of Beam (5hrs)

7.1 Introduction Beam
7.2 Use of statically determinant beam
7.3 Relationship between Load, Shearing Force and Bending Moment
7.4 Calculation and drawing of Axial Force, Shear Force and Bending Moment

8. Analysis of Truss (4 hrs.)

8.1 Introduction to determinant truss
8.2 Use of truss in engineering application
8.3 Analysis of force by method of joint
8.4 Analysis of force by method of section

9. Kinematics of Particles and Rigid body (6 hrs)

9.1 Rectilinear Kinematics: Continuous Motion
9.2 Position, Velocity and Acceleration of a Particle and Rigid body
9.3 Determination of Motion of Particle and Rigid body
9.4 Uniform Rectilinear Motion of a Particles
9.5 Uniformly Accelerated Rectilinear Motions of Particles
9.6 Curvilinear Motion of a Particle
9.7 Rectangular Components of velocity and Acceleration
9.8 Introduction of Tangential and Normal Components
9.9 Radial and Transverse Components

10. Kinetics of Particles and Rigid body: Force and Acceleration (6 hrs)

10.1 Newton's Second Law of Motion and Momentum
10.2 Equation of Motion and Dynamic Equilibrium: Relevant Examples
10.3 Angular Momentum: Rate of Change and Conservation
10.4 Motion of Various Particles and Relative Velocity
10.5 Equation of Motion- Rectilinear and Curvilinear
10.6 Rectangular Components: Tangential and Normal
10.7 Polar Coordinates: Radial and Transverse Components

11. Moment and Energy in Rigid body (2 hrs)

11.1 Introduction to Moment and Energy
11.2 Conservation of Linear and Angular Momentum

Text Books:

1. "Engineering Mechanics-Statics and Dynamics", Shames, I. H. 3rd ed., New Delhi, Prentice Hall of India, 1990.
2. "Mechanics of Engineers-Statics and Dynamics", F. P.Beer and E. R. Johnston, Jr. 4rh Edition, Mc Graw-Hill Book Co., New York, USA (Asia Editions), 1987.

References:

1. "Engineering Mechanics-Statics and Dynamics", R.C. Hibbeler, Ashok Gupta, 11th edition. New Delhi, Pearson, 2009.
2. "Engineering Mechanics- Statics and Dynamics", I.C. Jong and B.G. Rogers.
3. "Engineering Mechanics- Statics and Dynamics", D.K. Anand and P.F. Connif.
4. "Engineering Mechanics of Solids", Egor .P. Popov, 2nd Edition, New Delhi, Prentice Hall of India, 1996.

5. "Engineering Mechanics- Statics & Dynamics", Dr. D.S. Kumar,S.K. Kataria & Sons, New Delhi, Reprint 2011.
6. Practice guide in Applied Mechanics, D. B. Pandit, Ramesh Khanal

2. ELE 105.3 Basic Electrical Engineering (3-1-2)

Evaluation:

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

Course Objectives:

1. To analyze electric circuits (A.C. & D. C).
2. To work on electrical instrumentation projects.
3. To operate, distinguish and use electrical devices and machines.

Chapter	Content	Hrs.
1	**Introduction**	2
	Role of electricity in modern society, Energy sources and production, generation, transmission and distribution of electrical energy, consumption of electricity	
2	**DC Circuit Analysis**	15
	Circuits concepts (lumped and distributed parameters), linear and nonlinear parameter, passive and active circuits, Circuit elements (Resistance, capacitance and inductance), their properties and characteriscts in a geometrical and hardware aspects, color coding, Series of parallel compilation of resistances, Equivalent resistance and its calculation, star-delta transformation, concept of power, energy and its calculations, short and open circuit, ideal and non-ideal sources, source conversion, voltage divider and current divider formula, Kirchhoff's current and voltage laws, nodal method and mesh method of network analysis (without dependent source), network theorem (i.e Superposition, Thevonin's, Norton's), maximum power transfer.	
3	**Single Phase AC Circuits Analysis**	10
	Generation of EMF by electromagnetic induction, Generation of alternating voltage, sinusoidal functions-terminology (phase, phase angle, amplitude, frequency, peak to peak value), average values and RMS or effective value of any types of alternating voltage or current waveform, phase algebra, power triangle, impedance triangle, steady state response of circuits (RL, RC,RLC series and parallel) and concept about admittance, impedance reactance and its triangle), instantaneous power, average real power, reactive power, power factor and significance of power factor, resonance in series and parallel RLC circuit, bandwidth, effect of Q factor in resource.	
4	**Poly-phase AC Circuit Analysis**	6
	Concept of a balanced three phase supply, generation and differences between single phase over three phase system, star and delta connected supply and load circuits. Line and phase voltage\current relations, power measurement, concept of three phase power and its measurement by single and two wattmeter method	

5 Electric Machines **12**

Review of magnetic circuits

Transformers: Principle of operations, features, equivalent circuits, efficiency & regulation, open circuit & short circuit tests

DC motors: Performance & operation, basic characteristics of motors & generators, speed control & selection of motors

AC machines: Induction motors (working principles, construction features and uses), Synchronous motors (working principles, construction and uses)

Textbook

1. Boylested, Albert , "Introduction of Electric circuit" Prentice Hall of India Private Limited, New Delhi
2. Tiwari, S.N, "A first course of electrical engineering" att. Wheeler & Co.Ltd Allabhad.

References:

1) Thereja B. L & Thereja A. K " A text book of Electrical Technology, S Chand Publication.
2) Jain& Jain" ABC of Electrical Engineering""

Laboratory Work:

1. To measure current, voltage and power across the passive components.
2. To verify Kirchhoff's Current Law (KCL) & Kirchhoff's Voltage Law (KVL)
3. To verify Thevenin's Theorem.
4. To verify maximum power transfer theorem.
5. To verify superposition theorem.
6. To measure three phase power by using two wattmeter
7. To determine efficiency and voltage regulation of a single-phase transformer by direct loading.
8. To study open circuits & short circuits tests on a single phase transformer
9. To study the speed control of dc shunt motor by.
    i. Varying the field current with armature voltage held constant field control.
    ii. Varying the armature voltage with field current held constant armature control.
10. To study open circuits and load test on a dc shunt generator (separately excited)
    i. To determine magnetization characteristics
    ii. To determine V-I characteristics of a dc shunt generator

3. CHM 103.4 Chemistry (4-1-2)

Evaluation:

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

Course Objectives:

1. Analyze chemical behavior of materials
2. Analyze the water quality.
3. Analyze environmental aspects of various elements and compounds.

Chapter	Content	Hrs.
1.	**Ionic Equilibria and Electro Chemistry**	10
	Introduction and types of buffer solutions, mechanism, Henderson- Hassel Balch equation, electro chemical cells, Galvanic cell, cell notation, cell reaction, cell potential, single electrode potential , standard electrode potential, electro chemical series & its applications, Nernst equation, corrosion, its type, mechanism and control.	
2	**General Inorganic Chemistry**	10
	Ionization energy, electro negativity, electron affinity, characteristic properties of S and P block elements, introduction of Transition metals, characteristic properties of transition metals (electronic configuration, atomic radii, variable oxidation states, complex formation, color and magnetic properties.	
3	**General Organic Chemistry**	10
	Reaction intermediates: carbocations, carbanions and carbon free radicals, stereoisomerism	
	Organic reaction mechanism: Nucleophilic substitution reactions (SN1&SN2), Electrophilic aromatic substitution, Elimination (E1 & E2), Electrophilic and free radical addition reaction	
4	**Polymer Chemistry**	10
	Polymer and polymerization, basic concepts , types of polymerization (addition and condensation), thermoplastics and thermosetting plastics, preparation, properties and uses of : polyethylene, PVC, Teflon, Bakelite's, Nylon, polyester, polyurethelene and silicon, rubber, processing of natural rubber and vulcanization	
5	**Analytical Chemistry**	6
	Introduction and application of following analytical techniques: fractional distillation, chromatography (paper, thin layer) NRM, Mass spectroscopy	
6	**Industrial Chemistry**	4
	Introduction of paints, chemistry of paints, lubricants and its classification, cement, chemistry of cement, manufacture & its setting mechanism, Explosives: TNT, TNG	
7	**Environmental Chemistry**	10
	Water pollution- causes of water pollution, acid rain, alkalinity COD, DO, Hardness,(effects to human	

health), control

Air pollution: causes, global warming and climate change ozone layer depletion and CFC, control measures

Soil pollution: causes, effects and its control measures

Laboratory works
Objectives

- Use techniques apparatus and instructions properly
- Interpret, evaluate and report upon observations and experimental results
- Design/plan on investigation, select techniques, apparatus and materials
- Evaluate methods and suggest possible improvements

Laboratory works

1. Determine of total alkalinity of given water sample
2. Determination of hardness of water sample by complexometric titration
3. Determination of free chorine in the given water sample
4. Preparation of buffer and determination of pH of the solution
5. Estimation of DO in the given water sample
6. Estuation of COD in the given water sample
7. To separate the ink mixture by paper chromatography or TLC (Demo)
8. To purify a sample of mixture of crude alcohol and petroleum by fractional distillation (Demo)
9. To estimate carbon monoxide gas in the car exhaust (Demo)

Text books:

1. Physical Chemistry, B.S. Bahl and G.D. Tuli
2. Advanced inorganic Chemistry, J. D. Lee
3. Advance Organic Chemistry, Morisson and Boyd 6th edition
4. Engineering Chemistry (with experiments), Sunita Rattan , 4th edition Publisher of Engineering and Computer books

Reference Books:

1. Satya Prakash, Tuli, Basu, Madan: Advanced Inorganic Chemistry, S. Chanda & Company Ltd, New Delhi
2. Polymer Science, V.R. Gowariker, N. V. Vishwanathan
3. Environmental Chemistry, Anil Kumar Datta
4. Advanced Organic Chemistry, A. Bahl and B. S. Bahl
5. Text book of Chemistry P.N. Chaudhary and M.L. Bhusal
6. Lab manual of Engineering Chemistry by S.K. Bhasin and Sudha Rani

4. ENG 104.2 Communication Technique (2-2-1)

Evaluation:

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

Course Objectives:
The main objectives of this course are:

4. To develop the ability to deliver technical knowledge orally in English.
5. To be able to comprehend and take notes after listening.
6. To fasten reading skills in technical and non-technical reading materials.
7. To develop summarizing skills in writings.
8. To write reports, letters, description on technical talks, seminar papers, memoranda, application

Chapters Content **Hrs.**

1 Review of Written English **2**

- Identification of Sentence and clause
- Classification of sentence (simple, compound, complex)
- transformation of sentences

2 Oral Communication and Note Taking **9**

- Variety of English (BrE, AmE, formal, informal, polite, familiar, tentative)
- General rules of pronunciation (English Vowels and Consonants)
- General rules of stress and intonations
- Oral presentation/technical talk: Environmental pollution, construction, water resources, impact of satellite communication, urban development, impact of computer in modern society

3 Technical Writing Skills **10**

- Preparation of short memoranda (Importance, formats)
- Business letters (Importance-purposes)
- Preparation of job application and CV
- Description writing (Process, Mechanism, Place etc.)
- Calling meeting and writing minutes, notification, preparation of agenda

4 Reading Skills **9**

- Comprehension questions and exercises from:
- The use and the misuse of science, Road foundation, Beauty, Custom, The story of an hour (Kate Chopin), Knowledge and wisdom, Freedom, Letter from foreign grave (D. B Gurung), Natural Resources of Nepal: Forests & Water (Mani Bhadra Gautam)
- Note making and precise writing from any passage

Tutorial Works:

1. Some general rules of pronunciation..
2. To present a seminar paper/report/proposal.
3. To participate in a group discussion.
4. To conduct a meeting.
5. To prepare and practice to face an interview.

Textbook:

1. Andrea J. Rutherford. *Basic Communication Skills for Technology*. 2nd Edition. Addision Wesley. Pearson Education Asia (LPE) ISBN: 8178082810
2. Khanal Arjun, Communication Skills in English, Sukunda Pustak Bhawan, 2010

Reference Books:

1. Anne Eisenberg, *Effective Technical Communication*, Mc-Graw Hill 1982.
2. V.R. Narayanaswami, *Strengthen your writing*, Orient Longman, Madras.
3. Champa Tickoo & Jaya Sasikumar, *Writing with a Purpose*, Oxford University Press, Bombay.
4. A handbook of pronunciation of English words (with 90-minute audio cassettes) Communication Skills in English.
5. Chopin, Kate. "The Story of an Hour", *Creative Delights*
6. *Gautam Shreedhar, Creation & Criticism: A Miscellaneous Thought*
7. *Gautam Mani Bhadra, Essays, Stories, Passages, Paragraphs and Letter writing for the Young Learners, Nirantar Prakashan, Kathmandu, 2008*

5. MTH 111.3 Engineering Mathematics I (3-2-0)

Evaluation:

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

Course Objectives:

After the completion of this course students will be able to apply the concept of calculus (Differential and integral), analytical geometry and vector in their professional courses.

Chapter	Content	Hrs.
1	**Limit, Continuity and Derivative:**	15

i. Limit, continuity and Derivative of a function with their properties
ii. Mean values Theorem with their application
iii. Higher order derivative
iv. Indeterminate forms
v. Asymptote
vi. Curvature
vii. Ideas of curve tracing
viii. Extreme values of functions of single variables

2	**Integration with its Application:**	17

i. Basic integration, standard integral, definite integral with their properties
ii. Fundamental theorem of integral calculus (without proof)
iii. Improper integral
iv. Reduction formulae and use of beta Gamma functions
v. Area bounded by curves
vi. Approximate area by Simpsons and Trapezoidal rule,
vii. Volume of solid revolution

3	**Two dimensional geometry:**	7

i. Review (circle, Translation and rotation of axes)
ii. Conic section(parabola, ellipse, hyperbola),
iii. Central conics (Introduction only).

4.	**Vector Algebra:**	6

i. Review of vector and scalar quantity
ii. Space coordinates
iii. Product of two or more vectors
iv. Reciprocal system of vectors and their properties
v. Equations of lines and planes by vector methods

Text Books:

1. Engineering Mathematics I: Prof. D.D Sharma (Regmi), Toya Narayan Paudel, Hari Prasad Adhikari, Sukunda Publication Bhotahity , Kathmandu
2. Calculus and analytical geometry: George B Thomas, Ross L. Finney

Reference Books:

1. Calculus with analytical geometry: E.W. Swokoswski.
2. Coordinate Geometry: Lalji Prasad.
3. Vector Analysis: M. B. Singh
4. Integral Calculus: G.D. Panta.

6. MTH 121.3 Engineering Mathematics II (3 – 2 – 0)

Evaluation:

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

Course Objective:

The main objective of this course is to provide the basic knowledge of three dimensional geometry, Calculus of several variables, differential equation, Laplace transform. After the completion of this course, students can use their knowledge in their professional course.

Chapter	Content	Hrs
1	**Three Dimensional geometry :** i. Review of direction cosines, direction ratios, Planes ii. Straight lines iii. Sphere and its tangent plane iv. Cone and cylinder(definitions, standard equation only)	12
2	**Partial derivatives and Extreme values for function of two or more variables:** i. Definitions, total derivatives, Chain rule, Eulers theorem for function of two or three variables, its application ii. Extreme values for two or more variables	6
3	**Laplace transformation:** i. Definition ii. Derivation of formulae iii. Application of laplace transform, iv. Inverse laplace transform v. Convolution theorem on laplace transform and application	8
4	**Differential equation:** i. Order and degree of differential equation ii. First order differential equation with their solutions (separable, reducible to separable form exact ness condition), linear and Bernoulies equation) iii. Second order differential equation (Homogeneous and non homogeneous) with constant coefficient as well as variable coefficients. iv. Initial value problem. v. Power Series solution vi. Legendres and Bessel equation with their solution, properties and application	13
5.	**Double Integral:** i. Definitions, Fubinis theorems (statement only) ii. Change of order, iii. Change Cartesian integral to equivalent polar integral iv. Area and volume by double integral	6

Text Books:

1. Engineering Mathematics II: Prof. D.D Sharma (Regmi), Toya Narayan Paudel, Hari Prasad Adhikari, Sukunda publication, Bhotahity, Kathmandu.
2. Advance Engineering Mathematics : Erwin Kreyszig.

Reference Books:

1. Calculus with analytical geometry: E.W. Swokoswski.
2. Algebra: G.D Pant
3. Three Dimensional Geometry: Y.R Sthapit, B.C Bajracharya
4. Calculus and analytical geometry: George B Thomas, Ross L. Finney

7. MEC 109.2 Engineering Drawing (0-0-6)

Evaluation:

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

Course Objectives:

1. To develop sketching, lettering and drafting skills
2. To draw projections, drawings of various geometric figures.
3. To draw assembly of machine parts.
4. To develop ability of preparing working drawings

Course Contents:

1. Instrumental Drawing, Practices and Techniques (12 hrs)

Equipment and metals, Description of drawing instruments, auxiliary equipment and drawing materials, Techniques of instrument drawing, pencil sharpening, securing paper, proper use of T-squares, triangles, scales, dividers, compasses, erasing shields, French curves, inking pens.

Freehand Technical Lettering

Lettering strokes, letter proportions, use of pencils and pens, uniformity and appearance of letters, freehand techniques, inclined and vertical letters and numerals, upper and lower cases, standard English lettering forms.

Dimensioning

Fundamentals and Techniques: size and location dimensioning, IS conversion; Use of scales, measurement units, reducing and enlarging drawings; General dimensioning practices: placement of dimensions aligned and unidirectional recommended practice, some 50 items.

2. Applied Geometry (24 hrs)

Plane geometrical construction: Bisecting and trisecting lines and angles, proportional division of lines, construction of angles, triangles, squares, polygons, constructions using tangents and circular archs. Methods of drawing standard curves such as ellipse, parabolas, hyperbolas, involutes, spirals, cycloid and helices (cylindrical and helical); Solid geometrical construction: Classification and pictorial representation of solid regular objects such as: prisms, square, cubical, triangular and oblique, Cylinders: right and oblique, Cones: right and oblique, Pyramids: square, triangular, oblique, truncated; Doubly-curved and warped surfaces: Sphere, torus, oblate ellipsoid, conoid, serpentine, paraboloid, hyperboloid

Basic Descriptive Geometry

Introduction: Application of descriptive geometry principles to the solution of problems involving positioning of objects in three-dimensional space; The projection of points, and planes in space; Parallel lines; True length of lines: horizontal, inclined and oblique lines; Perpendicular lines; Bearing of a line; Point view of end view of a line; Shortest distance from a point to a line; Principal lines of a plane; Edge view of a plane; True shape of an oblique plane;

Intersection of a line and plane; Angle between a line and a plane; Angle between two non-intersecting (skew) lines; Dihedral angle between two planes; Shortest distance between two skew lines.

3. Theory of Projection Drawing (24hrs)

Perspective projection drawing; Orthographic projection; Axonometric projection; Oblique projection; First and third angle projection;

Multi-view Drawings

Principal views: Methods for obtaining orthographic views: Projection of lines, angles and plane surfaces, analysis in three views; Projection of curved lines and surfaces; Object orientation and selection of views for best representation; Full and hidden lines. Orthographic drawings: Making an orthographic drawing, Visualizing objects from the given views; Interpolation of adjacent areas; True-length lines; Representation of holes; conventional practices.

Sectional views

Full section view; Half section; Broken section; Revolved section; Removed (detail) sections; Phantom of hidden section; Auxiliary sectional views; Specifying cutting planes for sections; conventions for hidden lines, holes, ribs, spokes.

Auxiliary Views

Basic concept and use of auxiliary views; Drawing methods and types of auxiliary views; Symmetrical and unilateral auxiliary views; Projection of curved lines and boundaries; Line of intersection between two planes; True size of dihedral angles; True size and shape of plane surfaces.

4. Development and Intersections (15hrs)

Development: General concepts and practical considerations, Development of a right or oblique prism, cylinder, pyramid and cone; Development of truncated pyramid and cone; Triangulation method for approximately developed surfaces; Transition pieces for connecting different shapes; Development of a sphere; Intersections: Lines of intersection of geometric surfaces; Piercing point of a line and a geometric solid; intersection lines of two planes; Intersection of prisms and pyramids; Intersection of a cylinder and an oblique plane; Intersection of a sphere and an oblique plane; Constructing a development using auxiliary views; Intersection of two cylinders; Intersection of a cylinder and cone.

5. Machine Drawing (15hrs)

Introduction: production of complete design and assembly drawings; Fundamental techniques: size and location dimensioning; placement of dimension lines and general procedures; standard dimensioning practice (IS system); Limit dimensioning: nominal and basic size, allowance, tolerance, limits of size, clearance fit, interference fit; basic hole system and shaft systems; Thread and standard machine assembly elements: screw threads: ISO standards, representation and dimensioning; Fasteners: type and drawing representation, keys, collars, joints, springs bearings; Assembly drawings: drawing layout, bill of materials, drawing layout, bill of materials, drawing numbers.

Laboratory Work:

Freehand technical lettering and use of drawing instruments; Dimensioning; Geometrical and Projection drawing; Descriptive geometry; Projection and multiview drawings; Sectional views; Auxiliary views, Freehand sketching and visualization; Development and intersections; machine and assembly drawings.

Reference Books:

8. Luzadder, *Fundamentals of Engineering Drawing*, Prentice Hall of India Ltd., 8th edition, 1981.
9. French, C.J. Vierck and R.J. Foster, *Engineering Drawing and Graphic Technology*, McGraw-Hill, 1981.
10. Machine drawing P.S. Gill, S.K. Kataria and Sons, India, 7th Edition, 2008.

8. MEC 178.1 Mechanical Workshop (0-0-3)

Evaluation:

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

Course Objectives:

To provide instructions and practical experience in basic mechanical workshop methods

Course Contents:

Chapters	Content	Hrs.
1	**Mechanical Workshop Materials** Introduction to mechanical workshop, Basics of steel and cutting materials, Common non-ferrous metals, Important mechanical properties.	4
2	**Measurement and Measuring Equipment**	1.5
3	**Bench Tools and Basic Hand Operations** Filing, Sawing, Sheet metal working, screw thread and screw thread cutting	1.5
4	**Joining Processes** Riveting, Soldering, Brazing, Welding	1.5
5	**Introduction to Machine Tools** Elements of machine tools, Cutting actions and tooling	1.5
6	**Familiarization with Basic Machine Tools** Lathe, Milling machine, Drill presses, Power saws, Shaping Machine and Grinding machines	5

Practical:

6. To convert a metallic job piece into a prescribed form using mechanical bench tool.
7. To turn a cylindrical job piece to prescribed dimension by using lathe machine.
8. To convert a metallic job piece to prescribed dimension by using milling machine.
9. To provide surface finish to a metallic piece by using the shaper machine.
10. To weld required metallic pieces together by using electric arc and gas welding, to given shape and size.
11. To make knot & bolt of given size and type
12. To make tray/dust bin/ pen holder or similar item with sheet metal.

Reference Books:

11. Anderson and E.E. Tatro, *Shop Theory*, McGraw-Hill 5th edition, 1942.
12. Lascoe, C.A. Nelson and H.W. Porter, *Machine Shop Operation and Setups*, American Technical Society, 1973.

13. *Machine Shop Practice – Volume II*, Industrial Press, New York, 1971.
14. Oswald, *Technology for Machine Tools*, McGraw-Hill Ryerson, 3rd edition.
15. Oberg, Jones and Gorton, *Machinery's Handbook*, 23rd edition, Industrial Press, New York

9. CMP 103.3 Programming in C (3-0-3)

Evaluation:

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

Course Objectives:
The object of this course is to acquaint the students with the basic principles of programming and development of software systems. It encompasses the use of programming systems to achieve specified goals, identification of useful programming abstractions or paradigms, the development of formal models of programs, the formalization of programming language semantics, the specification of program, the verification of programs, etc. the thrust is to identify and clarify concepts that apply in many programming contexts:

Chapter	Content	Hrs.
1	**Introduction** History of computing and computers, programming, block diagram of computer, generation of computer, types of computer, software, Programming Languages, Traditional and structured programming concept	3
2	**Programming logic** Problems solving(understanding of problems, feasibility and requirement analysis) Design (flow Chart & Algorithm), program coding (execution, translator), testing and debugging, Implementation, evaluation and Maintenance of programs, documentation	5
3	**Variables and data types** Constants and variables, Variable declaration, Variable Types, Simple input/output function, Operators	3
4	**Control Structures** Introduction, types of control statements- sequential, branching- if, else, else-if and switch statements, case, break and continue statements; looping- for loop, while loop, do—while loop, nested loop, goto statement	6
5	**Arrays and Strings** Introduction to arrays, initialization of arrays, multidimensional arrays, String, function related to the strings	6
6	**Functions** Introduction, returning a value from a function, sending a value to a function, Arguments, parsing arrays and structure, External variables, storage classes, pre-processor directives, C libraries, macros, header files and prototyping	6

7 Pointers **7**

Definition pointers for arrays, returning multiple values form functions using pointers. Pointer arithmetic, pointer for strings, double indirection, pointer to arrays, Memory allocation-malloc and calloc

8 Structure and Unions **5**

Definition of Structure, Nested type Structure, Arrays of Structure, Structure and Pointers, Unions, self-referential structure

9 Files and File Handling **4**

Operating a file in different modes (Real, Write, Append), Creating a file in different modes (Read, Write, Append)

Laboratory:

Laboratory work at an initial stage will emphasize on the verification of programming concepts learned in class and use of loops, functions, pointers, structures and unions. Final project of 10 hours will be assigned to the students which will help students to put together most of the programming concepts developed in earlier exercises.

Textbooks:

1. Programming with C, Byran Gottfried
2. C Programming, Balagurusami

References

1. A book on C by A L Kely and Ira Pohl
2. The C Programming Language by Kerighan, Brain and Dennis Ritchie
3. Depth in C, Shreevastav

10. CMP 104.3 Object Oriented Programming in C++ (3-1-3)

Evaluation:

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

Course Objectives:

- To familiarize with Object Oriented Concept.
- To introduce the fundamentals of C++
- To enable the students to solve the problems in Object Oriented technique
- To cope with features of Object Oriented Programming

Course Contents:

Chapter	Content	Hrs.
1	**Thinking Object Oriented** Object oriented programming a new paradigm, a way of viewing world agent, types of classes, computation as simulation, coping with complexity, nonlinear behavior of complexity, abstraction mechanism	4
2	**Classes and Methods:** Review of structures, classes and inheritance, state, behavior, method, responsibility, encapsulation, data hiding, Functions: friend function, inline function, static function, reference variable, default argument	7
3	**Message, Instance and Initialization** Message, message passing formalization, message passing syntax in C++, mechanism for creation and initialization (constructor and its types), Issues in creation and initialization: memory map, memory allocation methods and memory recovery	6
4	**Object Inheritance and Reusability** Introduction to inheritance, Subclass, Subtype, Principle of Substitutability; Forms of polymorphism and their implementation in C++,inheritance merits and demerits, composition and its implementation in c++, The *is-a* rule and *has-a* rule, Composition and Inheritance contrasted, Software reusability	9
5	**Polymorphism** Polymorphism in programming language, Varieties of polymorphism, compile time polymorphism, function overloading, operator overloading, type conversion, polymorphic variable, run time polymorphism, object pointer, this pointer, virtual function, overriding, deferred method, pure polymorphism.	8
6	**Template and generic programming** Generic and template functions and classes, cases study: container class and the	4

standard template library, Exception handling

7 Object oriented Design **7**

Reusability implies non- interference, Programming in small and programming in large, components and behaviors, role of behaviors in OOP, CRC, sequence diagram, Software components, formalizing the interface, interface and implementation, Design and representation of components, coming up with names, implementation components, integration of components

Laboratory Work

There shall be 20 exercises in minimum, as decided by the faculty. The exercises shall encompass a broad spectrum of real-life and scientific problems, development of small program to the development of fairly complex subroutines, programs for engineering applications and problem solving situations. Laboratory assignments will be offered in groups of two to four for evaluation purpose. In general, the Laboratory Work must cover assignments and exercises from the following areas:

1. Data types – control structures, functions and scoping rules.
2. Composite data types, C++ strings, use of " Constant " keyword, pointers and references
3. Classes and data abstraction
4. Inheritance, abstract classes and multiple inheritance
5. Friend functions, friend classes and operator overloading.
6. Static class members
7. Polymorphism, early binding and late binding
8. C++ type conversion
9. Exception handling
10. Function templates, class templates and container classes.

Textbooks:

1. Budd, T., *An Introduction to Object Oriented Programming*, Second Edition, Addison-Wesley, Pearson Education Asia, ISBN: 81-7808-228-4.
2. R. Lafore, *Object Oriented Programming in Turbo C++*, Galgotia Publications Ltd. India, 1999

Reference Books:

1. E Balaguruswamy, Object Oriented Programming with C++, Third Edition
2. Tata McGraw-Hill ISBN:0-07-059362-0, Parson David, Object Oriented Programming with C++, BPB Publication\ISBN817029-447-9

11. PHY 102.4 Physics (4-2-2)

Evaluation:

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

Course Objectives:

The main objectives of this course are:

1. To apply the theory of simple Harmonic motion in different elastic systems.
2. To apply theory of wave propagation and knowledge of resonance.
3. To apply and analyze the Optical properties in different optical systems.
4. To make use of fundamentals of electromagnetic equipment.
5. To use the knowledge of basic physics in different engineering fields.

Chapter	Content	Hrs
1	**Mechanical Oscillation** Introduction and equation of Simple Harmonic Motion, energy in Simple Harmonic Motion, oscillation of mass –spring system, compound pendulum	4
2	**Wave motion** Introduction of wave, wave velocity and particle velocity, types of waves, equation, energy, power and intensity of plane progressive wave, standing wave and resonance.	4
3	**Acoustics** Reverberation of sound, absorption coefficient, Sabines formula, introduction, production and applications of ultrasonic wave	4
4	**Physical Optics** Interference: introduction, coherent sources, interference in thin films due to reflected and transmitted light, Newton's Ring (3) Diffraction: introduction, fraunhoffer diffraction at single silt and double silt diffraction grating (2) Polarization: introduction, double refraction, Nicol prism, optical activity, specific rotation, wave plates (3)	8
5	**Laser and Fiber Optics** Introduction of laser, spontaneous and stimulated emission, optical pumping, He-Ne laser, Ruby Laser, use of laser, Propagation of light waves, types of optical fiber, applications of optical fiber	4
6	**Electrostatics** Electric charge, electric force, electric flux, electric potential, Gauss law and its applications, electric field intensity and electric potential due to dipole, electric potential due to quadrupole, capacitors, electrostatic potential energy, dielectrics and gauss law charging and discharging of capacitor	8

7 Electricity and magnetism **10**

Electric current, resistance, resistivity and conductivity, atomic view of resistivity, magnetic field, magnetic force, Lorentz force, Hall effect, Biot-Savart's law and its applications, force between two parallel conductors, Ampere's circuital law and its applications, Faraday's law of electromagnetic induction, self-induction R-L circuit, energy stored in magnetic field and magnetic energy density

8 Electromagnetism **9**

LC oscillation, Damped oscillation, forced oscillation and resonance, Maxwell's equations displacement current, wave equations in free space, continuity equation, E and B fields, poynting vector, radiation pressure

9 Photon and matter waves **4**

Photon, group velocity and phase velocity, De brogile wavelength, Schrodinger wave equation, one dimensional potential well, tunneling effect

10 Semiconductors and super conductivity **5**

Introduction, types of semiconductors Dopping, P-N Junction, Metal- semiconductor junction, junction breakdown, junction capacitance, electrical conduction in metals, insulators and semiconductors according to band theory of solids, introduction to superconductor

Textbooks:

3. Fundamental of Physic by Robert Rescnick and David Hallday
4. A Text Book of Engineering Physics, T. R. Lamichane
5. A text book of optics by Subramanyam and Brijlal
6. Modern physics by R. Murugason

Reference Books:

16. Concept of physic by H.C Verma
17. Modern Engineeering Physic by A.S Basudeva
18. Electronics by B.L Thereja
19. Principles of Electronics, V. K. Meheta

Laboratories:

1. To determine the acceleration due to gravity & radius of gyration by single bar pendulum.
2. To determine the frequency AC mains by using son mater apparatus
3. To determine the wave length by using diameter of Newton's ring
4. To determine the wave length of laser light by using diffraction grating
5. To determine the value of Modulus of Elasticity of the material given and Moment of Inertia of Circular disc using torsional pendulum
6. To determine the capacitance of given capacitor by charging and discharging through resistor
7. To determine the low resistance of a given wire and resistance per unit length of the wire by using Carey-foster bridge
8. To plot a graph current and frequency in an LRC series circuit and to find: i) the resonance frequency
   ii) the quality factor

Lab textbook: B. Sc Practical Physics by C. L. Arora

12. MEC 189.2 Thermal Science (2-1-2)

Evaluation:

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

Course Objectives:

The broad objective of this course is to provide working knowledge of theories and applications of thermal science. The specific objectives of the course are:

1. To make able to apply laws of thermodynamics in various systems.
2. To make able to distinguish the cycles in various engines, and pumps.
3. To make able to calculate energy/quantity of heat transfer by conduction and radiation.

Chapter **Content** **Hrs.**

1 Concept and definitions **2**

Thermodynamics, Applications of thermodynamics, Thermodynamic system, Macroscopic and microscopic and microscopic Approaches,

Properties and state of a substance: Thermodynamic properties and types, State, path, process, cycle.

- Processes (definition, characteristics, features, Examples): Quasi-equilibrium(states) process, Reversible process, Irreversible process,
- Specific volume, Pressure, Atmospheric pressure, Gauge pressure, Absolute pressure
- Equality of temperature: Zeroth law of thermodynamics

2 Properties of pure substances **3**

- Pure substance: Homogenous in composition, Homogenous in chemical aggregation, Invariable in chemical aggregation
- Vapour-liquid solid phase equilibrium in pure substance: Steam generation(formation) process from ice to steam, Wet steam and quality, T-v diagram of water, P-v Diagram of water, P-t diagram of water
- Equations of state for a simple compressible substance:
- Tables and diagrams of thermodynamic properties
- Determination of Specific volume, Specific enthalpy and Specific entropy of wet and superheated steam

3 Work and heat **2**

Definition of work: in mechanics and in thermodynamics,

Work done in quasi-equilibrium process

Displacement work, Work done in different reversible processes:

- Isochoric process
- Isobaric process
- Isothermal process
- Polytrophic process
- Definition of heat: comparison between heat and work,

4 First law of thermodynamics **4**

- First law for cycle: First law for closed system undergoing a cycle, Verification of this low by wheel paddle experiment
- First law for process: Difference between stored and internal energy, Stored energy
- Internal energy: Joule's law and its verification
- Enthalpy
- Specific heats: Specific heat capacity of gas at constant volume, Specific heat capacity of gas constant pressure
- First law as a rate equation:
- Conversation of mass and the control volume
- First law for control volume
- **Steady state steady flow process:** Assumption, Steady state steady flow energy equation(SFEE), Application of SFEE: Heat exchanger, nozzle, diffuser, turbine, Rotary compressor, Throttling device, Boiler
- Uniform state uniform flow process: Assumptions, 1st law for uniform state uniform flow process

5 Second law of thermodynamics **3**

- Heat engines: 4 components diagram and the schematic diagram, efficiency

Refrigerator and heat pump: 4 components diagram and schematic diagram, COP of refrigerator and heat pump

- **Second law:** Limitation of first law of thermodynamics, Kelivn-Plank statement, Clausius statement

    - Equivalence of Kelvin-Plank and Clausius statements:
    - Factors causing irreversibility
    - Carnot theorem
    - Thermodynamic temperature scale

6 Entropy **4**

Inequality of Clausius, Entropy as a property of a system, Entropy of pure substance, Entropy change in reversible process, lost work, principle of increase of entropy, Entropy change of an ideal gas, the poly-topic process for an ideal gas, concepts of reversibility, irreversibility and availability

7 Some Power Cycles **4**

- Vapor Power Cycles: Rankine cycle (working process, efficiency, Effect of pressure and temperature on Rankine cycle)
- Air Standard Cycles: Air standard cycles: Carnot cycle (Working processes & Efficiency), Brayton cycle (Working processes & Efficiency)
- Internal combustion engines: Otto cycle (Workings processes & Efficiency), Diesel cycle (Working processes & Efficiency), Comparison between Otto an diesel cycle

8 Heat transfer **7**

- Modes of heat transfer: Conduction, Convection, radiation
- Conduction : Fourier's law (Statement, Mathematical modeling, Assumption for this laws, Thermal conductivity
- One dimensional steady state heat conduction: Through a plane, Through a hollow cylinder, Through a hollow sphere
- Composite wail: Heat flow through multilayer plane slabs, Numerical on wall of planes, cylinders and spheres in series.
- Thermal resistance and conductance: Electrical analogy of the conduction heat flow
- Overall heat transfer co-efficient: Heat transfer through a plane slab separating two fluid media
- Basic laws of radiation: Emissive power and emissivity, Stefan-Boltzmann;s law, Kirchoff;s law, Wei's displacement law
- Black and gray bodies: Reflectivity, absorptive and transmissibility, Black and grey bodies
- Radiant exchange between infinity parallel planes
- Newton's law
- Mechanism of forced and free convection
- Dimensionless parameters: Reynold's number, Nusselt's number, Pradndtl's number

9 Introduction to Refrigeration System **1**

Introduction, Refrigeration cycle

Laboratory Work:

1. To measure the pressure, specific volume and temperature
2. To find out the efficiency of a compressor.
3. To measure the rate of heat transfer by conduction.
4. To measure performance of a small internal combustion engine
5. To measure the heat transfer by thermal radiation.
6. To measure the performance of a Refrigeration/Heat pump

Textbooks:

1. Howell J.R. and R.O. Buckius, *Fundamentals of Engineering Thermodynamics*, McGrow-Hill Publishers, 1994.

Reference Books:

1. Van Wylen, G.J. and Richard E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley Eastern Limited, New Delhi, 1989.
2. Bayazitoglu, Y. and M. Necati Ozisik, *Elements of Heat Transfer*, McGraw-Hill Book Company, 1998.
3. Kreith, F., *Principles of Heat Transfer*, International Text book Company, Scranton Pennsylvania, 2nd Edition, I965.

MTH 211.3 Engineering Mathematics III (3-2-0)

Evaluation:

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

Course Objectives:

The main objectives of this course is to provide the basic knowledge of Linear algebra, vector calculus, fourier series, linear programming by graphical and simplex methods. After the completion of this course, students can use their knowledge in their professional course.

Course Contents:

1. **Matrix and Determinant:** **(8 hrs)**
   - 1.1 Review of Matrix and determinant with their properties
   - 1.2 System of linear equation with their solutions by Gauss elimination methods
   - 1.3 Rank of matrix
   - 1.4 Consistency of system of linear equation
   - 1.5 Vector space and sub space
   - 1.6 Linear transformation
   - 1.7 Eigen values and vectors, Cayley Hamilton theorem (Statement only) and its application.

2. **Vector Calculus** **(16 hrs)**
   - 2.1 Differentiation and integration of vectors
   - 2.2 Gradient divergence and curl with their properties (without proof)
   - 2.3 Line integral: Definition of line integral, Evaluation of line integral, properties, Greens theorem, Area by Greens theorem
   - 2.4 Surface integral: Surface integral, tangent planes, Gauss divergence theorem, Dirichelet integral
   - 2.5 Line integral: Stokes theorem

3. **Infinite series** **(8 hrs)**
   - 3.1 Sequence and series
   - 3.2 Necessary condition of convergence of infinite series
   - 3.3 P-test (hyper-harmonic test)
   - 3.4 Ratio test
   - 3.5 Root test
   - 3.6 Integral test
   - 3.7 Leibnitz test and absolute convergence
   - 3.8 Interval of convergence of power series.
   - 3.9 Taylor and Maclaurin expansion (Statement only) and its application

4. **Fourier Series** **(6 hrs)**
   - 4.1 Periodic function, Trigonometric series, even and odd function
   - 4.2 Fourier series of a function with period 2π and arbitrary period 2L
   - 4.3 Fourier sine and cosine series representation of the half range function.

5. Linear Programming **(7 hrs)**

5.1 System of Linear Inequalities
5.2 Linear Programming
- 5.2.1 Model Formulation
- 5.2.2 Graphical Solution
- 5.2.3 Simplex method
- 5.2.4 The Dual model
- 5.2.5 Dual Simplex Method

Text Books:

1. Kreyszig, Erwin. *Advance Engineering Mathematics* (8th edition). New Delhi: Wiley-Easter Publication.
2. Paudel, Toya Narayan. *Engineering Mathematics III*, Bhotahity: Sukunda publication,

References:

1. Thomas, George B. & Finney, Ross L. *Calculus and Analytical Geometry.*
2. Swokoswski, E.W., *Calculus with Analytical Geometry.*
3. Singh, M.B., *Vector Analysis.*
4. Pant, G. D., *Algebra.*

Applied Mechanics II (2-2-0)

Evaluation:

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

Course Objectives:

The purpose of the course is to provide basic knowledge of engineering mechanics dynamics portion to the students such that they can understand the basics of kinematics and kinetics for both particles and rigid bodies and their motion which can be applied in wide range of engineering applications.

Course Contents:

1. **Kinematics of Particles** **(5 hrs)**
   - 1.1 Rectilinear Motion of Particles
   - 1.2 Curvilinear Motion of Particles
   - 1.3 Rectangular Components of Velocity and Acceleration
   - 1.4 Tangential and Normal Components
   - 1.5 Radial and Transverse Components
   - 1.6 Detailed Gravitational Motion

2. **Energy and Momentum Methods of Particles** **(5 hrs)**
   - 2.1 Work done by Spring and Gravity
   - 2.2 Work done by a Force
   - 2.3 Kinetic and Potential Energy
   - 2.4 Principle of Work and Energy Applications
   - 2.5 Power and Efficiency
   - 2.6 Conservation of Energy
   - 2.7 Principle of Impulse and Momentum
   - 2.8 Impulsive Motion and Impact
   - 2.9 Direct Central and Oblique Impact

3. **Systems of Particles** **(5 hrs)**
   - 3.1 Newton's Second Law and Systems of Particles
   - 3.2 Linear and Angular Momentum of a System of Particles
   - 3.3 Equations of Motion, Motion due to Central Force and Dynamic Equilibrium
   - 3.4 Conservation of Momentum
   - 3.5 Kinetic and Potential Energy of a System of Particles
   - 3.6 Conservation of Energy of a System of Particles
   - 3.7 Principle of Impulse and Momentum of a System of Particles
   - 3.8 Steady Streams of Particles
   - 3.9 System with Variable Mass

4. **Kinematics of Rigid Bodies** **(4 hrs)**
   - 4.1 Introduction

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4.2 Translation and Rotation about fixed axis
4.3 General Plane Motion
4.4 Absolute and Relative Velocity in General Plane Motion
4.5 Instantaneous Centre of Rotation
4.6 Absolute and Relative Frame; Coriolis Acceleration in Plane Motion
4.7 Rate of Change of a General Vector with respect to a rotating Frame; Coriolis Acceleration
4.8 General Motion and Motion about a Fixed Point
4.9 Three-dimensional Motion of a Particle relative to a rotating Frame; Coriolis Acceleration

5. Revision of Plane Motion of Rigid Bodies: Forces, Moments and Accelerations (4 hrs)

5.1 Introduction
5.2 Equation of Motion of a Rigid body in Plane Motion
5.3 Angular Momentum of Rigid bodies in Plane Motion
5.4 Plane Motion of Rigid body; D'Alemberts Principle
5.5 Application of Rigid body Motion in Plane

6. Plane Motion of Rigid bodies: Energy and Momentum (5 hrs)

6.1 Principle of Work and Energy for Rigid bodies
6.2 Work done by External Forces
6.3 Kinetic Energy of Rigid body in Plane Motion
6.4 Conservation of Energy : Work- Energy Application
6.5 Impulse and Momentum for Systems for Rigid bodies
6.6 Conservation of Angular and Linear Momentum
6.7 Impulsive Motion and Eccentric Impact

7. Mechanical Vibration (2 hrs)

7.1 Undamped free Vibration for Particles and Rigid bodies
7.2 Simple Harmonic Motion
7.3 Frequency and Period of Oscillation
7.4 Application of Vibration in Civil Engineering-

Text Books:

1. "Engineering Mechanics-Statics and Dynamics", Shames,I.H. 3rd ed., New Delhi, Prentice Hall of India, 1990.
2. "Mechanics of Engineers-Statics and Dynamics", F. P.Beer and E. R. Johnston, Jr. 4th Edition, Mc Graw-Hill Book Co., New York, USA (Asia Editions), 1987.

References:

1. "Engineering Mechanics-Statics and Dynamics", R.C. Hibbeler, Ashok Gupta, 11th edition. New Delhi, Pearson, 2009.
2. "Engineering Mechanics- Statics and Dynamics", I.C. Jong and B.G. Rogers.
3. "Engineering Mechanics- Statics and Dynamics", D.K. Anand and P.F. Connif.
4. "Engineering Mechanics of Solids", Egor .P. Popov, 2nd Edition, New Delhi, Prentice Hall of India, 1996.
5. "Engineering Mechanics- Statics & Dynamics", Dr. D.S. Kumar,S.K. Kataria & Sons, New Delhi, Reprint 2011.

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MAT 201.2 Civil Engineering Materials (2-0-2)

Evaluation:

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

Course Objectives:

This course is intended to provide a basic knowledge of various civil engineering materials that can be used in construction and maintenance of civil engineering project. Different materials, their manufacturing process, composition and properties has been introduced which provides in important insight of materials that will help in selection and proper use of these materials. In addition, this course objects to provide hands-on experiences with testing of construction materials.

Course Contents:

1. **Introduction** **(3 hrs)**
   - 1.1 Introduction and scope of civil engineering material
   - 1.2 Types of civil engineering materials (metals, timber, ceramics, polymers, composites)
   - 1.3 Properties of civil engineering materials: physical- density, specific gravity, opacity, porosity, water absorption capacity, fire resistivity; mechanical- strength (compressive, tensile, shear, flexural, impact), hardness, ductility, elasticity, resilience, toughness, stiffness, abrasive resistance, fatigue, creep; thermal- specific heat, thermal conductivity, thermal expansion; electrical- conductivity, electric permittivity, dielectric strength, magnetic- magnetic permeability, magnetic retentively
   - 1.4 Material-Environment (temperature, humidity, rain and fire) interaction

2. **Clay Products** **(4.5 hrs)**
   - 2.1 Constituents of good brick earth
   - 2.2 Manufacturing of bricks
   - 2.3 Qualities of good bricks
   - 2.4 Classification of bricks (different classes and ISI classification) and their characteristics
   - 2.5 Different tests for brick (shape and size, water absorption, efflorescence, compressive strength)
   - 2.6 Stabilized earth bricks, sand-lime bricks and refractory bricks
   - 2.7 Miscellaneous clay products: tiles, terracotta, earthenware, stoneware, concrete blocks
   - 2.8 Glazing

3. **Stone and Aggregates** **(4.5 hrs)**
   - 3.1 Physical classification of stones (stratified, unstratified and foliated)
   - 3.2 Quarrying, dressing and seasoning of stone
   - 3.3 Artificial Stone: Characteristics and uses

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3.4 Classification of aggregate (fine and coarse)
3.5 Gradation of aggregate
3.6 Fineness modulus of aggregate
3.7 Bulking of Sand
3.8 Testing of coarse aggregate (water absorption, shape, abrasion, toughness, impact, soundness and reactivity)
3.9 Testing of sand (for clay, organic materials and salts)

4. Cementing Materials **(4.5 hrs)**

4.1 Clay as a cementing material
4.2 Lime: types (fat, hydraulic and poor), properties and its uses
4.3 Indian standard classification of lime
4.4 Cement, its composition (Bogue compounds) and properties
4.5 Hydration, heat of hydration and gain of strength of cement
4.6 Ingredients of cement and cement manufacturing process
4.7 Types of cement (OPC, PPC, RHC, white cement) and their uses
4.8 Testing of cement (fineness, soundness, consistency, setting time, compressive strength and tensile strength)
4.9 Mortar: function and types (mud, lime, cement and gauged)

5. Mechanical behavior **(3 hrs)**

5.1 Types of stress/strains (True and Engineering) and their relationship
5.2 Stress-strain curve of ductile and brittle materials
5.3 Fracture of metal: ductile and brittle
5.4 Mechanism of brittle fracture: Griffith's theory
5.5 Hardness: Types (scratch, indentation and rebound) and its tests (brinell and rockwell)
5.6 Impact strength and its test (charpy and izod)

6. Metals and Alloys **(5 hrs)**

6.1 Iron: types, manufacturing process, properties and uses
6.2 Steel: composition and types (carbon steel and alloy steel)
6.3 Types of carbon steels and their uses
6.4 Basic introduction of heat treatment of steel
6.5 Different forms of rolled steel section
6.6 Reinforcing steels (TOR and TMT)
6.7 Properties, advantages and uses of stainless steel, tool steel, brass, aluminum and duraluminum
6.8 Corrosion of metals and its prevention

7. Timber **(3 hrs)**

7.1 Timber: source, types, classification, characteristics, advantages and uses
7.2 Growth and structure of exogeneous tree
7.3 Defects in timber
7.4 Seasoning of timber: air, water, kiln, chemical, electrical and boiling
7.5 Preservation of timber
7.6 Properties and uses of bamboo
7.7 Wood based products (veneer, plywood, impreg timber, compreg timber, boards)

8. **Miscellaneous Materials** **(2.5 hrs)**

8.1 Types, properties and uses of Asphalt, Bitumen and Tar
8.2 Types, properties and uses of Glass, Plastics and Rubber
8.3 Gypsum products and Composite materials

Laboratory Works:

1. Determination of specific gravity of cement
2. Determination of bulk density of sand and coarse aggregate
3. Gradation and determination of fineness modulus of aggregate
4. Test of sand for presence of clay and organic materials
5. Generation of curve for bulking of sand
6. Water absorption and efflorescence test of bricks
7. Determination of compressive strength of brick and cement.
8. Abrasion and toughness test of coarse aggregate
9. Determination of fineness, consistency, soundness, setting time of cement
10. Toughness test of timber and mild steel

Field Visit:

One industrial visit.

Text Books:

1. Singh, P. (2008). *Civil Engineering Material.* Katson Books.
2. Rajput, R.K. (2004). *Engineering Material*, New Delhi: S. Chand & Company Ltd.

References:

1. Singh, G., & Singh, J. *Building Materials.* Delhi: Standard Publishers Distributors.
2. Khurmi R.S. & Sedha. *Material Science and Processes.* New Delhi: S. Chand and Company Ltd.
3. Peter A. Thronton & Vito J. Colangelo (1985). *Fundamentals of Engineering Materials.* Prentice Hall.

WRE 250.3 Fluid Mechanics (3-2-2)

Evaluation:

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

Course Objectives:

The course aims to acquaint the students with basic concepts of Fluid Mechanics. The general objectives of the course is to provide sound understanding of the properties of fluids and fluid forces in static and dynamic applications and to apply understanding to the solution of a wide variety of engineering fluids problems including problems in the application phase of irrigation and hydropower engineering courses.

Course Contents:

1. **Physical Properties of Liquid** **(4 hrs)**
   - 1.1 Definition of Fluid Mechanics: basic concept, scopes and application in civil engineering
   - 1.2 Matters as solid, fluid or gas; shear stress in fluids and difference between solids and fluids
   - 1.3 Control volume and continuum concept in fluid mechanics
   - 1.4 Physical properties of liquid: mass density, specific weight, specific volume, relative density, specific gravity, cavitations and vapor pressure, cohesion and adhesion, surface tension, capillarity (relations, their dimensions, units as well as values for different materials)
   - 1.5 Viscosity: definitions, causes of viscosity in liquid and gases, Newton's law of viscosity, variation of viscosity with temperature, classification of fluids as Newtonian and Non-Newtonian

2. **Fluid pressure and its measurement** **(5 hrs)**
   - 2.1 Introduction, intensity of pressure
   - 2.2 Pascal's law
   - 2.3 Fundamental equation of fluid statics (Pressure-Depth relationship)
   - 2.4 Absolute, gauge and atmospheric pressure at a point and their relationship
   - 2.5 Pressure head at a point and units of pressure measurement
   - 2.6 Measurement of pressure:
     - 2.6.1 Manometers: Simple manometer as piezometer, U-tube manometer, vertical and inclined single column manometer, differential manometer, inverted U-tube differential manometer, micro-manometer as differential manometer
     - 2.6.2 Mechanical gauge: Introduction, general working principle and simple diagram of bourden tube pressure gauge, diaphragm pressure gauge, bellows pressure gauge and dead weight pressure gauge

3. **Hydrostatic Forces on submerged surfaces** **(5 hrs)**
   - 3.1 Introduction

3.2 Total pressure and centre of pressure (horizontal, vertical and inclined plane and curve surfaces)
3.3 Pressure diagram (horizontal, vertical and inclined plane and curve surfaces)
3.4 Computation of pressure forces on gates, dams, head water tank and other hydraulic structures (plane and curve)

4. Equilibrium stability **(6 hrs)**

4.1 Buoyancy, floatation concept, thrust on submerged and floating surfaces
4.2 Condition of equilibrium: stability of submerged and floating bodies
4.3 Metacentre and determination of metacentric height (analytical and experimental method)
4.4 Liquid in relative equilibrium: liquid in a container subjected to uniform acceleration in horizontal, vertical and inclined directions; and uniform radial acceleration about vertical axis

5. Fluid Kinematics **(4 hrs)**

5.1 Introduction
5.2 Approaches: Lagrangian and Eulerian
5.3 Description of flow patterns: streamlines, streak lines, path lines, stream tube
5.4 Types of fluid flow: uniform and non-uniform, steady and unsteady, one dimensional, two and three dimensional, laminar and turbulent
5.5 Conservation principle of mass and continuity equation of Cartesian and polar co-ordinates
5.6 Flow through stream tube, discharges and mean velocity of flow

6. Fluid-Dynamics **(4 hrs)**

6.1 Introduction
6.2 Various of forces acting on a fluid in motion (gravitational, pressure, viscous, turbulent, surface tension and compression)
6.3 Introduction to Reynolds' and Navier-Stokes' equation of motion
6.4 Development of Euler's equation of motion and its application
6.5 Various forms of energies/head in fluid flow,
6.6 Bernoulli's equation: derivation, assumptions, applications and its physical meaning

7. Flow Measurements **(7 hrs)**

7.1 Flow measurement devices: Venturimeter (horizontal, inclined & vertical), Orifice meter, Nozzle meter and Pitot tube
7.2 Flow through orifices: small orifice, large orifice, partially and totally submersed orifices
7.3 Hydraulic coefficients (Cv, Cc and Cd) and their determination
7.4 Notches and weirs: definition and classification
7.5 Discharge equation for rectangular, triangular, trapezoidal and Cippoletti notches with & without approach velocity consideration, narrow crested weir, broad crested weir, sharp crested weir and ogee weir
7.6 Emptying and filling of reservoir: without inflow (rectangular/cylindrical, conical and hemispherical tank or vessel), with inflow (cylindrical /rectangular tank or vessel)

8. Momentum Analysis of Flow **(5 hrs)**

8.1 Introduction

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8.2 Derivation of impulse-momentum equation
8.3 Applications of equations to calculate forces on pipe bends enlargements and reducers
8.4 Forces exerted by jets on stationary and moving vanes of different shapes (vertical, inclined and curved)
8.5 Concept of angular momentum and its applications with example

9. Flow Through Submerged Body and Boundary Layer Theory (3 hrs)

9.1 Introduction to drag and lift forces on a submerged body
9.2 Expression for drag and lift forces
9.3 Drag (pressure & friction) on flat, cylindrical and spherical shaped body, concept of aerofoil
9.4 Boundary layer theory: definition, boundary layer concept along a thin flat plate (laminar, transition, turbulent boundary layers and laminar sub layer), characteristics
9.5 Boundary layer thickness: displacement, momentum and energy thicknesses
9.6 Civil engineering applications of boundary layer concept

10. Dimensional Analysis (2 hrs)

10.1 Introduction to dimensional analysis (physical quantity and their dimensions)
10.2 Methods of dimensional analysis: Rayleigh's method and Buckingham's π-theorem
10.3 Applications of dimensional analysis

Laboratories:

1. Newton's law of viscosity
2. Hydrostatic force on a submerged body
3. Stability of a floating body
4. Verification of Bernoulli's theorem
5. Impact of flow jet
6. Flow through edged orifice
7. Flow over broad-crested weir

Text Books:

1. Modi, P.N. and Seth, S. M. *Fluid Mechanics and Hydraulics*
2. Rajput, R. K. *Fluid Mechanics and Hydraulic Machines*

References:

1. Bansal, R. K. *A Text book of Fluid Mechanics*
2. Jain, A.K. *Fluid Mechanics and Hydraulics*
3. Jagdish Lal. *Fluid Mechanics and Hydraulics*
4. Webster. *Fluid Mechanics*
5. Dixit, A. *Water science*
6. Garde, R. J. *Fluid Mechanics*

CNS.

MEC 288.3 Strength of Materials (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 provide basic concept of force, stress, strain and basic properties of materials under stress. The course will also give concept of thin walled vessels and columns. Student will be able to use software and compare the results.

Course Contents:

1. **Introduction** **(1 hrs)**
   - 1.1 Types of loads – Static, Dynamic; Self weight, Imposed; Temperature
   - 1.2 Types of supports and their symbolic representation
   - 1.3 Reactions

2. **Geometrical Properties of Plane Areas** **(6 hrs)**
   - 2.1 Centroids of areas
   - 2.2 Centroids of composite and built - up steel section
   - 2.3 Moment of inertia, Polar moment of inertia, Product of inertia, Radius of gyration
   - 2.4 Parallel axis theorem
   - 2.5 Moment of inertia of composite and built - up steel section
   - 2.6 Transformation equations for Moment of inertias and product of inertia
   - 2.7 Principal axes and principal moments of inertia
   - 2.8 Use of Mohr's Circle for transformation of moment of inertias and to find Principal MOI

3. **Stress and Strain Analysis** **(8 hrs)**
   - 3.1 Axial loading, normal stress, normal strain and Hooke's law
   - 3.2 Transverse loading, shear stress, shear strains and their relationship
   - 3.3 Poisson's ratio, volumetric strain, bulk modulus and Generalized Hook's law
   - 3.4 Stress under general loading condition and components of stress
   - 3.5 Elastic and elasto-plastic behavior in axial loading
   - 3.6 Ultimate stress. Allowable stress and factor of safety
   - 3.7 Deformation of axially loaded bars (uniform, varying cross section and composite)
   - 3.8 Problems involving temperature effect
   - 3.9 Relation between the elastic constants
   - 3.10 Statically indeterminate axially loaded members (elementary)
   - 3.11 Stress tensor.

4. **Analysis of Beams And Frames** **(5 hrs)**
   - 4.1 Static indeterminacy (external and internal) (introduction)

4.2 Axial force, Shear force and Bending moments in structural members and their sign conventions.
4.3 Superposition of axial force, shearing force and bending moment
4.4 Determination of internal forces in statically determinate beams and rigid jointed plane frames
4.5 Maximum shearing force and bending moment and their position
4.6 Macaulay's method
4.7 Plotting axial force, shear force and bending moment diagrams for plane frames
4.8 Use of structural analysis software for analysis of structure

5. Transformation Of Stress And Strain **(5 hrs)**

5.1 Introduction
5.2 Equations for transformation of plane stress
5.3 Principal stresses, Maximum shear stress and their planes
5.4 Equations for transformation of plane strain
5.5 Principal strains, Maximum shear strain and their planes
5.6 Mohr circle of stresses and strains

6. Theory Of Flexure **(6 hrs)**

6.1 Beams of uniform and symmetric cross-section in pure bending
6.2 Normal and shearing stress due to bending
6.3 Analysis of composite beams
6.4 Problems based bending and shear stress
6.5 Calculation of deflection in uniform and symmetric beams in bending in simple cases.

7. Torsion **(4 hrs)**

7.1 Introduction
7.2 Calculation of torsional moment in element by the method of section
7.3 Analysis of torsional stress in solid circular section and their deformations (Torsional equation)
7.4 Shear stress distributions in hollow circular section
7.5 Power transmitted by shaft
7.6 Elastic and plastic torsion (Introduction only)

8. Thin Walled Structures **(3 hrs)**

8.1 Definition and characteristics of thin-wall vessels and shell structures
8.2 Types of stresses in thin-walled vessels
8.3 Calculation of stresses and strains in thin-walled spherical and cylindrical vessels

9. Buckling And Stability in columns **(3 hrs)**

9.1 Buckling and stability in columns
9.2 Euler's formula for columns with different end restraints
9.3 Generalized Euler's formula and drawback of Euler's theory
9.4 Concept of effective length and slenderness ratio
9.5 Rankine's formula

10. Springs **(4 hrs)**

10.1 Types of Springs

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10.2 Close coiled, open coiled springs and laminated springs
10.3 Numerical based on springs
10.4 Impact loading and stress. (introduction)

Laboratories:

1. ~~Newton's law of viscosity~~
2. Material properties in uneasily structures (a) tension test (b) bending test.
3. Torsion test to determine modulus of rigidity.
4. Graphical method (Mohr's circle) of determining principal stresses and strains (Maximum shear stress).
5. Column behaviuor

Text Books:

1. Rajput, R.K. (2006). *Strength of Materials*, S. Chand & Company Ltd
2. Gere and Timosenko. *Mechanics of Materials*
3. Ramamurtham, S. *Strength of Materials*

References:

1. Timoshenko & Young. *Elements of Strength of materials*. East West Press Pvt. Ltd.
2. Ryder. G. H. *Stregth of Materials*. McMillan ELBS
3. Popov, E.P. *Mechanics of Materials*. Prentice Hall of India

GEO 262.3 Engineering Geology (3-1-2)

Evaluation:

	Theory	Practical	Field Work	Total
Sessional	20	15	15	50
Final	50	-	-	50
Total	70	15	15	100

Course Objectives:

This course has been designed to provide basic knowledge of geology to the students of civil engineering. It would be helpful for them to understand how to identify the different types of rocks, minerals, geological structures, geological processes and their impacts on engineering structures. The students will also be able to analyze and use of geological and engineering geological maps. After completing this course the students will know basic information on hydro-geology, geological setting of Himalaya, and geological structures for development of different infrastructures.

Course Contents:

1. **Introduction to Engineering Geology** **(2 hrs)**
   - 1.1 Definition of geology and branches of geology
   - 1.2 Introduction of engineering geology (definition according to IAEG)
   - 1.3 Scope and objective of engineering geology in the field of civil engineering
   - 1.4 Importance of engineering geology in the context of Nepal

2. **Structure of the Earth** **(2 hrs)**
   - 2.1 Internal structure of the Earth
   - 2.2 Plate tectonics and mountain building process
   - 2.3 Origin of Himalaya
   - 2.4 Geomorphology of Nepal Himalaya

3. **Mineralogy** **(4 hrs)**
   - 3.1 Introduction of minerals and crystal
   - 3.2 Crystallographic axes and angle, crystal system
   - 3.3 Physical properties of minerals
   - 3.4 Rock forming minerals and their engineering significance

4. **Petrology** **(6 hrs)**
   - 4.1 Petrographic classification of rocks and rock cycle
   - 4.2 Introduction, Classification, Structures, textures, uses and engineering significance of igneous rock, sedimentary rock and metamorphic rock
   - 4.3 Identification criteria of sedimentary, metamorphic and igneous rock in the field.

5. **Structural geology** **(8 hrs)**
   - 5.1 Primary and secondary structures
   - 5.2 Penecontemporaneous structures
   - 5.3 Introduction to rock deformation reasons and its effect

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5.4 Attitude of geological structures (Dip, Strike, Plunge, Trend)
5.5 Study of folds faults, joint and unconformity
5.6 Identification criteria of geological structures in the field
5.7 Study of rock mass classification system
5.8 Introduction of bore hole and bore hole problems.

6. Rock slope engineering and earth processes **(8 hrs)**

6.1 Introduction to different geological agent: running water, ground water, glacial , wind and sea water
6.2 Various landforms produced by gelogical agents
6.3 Study of earth processes (Weathering, erosion, subsidence, expansive soil, mass wasting, volcanism Earthquake and glaciation) and the effect on development of surfaces of the earth
6.4 Geological Indicators of impending disasters
6.5 Stereographic projection
6.6 Kinematic analysis of discontinuities and the slope

7. Hydrogeology **(2 hrs)**

7.1 River channel morphology
7.2 Gound water movement and its origin
7.3 Introduction to aquifer
7.4 Springs.Engineering
7.5 Significance of subsurface water movement

8. Site Investigation **(6 hrs)**

8.1 Elements of an investigation
8.2 Type of site investigation (Direct and Indirect Methods)
8.3 Study of topographic, geological and engineering geological maps
8.4 Geological investigation for dam, reservoir, road, building, bridges and tunnel

9. Geology of Nepal **(3 hrs)**

9.1 Geological division of Nepal
9.2 Engineering geological problem of each geological division of Nepal
9.3 Major rock type, Soil type, construction material and geological structure found in different geological division of Nepal

10. Study of reserve estimation of construction material **(4 hrs)**

10.1 Types of reserves
10.2 Introduction to methods of estimation of reserve (cross section, isopath, extended area and block method)
10.3 Basic information of different quarry sites of limestones and Iron in Nepal

Laboratories:

1. Identification of minerals
2. Identification of rocks
3. Study of topographic maps, geological maps,
4. Engineering geological mapping for road and landslide
5. Study of Arial Photographs and Image Satellite.
6. Study of borehole problems
7. Plotting of stereo-net

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Field Visit:

Three days field trip for geological survey and study.

Text Books:

1. Singh, P. (2004). *A Text Book of Engineering & General Geology*, Delhi: S.K. Kataria & Sons.
2. Sharma C.K. *Geology of Nepal*. Educational Enterprises.

References:

1. Banger, K.M. *Principles of Engineering Geology*. Standard Publisher Distributors.
2. Dahal, R.K. (2006). *Geology for technical students*. Bhrikuti Academic Publications.
3. Upreti, B.N. *Geology of Nepal Himalaya* (Unpublished).
4. Ander. *Principles of Physical Geology*, New York: John Wiley and Sons.
5. Billings, M.P. *Structural Geology*, New Delhi: Prentice Hall of India Private Limited

Project I (0-0-2)

Evaluation:

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

Course Objectives:

Project I is a compulsory course intended to enable the students to be familiar, distinguish and write the general and technical reports and proposals. During the course of study, student should select a course topic in any field of Civil Engineering. Certain guidelines will be provided by the course coordinator at the start of the semester. Individual study topic shall be assigned to the student. At the end of the semester, student shall submit a hard copy report. Besides this, course will also develop the skills of oral presentation; make them able to prepare seminar papers, workshop papers and poster designing. The major objectives of this course are:

1) To enable the student for identifying problems in some field of Civil Engineering
2) To promote students for collecting some sort of relevant data and prepare proposal for addressing the issue
3) To impart skill for writing a proposal on the identified problem after the preliminary study
4) To develop the skills of oral presentation; make them able to prepare seminar papers, workshop papers and poster designing

Course Coverage

1. **Identifying the problem in the field of civil Engineering**

2. **Writing Proposal**
   - 2.1 Introduction
   - 2.2 Parts of the proposal
     - 2.2.1 Title page
     - 2.2.2 Abstract/Summary
     - 2.2.3 Statement of Problem
     - 2.2.4 Objectives
     - 2.2.5 Procedure/Methodology
     - 2.2.6 Conclusion

3. **Report Writing**
   - 3.1 Informal Reports : Memo writing
   - 3.2 Project Report
     - 3.2.1 Introduction
     - 3.2.2 detail contents
     - 3.2.3 conclusion
   - 3.3 Formal report
     - 3.3.1 executive summary
     - 3.3.2 Introduction
     - 3.3.3 Main body
     - 3.3.4 Conclusion and recommendation

3.3.5 Annexes

4. **Presentation Skills**
5. **Seminar Paper Presentation**
6. **Engineering Poster Design**
7. **Workshop paper Training**

Evaluation:

Individual presentation of submitted report is the final evaluation of the course. Evaluation scheme is as below:

- 50 marks is assigned by the course coordinator for overall study period and hard copy report.
- 50 marks is assigned for the presentation of the report.

References:

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

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'smethod
5.5 Runge-Kuttamethods
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 relevantexamples.

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 Publidhing 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: TataMcGraw 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.

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 ofpresentation 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 **(4hrs)**

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 ofdata: stem- and-leaf displays
1.6 Frequencydistribution
1.7 Diagrammatic and graphical presentation of data: Pareto diagram
1.8 Pie-diagram, histogram, frequency curve and frequency polygon
1.9 Cumulativefrequency curve or ogive curve

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

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 ofcontinuous random variables

4.6 Continuous probability distribution: rectangular distribution, exponentialdistribution, 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 (7hrs)

7.1 Null and alternative hypothesis, level of significance, type I and type II error, critical value, P-value, one and two tailed test, 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.

Reference Books:

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.

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 **(2hrs)**

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 **(6hrs)**

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 **(3hrs)**

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 **(5hrs)**

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

6. Influence Line Diagrams for Simple Structures **(9hrs)**

6.1 Moving loads and influence lines

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)

7. Statically Determinate Arches **(5hrs)**

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

8. 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

9. 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.

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.

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, electronic components, equipment and their use. Moreover, it provides fundamental skills on applications of electronic devices, communication system,digital systems and their applications.

Course contents:

1. Semiconductor Diode **(6hrs)**

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 breakdown:zener breakdown and avalanche breakdown
1.8 DC regulated power supply , half wave and full wave rectifier (center tap and bridge) and 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 **(5hrs)**

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 anddifferentiator
3.6 Positive feedback and Barkhausen criteria for oscillations

4. Digital Electronics **(5hrs)**

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 **(4hrs)**

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.

Reference Books:

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.

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 pipe flow as well as in open channel, which aims to impart the concept of water resources engineering and their application in the field of civil engineering.

Course Contents:

1. Flow through Pipes (7 hrs)

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

4. Introduction to Open Channel Flow (2 hrs)

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.

5. Uniform Flow (6 hrs)

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.

6. Energy and Momentum Principles in Open channel flow (4 hrs)

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) **(6 hrs)**

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 and adverse) and Characteristics of flow profiles in prismatic channels.
7.4 Computation of GVF in prismatic channels by graphical integration, direct step and standard step methods.

8. Hydraulic jump and its Analysis **(4 hrs)**

8.1 Characteristics of Rapidly Varied Flow (RVF).
8.2 Hydraulic jump and its uses as an energy dissipater: jumps in a horizontal rectangular channel, jump variables (conjugate depth, height of jump, length of 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 **(2 hrs)**

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 **(3 hrs)**

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 and 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 (channel 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.

Text 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.

Reference Books:

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 Hill 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.*

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.

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)
- measurestream 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. **PhysicalHydrology** **(6 hrs)**
   - 2.1 Causes, forms and types of precipitation
   - 2.2 Measurement of rainfall (typesand adequacy ofrain 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 IsohyetalMethods)
   - 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** **(5hrs)**
   - 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 landuse)
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 **(6hrs)**

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 topographicalmap 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 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.

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 andtheir determination forcoarse 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

6. **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

7. 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 anisotropiccondition

8. Vertical Stresses below applied load **(5 hrs)**

8.1 Concept of stress distribution on soil
8.2 Boussinesq's and Westergaard'stheory
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.

9. 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 hrs)**

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 hrs)**

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

Practical:

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 Engineering (Geotechnical Engineering Series)*. CBS Publishers and Distributors Pvt. Ltd.
2. Ranjan,Gopal&Rao,A.S.R. (2000).*Basic and Applied Soil Mechanics*. New Delhi: New Age International Publishers.

References:

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

Structural AnalysisII (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** **(2hrs)**
   - 1.1 Types of indeterminate structures
   - 1.2 Static and Kinematic Indeterminacy (2D and 3D structures)

2. **Consistent Deformation Method** **(7hrs)**
   - 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** **(5hrs)**
   - 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** **(3hrs)**
   - 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** **(4hrs)**
   - 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 Applicationto simple statically indeterminate beams and frames

8. Matrix Method of Analysis **(9hrs)**

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 Stiffnessmatrix method for beams and frames
8.7 Energy principle and its application to simple structures

9. Direct-stiffness method **(4hrs)**

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:

1. Analysis of indeterminate plane frame
2. Analysis of two-hinged arches
3. Computer-simulation for analysis of indeterminate trusses
4. Computer-simulation for analysis of indeterminate beams and 3D-frames
5. 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 Books:

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

References:

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

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.

Reference Books:

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 VidarthiGrihaPrakashan.

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

6. 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 using 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.

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%).

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 coverage

1. **Theoritical Background** **(5 hrs)**
   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** **(10 hrs. in the field)**
   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*

Irrigation Engineering (3-2-0)

Evaluation:

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

Course Objectives:

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

- design surface and groundwater irrigation systems
- operate and manage irrigation systems
- design infrastructure needs for acquisition, conveyance, distribution and control for regulated flow of water from the source to the farmers' fields
- design removal of excess water to maintain condition for crop production

Course Contents:

1. Introduction **(2 hrs)**

1.1 Definition of irrigation
1.2 Classification/types of irrigation systems
1.3 Functions and advantages of irrigation
1.4 Irrigation development in Nepal

2. Soil Moisture and Crop Relation **(4 hrs)**

2.1 Climate-soil-water-crop (CSWC) relationship
2.2 Soil moisture regimes; Crop water requirements
2.3 Factors affecting crop water requirements
2.4 Base period, Kor period, duty, delta and their relationships
2.5 Command area of irrigation system- GCA, CCA and NCA
2.6 Principal crops, their seasons and water requirements

3. **Methods of Irrigation** **(3 hrs)**

3.1 Different methods of irrigation
3.2 Hydraulics of irrigation distribution
3.3 Efficiency and suitability of different irrigation methods

4. **Canal Design** **(8 hrs)**

4.1 Components of surface gravity irrigation systems
4.2 Classification of canals
4.3 Types of permanent and inundation canals
4.4 Components of canal cross-section - side slope, berm, free board, banks, service roads, spoil banks
4.5 Alignment of canals
4.6 Canal seepage and evaporation and other losses
4.7 Use of Manning's equation in canal design

4.8 Tractive force approach in canal design
4.9 Silt theories- Kennedy's silt and Lacey's regime theories
4.10 Design of canals in alluvial formation
4.11 Options of canal lining
4.12 Advantages and economics of canal lining
4.13 Design of lined canals
4.14 Specific design considerations for canals in hill irrigation systems

5. Hydraulic Structures in Surface Gravity Irrigation System **(13 hrs)**

5.1 Headworks- types, functions and components, silt excluder, silt extractor
5.2 Conditions and causes of failure of hydraulic structures in alluvial formation
5.3 Bligh's, Lanes and Khosla's seepage theory
5.4 Cross drainage structures, conditions for their applications and designs
5.5 Canal Escapes
5.6 Types of canal drops and their design considerations
5.7 Functions of head and cross-regulators
5.8 Design considerations for head regulator
5.9 Types of canal outlets and their design considerations
5.10 Design of pipe outlets

6. Hill Irrigation **(3 hrs)**

6.1 Specific design considerations in hill irrigation
6.2 Choices of intake, control and regulation structures
6.3 Environmental protection measures in hill irrigation

7. River Control and Drainage **(4 hrs)**

7.1 Effect of water logging and their control
7.2 Considerations in the design of surface and sub-surface drainage systems
7.3 Objectives of river training
7.4 Types of river training works and their necessities
7.5 Design considerations of marginal banks, guide banks and spurs

8. Planning and Design of Groundwater Irrigation Schemes **(6 hrs)**

8.1 Exploration and development of groundwater
8.2 Types of wells- shallow and deep
8.3 Components of tube-wells
8.4 Design considerations of shallow and deep wells
8.5 Types and selection of pumps
8.6 Conveyance and distribution systems in groundwater irrigation schemes
8.7 Design of underground pipeline system
8.8 Conjunctive use of surface and groundwater

9. Planning and Management of Irrigation System **(2 hrs)**

9.1 Operation and management needs of surface and groundwater irrigation schemes
9.2 Canal operation plans
9.3 Participatory management

Tutorials:

1. Water requirement (crop and irrigation) and irrigation scheduling.
2. Design of lined canals and canal cross-section in alluvial formation.
3. Design of guide bund and marginal embankment.
4. Design of hydraulic structures based on Bligh's and Khosla's theory.
5. Design of cross and head regulators, aqueduct and canal drops.
6. Design of sub-surface drainage system and underground pipe line conveyance in tube wells.

Field Trip: A one-day field trip to an irrigation project in Nepal. Students need to submit individual report based on field trip.

Text Books:

1. Varshney, R.S., Gupta S.C. and Gupta R.L. *Theory and Design of Irrigation Structures(Vol. I and II).* Roorkee:Nem Chand and Brothers.
2. Garg, S.K. *Irrigation Engineering and Hydraulic Structures.* New Delhi:Khanna Publishers.
3. Arora, R.K.*Irrigation Water Power and Water Resources Engineering.* New Delhi:Standard Publication.

References:

1. WECS (1998).*Design Guidelines for Surface Irrigation in Terai and Hills of Nepal, (Vol. I and II).*
2. DoI(1990).*Design Manuals for Irrigation Projects in Nepal(Vol. I to XIII).* Planning and Design Strengthening Project, UNDP-NEP/85/013-World Bank: Sir M MacDonald and Partner Ltd.
3. Michael, A.M.(2011).*Irrigation Theory and Practice.* New Delhi: Vikash Publishing House.
4. FAO (1977). *Guidelines for Predicting Crop Water Requirements.* FAO Irrigation and Drainage Paper No. 24.

Foundation Engineering (3-2-1)

Evaluation:

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

Course Objectives:

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

- conduct site investigation for design of foundation
- calculate bearing capacity of soil
- select type of foundation for construction and design ofdeep foundations
- calculate earth pressure and design retaining wall and sheet piles
- design foundation soil improvement
- calculate pressure under mat foundation
- design pile and well foundation

Course Contents:

1. **Introduction** **(1 hr)**
   - 1.1 Purpose, importance and types of foundation
   - 1.2 Factors affecting choice of foundation

2. **Site Investigation** **(6 hrs)**
   - 2.1 Objectives and methodsof soil exploration
   - 2.2 Soil sampling, types of sample, soil samplers and its basic requirementsfor cohesive soil
   - 2.3 Planning of exploration, number of bore holes, depth of exploration
   - 2.4 Field penetration tests and their suitability
     - 2.4.1 Standard Penetration Test (SPT)
     - 2.4.2 Static Cone Penetration Test (SCPT)
     - 2.4.3 Dynamic Cone Penetration Test (DCPT)
   - 2.5 Methods of boring
   - 2.6 Groundwater observation
   - 2.7 Bore hole logs
   - 2.8 Site investigation report

3. **Lateral Earth Pressure Theories** **(7 hrs)**
   - 3.1 Definition and types of earth pressures
   - 3.2 Rankine's earth pressure theory for active and passive states
   - 3.3 Coulomb's earth pressure theory and its graphical solution
   - 3.4 Culmann's graphical construction of earth pressure
   - 3.5 Trial wedge method for earth pressure

4. **Earth Retaining Structure and Coffer Dam** **(5 hrs)**
   - 4.1 Flexible retaining structures
     - 4.1.1 Sheet pile wall and its classification

4.1.2 Analysis of sheet pile wall (cantilever sheet pile wall and anchored sheet pile wall)

4.1.3 Introduction to gabion wall

4.2 Types and proportioning of earth retaining structures

4.3 Stability analysis of earth retaining structures

4.4 Coffer dam

5. Arching in Soil and Braced Cuts **(3 hrs)**

5.1 Theory of arching in soils and its practical applications

5.2 Bracing for open cuts

5.3 Earth pressure against bracing in cuts

5.4 Strut loads

6. Bearing Capacity and Settlement of Shallow Foundation **(6 hrs)**

6.1 Introduction

6.2 Modes of soil failure

6.3 Terzaghi'stheory and its extension (Mayerhof, Handson and Vesic theory)

6.4 Effect of water table

6.5 Paukar and Bells theory of failure

6.6 Rankine's classical earth pressure theory

6.7 Use of various charts/formulae to find bearing capacity using N-value

6.8 Bearing capacity from in-situ tests (Plate Load Test).

6.9 Settlement and its type

6.10 Proportioning of spread footing for equal settlement

6.11 UBC on layered soil

6.11.1 Foundation on layered sand (dense sand over loose sand)

6.11.2 Foundation on dense sand overlying soft clay

7. Mat Foundations **(3 hrs)**

7.1 Introduction and types

7.2 Bearing capacity and settlement

7.3 Compensated foundation (Floating Foundation)

7.4 Conventional methods of analysis

8. Pile Foundations **(6 hrs)**

8.1 Introduction, classification and uses

8.2 Selection of pile type

8.3 Determination of pileload capacity

8.3.1 Static approach

8.3.2 Dynamic approach

8.4 Pile capacity by in-situ test

8.5 Pile load test (Progressive Loading)

8.6 Group action of piles

8.7 Efficiency of pile group

8.8 Negative skin friction

8.9 Construction of piles

9. Well Foundation **(4 hrs)**

9.1 Introduction, types and shapes
9.2 Components of well foundation
9.3 Depth of well foundation
9.4 Forces acting on well foundation
9.5 Construction and sinking of well
9.6 Lateral stability

10. Foundation Soil Improvements **(3 hrs)**

10.1 Introduction
10.2 Mechanical compaction
10.3 Preloading
10.4 Sand compaction piles and stone columns
10.5 Soil stabilization by the use of admixtures
10.6 Soil stabilization by injection of suitable grouts

11. Machine Foundation **(1 hr)**

11.1 Introduction
11.2 Types of machine foundation

Practical

1. Unconfined compression test
2. Triaxial tests
3. Standard penetration test
4. Dynamic cone penetration test

Text Books:

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

References:

1. Terzaghi, Karl and Peck, R.B. John Wiley. (1967).*Soil Mechanics in Engineering Practice*, New York.
2. Das Braja M.*Principles of Geotechnical Engineering*. California State University Sacramento: Thomson/Brookdcole Publication.
3. Punmia B.C, Jain A.K. and Jain Arun K. (2005).*Soil Mechanics and Foundation engineering*, India: Laxmi Publication Pvt. Ltd.
4. Arora K.R. (1997).*Soil Mechanics and Foundation Engineering*, India: Standard Publisher Distribution.
5. Bowels Joseph E. (1997).*Foundation analysis and Design*. McGraw-Hill International Edition.
6. PoulsH.G. and Davis E.H.*Pile Foundation Analysis and Design*. John Wiley and sons.
7. Venkatramaiah C. *Geotechnical Engineering*. India: New Age International (P) Limited Publisher.

Concrete Technology and Masonry Structures (3-1-2)

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:

- inspect and supervise concreting works
- carry-out mix-design of concrete
- test various properties of fresh and hardened concrete
- analyze and design simple masonry structures
- conduct tests on masonry units and masonry structures

Course Contents:

Part I: Concrete Technology

1. Introduction **(3 hrs)**

1.1 Use of concrete in structure
1.2 Constituents of concrete
  1.2.1 Coarse and fine aggregate
  1.2.2 Cement
  1.2.3 Water
  1.2.4 Admixtures

2. Properties of Fresh Concrete **(6 hrs)**

2.1 Hydration of cement
2.2 W/C ratio
2.3 Mixing, handling, placing, compaction and curing of concrete
2.4 Workability and its tests (slump test, compaction factor test and flow test)
2.5 Segregation and bleeding
2.6 Types and functions of admixtures
2.7 Concreting in extreme temperatures
2.8 Quality control at site

3. Properties of Hardened Concrete **(5 hrs)**

3.1 Deformation of hardened concrete, moduli of elasticity
3.2 Creep, shrinkage and thermal expansion
3.3 Fatigue, impact and cyclic loading
3.4 Effect of porosity, water-cement ratio and aggregate size
3.5 Durability of concrete

4. Introduction to Special Types of Concretes **(3 hrs)**

4.1 Light weight concrete
4.2 Aerated concrete
4.3 No-fines concrete
4.4 High density concrete
4.5 Fibre reinforced concrete

4.6 Self compacting concrete
4.7 Shotcrete

5. Mix Design of Concrete **(5 hrs)**

5.1 Introduction to nominal mix
5.2 Probabilistic concept in mix design approach
5.3 Concrete mix design as perDOE and ISmethod

6. Testing of Concrete and Quality Control **(3 hrs)**

6.1 Various strength of concrete: Tensile, Compressive, Shear and Bond
6.2 Compressive, tensileand bond strength tests
6.3 Non-destructive tests
6.4 Variability of concrete strength and acceptance criteria
6.5 Quality control and quality assurance

Part II: Masonry Structures

7. Introduction to Masonry Structures **(4 hrs)**

7.1 Composition of masonry and different types masonry units
7.2 Types of masonry structures
  7.2.1 Load bearing and non-load bearing masonry
  7.2.2 Reinforced and unreinforced masonry
7.3 Properties and strength of cement-mortar

8. Design of Masonry Walls for Gravity Loads **(8 hrs)**

8.1 Introduction to codal provisions (NBC109) and guidelines(NBC202)
8.2 Design for gravity loads (solid wall, wall with opening, wall with eccentric loading and wall acting as column)
8.3 Bonding elementsinmasonry: bond-stones, bands and dowels

9. Masonry Walls Under Lateral Loads **(5 hrs)**

9.1 Elements of lateral load resisting masonry system
9.2 In-plane and out-of-plane behavior of masonry walls
9.3 Failure behavior of masonry wall in lateral loads
9.4 Analysis for stresses on masonry wallsunder lateral loads
9.5 Ductile behavior of reinforced and unreinforced masonry structures

10. Testing of Masonry Elements **(3 hrs)**

10.1 Compressive strength of masonry units and masonry walls
10.2 Diagonal shear test
10.3 Non-destructive tests(Elastic wave tomography, Flat-jack and Push shear test)

Laboratories:

1. Workability test of fresh concrete.
2. Mix-design and Compressive strength test of concrete using cubes/cylinders.
3. Bond-strength test of concrete.
4. Non-destructive test of concrete.
5. Determination of strength of masonry units:blocks.
6. Determination of strength of cement mortar.
7. Determination of strength of masonry.

Text Books:

1. Shetty M. S. *Concrete Technology.* New Delhi: S. Chand and Company Ltd.
2. Arya, A.S. *Masonry and Timber Structures including Earthquake Resistant Design.* Nem Chand & Bros.

References:

1. Neville, A. M. *Properties of Concrete.*England: Pearson Education Limited.
2. Neville, A. M. & Brooks J.J. *Concrete Technology.* England: Pearson Education Ltd.
3. Dayaratnam, P. *Brick and reinforced brick structures.*
4. Hendry, A.W., Sinha, B.P. & Davies, S.R. *Design of Masonry Structure.* London: E & FN Spon.
5. DUDBC. *NBC109– Masonry: Unreinforced.*
6. DUDBC. *NBC202 – Load Bearing Masonry.*
7. BIS. *IS456:2000 – Plain and Reinforced Conctere – Code of Practice.*
8. BIS. *IS383:1970 – Specification for Coarse and Fine Aggregates from Natural Sources for Concrete.*

Design of Steel and Timber Structures (3-2-0)

Evaluation:

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

Course Objectives:

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

- design various types of joints, tension and compression members, beams and roofs of steel structures,
- design simple timber structural members.

Course Contents:

1. Introduction **(2 hrs)**

1.1 Structural behavior of steel
1.2 Advantages and disadvantages of steel structures.
1.3 Methods of design of steel structure (WSM andLSM)
1.4 Plastic method of design of steel structure

2. Analysis and Design of Joints **(5 hrs)**

2.1 Types of riveted joints
2.2 Types of welded joints
2.3 Axially and eccentrically loaded riveted joints (bracket connection)
2.4 Axially and eccentrically loaded welded joints
2.5 Codal provisions

3. Design of Tension Members (LSM) **(4 hrs)**

3.1 Net cross sectional area of tension members
3.2 Design of structural members in tension (I, angle and channel)
3.3 Design of steel ties
3.4 Design of lug angles

4. Design of Compression Members (LSM) **(6 hrs)**

4.1 Computation of permissible stress for compression members
4.2 Design of standard steel sections for compressive loads
4.3 Design of built up members
4.4 Design of lacing and battens
4.5 Design of eccentrically loaded columns
4.6 Design of column splices

5. Design of Column Bases (LSM) **(6 hrs)**

5.1 Design of base for axially loaded columns

5.2 Design of base for eccentrically loaded columns

6. Design of Steel Beam (LSM) **(8 hrs)**

6.1 Design of stiffened beams

6.2 Web crippling effect and buckling of beams

6.3 Design of unstiffened beams

6.4 Design of built up beams

6.5 Curtailment and design of rivets connecting cover plate

6.6 Design of stiffened and unstiffened connection in steel beams

7. Design of Plate Girders (LSM) **(5 hrs)**

7.1 Elements of plate girders

7.2 Design of flanges, webs and curtailment of flanges

7.3 Design of web stiffeners and load bearing stiffeners

8. Design of Roof Trusses (LSM) **(5 hrs)**

8.1 Types of roof trusses and their selection

8.2 Load calculation in roof trusses

8.3 Design of purlins

8.4 Design of bracings

9. Timber Structures **(4 hrs)**

9.1 Allowable stresses in timber

9.2 Design of solid, built-up and spaced columns

9.3 Designof timber beams

9.4 Types of joints and their detailing

9.5 Analysis and design of composite beams of steel and timber

Text Book:

1. Duggal, S.K.,Limit State *Design of Steel Structures*. Tata McGraw-Hill Education.

References:

1. Arya, Chanakya.*Design of structuralelements: concrete, steelwork, masonry and timber.*
2. Punmia, B.C. *Comprehensive Design of Steel structures*. New Delhi: Tata McGraw.
3. IS 800-2008.

Sanitary 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, student will be able to:

- describe sources of waste, their collection, conveyance, treatment and disposal system
- specify or calculate quantity and quality of waste water along with its disposal methods

Course Contents:

1. Introduction **(2 hrs)**

1.1. Definitions of common terms: sewer, sewerage, sewage/waste water, domestic sewage, industrial sewage, sanitary sewage, storm water, sullage , rubbish, garbage, refuse/solid waste

1.2. Historical development of waste water and solid waste management

1.3. Systems of sanitation

1.3.1. Conservancy system

1.3.2. Water carryingsystem

1.3.3. Merits and demerits of each system and their differentiation

1.4. Systems of sewerage:

1.4.1. Separate system,

1.4.2. Combined system and

1.4.3. Partially combined system

1.4.4. Merits and demerits of each system and their differentiation

2. Quantity of Waste Water **(3 hrs)**

2.1. Introduction to sources and types of waste water

2.2. Description of sanitary sewage, its sources, calculation of discharge of sanitary sewage, factors affecting quantity of sanitary sewage, peak flow

2.3. Description of storm water, factors affecting quantity of storm water, calculation of discharge of sanitary sewage by rational method and its limitations

2.4. Concept of time of concentration and time area graph

2.5. Numerical exercises on calculation of quantity of sanitary sewage and storm water

3. Quality of Waste Water **(5 hrs)**

3.1. Constituents of waste water

3.2. Properties of waste water

3.3. Aerobic and anaerobic decomposition

3.4. Cycles of decomposition: nitrogen cycle, carbon cycle and sulfur cycle

3.5. Biochemical oxygen demand (BOD), derivation of BOD equation, introduction to first and second stage BOD, Ultimate BOD, relative stability, population equivalent

3.6. Numerical exercises on calculation of BOD, relative stability and population equivalent

3.7. Examination of waste water

3.7.1. Sampling of waste water

3.7.1.1. Grab and composite samplers

3.7.1.2. Preservatives and storage

3.7.1.3. DO, BOD and COD sampling

3.7.2. Characteristics of waste water

3.7.2.1. Physical analysis: tests for color, odor, temperature and turbidity

3.7.2.2. Chemical analysis: tests for ammonical-nitrogen, DO, BOD, COD and chlorine

3.7.2.3. Introduction to biological analysis: membrane filter test

4. Design and Construction of Sewer (6 hrs)

4.1. Hydraulic formula for sewer design: Manning's formula, Manning's roughness coefficient, Chezy's formula, Bazin's formula, Kutter's formula, Hazen William's formula

4.2. Self cleansing velocity, minimum velocity and maximum velocity

4.3. Shapes of sewer: rectangular, horse shoe,circular and non-circular with their applications

4.4. Requirements of sewer materials, types of sewer materials: CI, concrete, PPR, PVC, DI, stainless steel, salt glazed stoneware.

4.5. Derivation of hydraulic elements of circular sewer

4.6. Derivation of proportionate variables for partial flow in circular sewer, partial flow diagrams

4.7. Stages of construction of sewer

4.8. Sewer appurtenances: manhole and its types, street inlets, catch basins, flushing devices, inverted siphon, ventilation in shaft, sewer outlets

4.9. Numerical exercises on sewer design for full flow and partial flow conditions

5. Disposal of Waste Water (4 hrs)

5.1. Objectives of sewage disposal

5.2. Natural methods of sewage disposal: dilution, land treatment

5.2.1. Dilution method: essential condition, self purification process of streams,

5.2.2. Factors affecting self purification of stream, oxygen sag curve and Streeter-Phelps equation (expressions only)

5.2.3. Land treatment method: essential conditions, merits, demerits

5.2.4. Methods of land treatment: broad irrigation, overland run-off, rapid filtration

5.2.5. Sewage sickness and preventive measures

5.3. Numerical exercises on calculation of critical DO deficit and plotting of oxygen sag curve

6. Waste Water Treatment (16 hrs)

6.1. Objectives of waste water treatment

6.2. Types of waste water treatment processes and typical layout of waste water treatment plant

6.3. Preliminary and primary treatment of waste water and their designs:
  6.3.1. screening
  6.3.2. skimming tank / flotation tank
  6.3.3. grit chamber
  6.3.4. sedimentation tank
  6.3.5. description of chemical precipitation and coagulation
6.4. Secondary treatment of waste water
  6.4.1. Sewage filtration: introduction of intermittent sand filter and contact beds, concepts, construction and design of trickling filter
  6.4.2. Activated sludge process: concept, construction and design
  6.4.3. Oxidation pond: concept, construction, design
  6.4.4. Introduction of membrane technology, GAC treatment in waste water treatment
  6.4.5. Introduction of membrane bio-reactors for waste water treatment
6.5. Numerical exercises on design of screening, skimming tank, grit chamber, sedimentation tank, trickling filter, activated sludge process and oxidation pond(till dimension calculation)

7. Treatment of Sludge and Disposal **(5 hrs)**

7.1. Sources of sludge and necessity of sludge treatment
7.2. Aerobic and anaerobic digestion process
7.3. Methods of sludge treatment
  7.3.1. Thickening: concept of volume moisture content relationship
  7.3.2. Dewatering: types and process
  7.3.3. Digestion: types, design processes
  7.3.4. Other methods: drying andcomposting
7.4. Methods of sludge disposal
  7.4.1. Sludge drying bed
  7.4.2. Lagooning
  7.4.3. Land filling
  7.4.4. Incineration
7.5. Numerical exercises on volume moisture content relationship, design of sludge digester

8. Disposal of Waste Water in Unsewered Area **(2 hrs)**

8.1. Brief description of pit privy, ventilated improved pit latrine (types and design), pour-flush latrine, compost latrine
8.2. Concept, construction, maintenance, working and design of septic tank
8.3. Disposal of septic tank effluent: soak pit (design), drain field, evapo-transpiration mound,
8.4. Leaching cesspool
8.5. Numerical exercises on design of VIP latrine, septic tank and soak pit

9. Disposal of Solid Waste **(2 hrs)**

9.1. Types and characteristics of solid waste
9.2. Composition of solid waste

9.3. Methods of solid waste collection
9.4. Disposal of solid waste by dumping, incineration, composting and sanitary landfill

Field Visit

One local field visit at components of waste water treatment system and landfill.

Tutorials:

Minimum 6 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 waste water sample.
2. Determination of chlorine in waste water sample by Starch Iodide method.
3. Determination of dissolved oxygen of waste water sample from Winkler's Method and BOD test.

Text Book:

1. Punmia, B. C., Jain, Ashok & Jain,Arun.Environmental Engineering - II: Waste Water *Engineering*. New Delhi: Laxmi Publications.

Reference:

1. Modi, P. N. *Environmental Engineering, Volume II: Waste Water Treatment, Disposal and Air Pollution Engineering*. Delhi: Standard Book House.
2. Garg,S. K. *Environmental Engineering (Vol. II): Waste water Engineering*.Delhi:Khanna Publishers.

Design of Reinforced Cement Concrete Structures (3-2-1)

Evaluation:

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

Course Objective:

The main objectives of this course are to make students able to:

- design simple reinforced cement concrete structures,
- use limit state method of design for beam, slab, staircase, columns, footings and
- perform detailing of various RCC structures.

Course Contents:

1. **Introduction** **(2 hrs)**
   - 1.1 Limitation of plain concrete
   - 1.2 Properties of reinforcement and concrete
   - 1.3 Analysis of forces and stresses in reinforced concrete structure

2. **Design Methods** **(5 hrs)**
   - 2.1 Working stress method for design of RCC structures
   - 2.2 Ultimate load method for design of RCC structures
   - 2.3 Limit state method for design of RCC structures
   - 2.4 Types of Limit state methods
   - 2.5 Characteristic loads and strength of materials
   - 2.6 Partial safety factors and their considerations in structural design

3. **Limit State Design for Beams and Slabs** **(15 hrs)**
   - 3.1 General design considerations
   - 3.2 Analysis of singly and doubly reinforced rectangular beam section
   - 3.3 Analysis of singly reinforced flanged beam section
   - 3.4 Strength and serviceability requirements for flexure members
   - 3.5 Design and detailing of simply supported and continuous beam (for flexure, shear and torsion)
   - 3.6 Design and detailing of slabs spanning in one or both directions

4. **Limit State Design for Columns and Footings** **(12 hrs)**
   - 4.1 General design considerations
   - 4.2 Design and detailing of short/slender rectangular & square columns
   - 4.3 Design and detailing of circular column (with circular/helical tie)
   - 4.4 Design and detailing of axially and eccentrically loaded isolated footing
   - 4.5 Design and detailing of combined footing
   - 4.6 Design and detailing of raft (mat) footing

5. **Design and Detailing of Miscellaneous Structures** **(11 hrs)**
   - 5.1 Design and detailing of dog legged and open well staircase
   - 5.2 Design concepts and detailing of underground water tank and overhead tank
   - 5.3 Design concepts and detailing of domes, folded plates and Intze tank

Laboratories:

1. Pure bending failure of a beam and its load-deformation characteristics
2. Shear failure of a beam and its load-deformation characteristics
3. Combined bending and shear failure of a beam and its load-deformation characteristics
4. Lap-splice failure of longitudinal bar in beam

Text Books:

1. Jain, A.K. *Reinforced Concrete: Limit State Design*. Roorkee: Nem Chand and Co.
2. Jai, Krishna and Jain, O. P. *Design of R.C.C. Structure*.

References:

1. Dayaratnam, P. *Design of Reinforced Concrete Structures.* New Delhi: Oxford & IBH Publishing Co.
2. Sinha, S.N. *Reinforced Concrete Design*. India: Prentice Hall Private Limited.
3. Rao, K. L. *Design of R.C.C. Structures.*
4. Varghese, P.C. *Limit State Design of Reinforced Concrete Structure*s. India: Prentice Hall Pvt. Ltd.
5. Kumar, Sujeet. *Concrete Structures-I.* New Delhi: S.K. Kataria & Sons.
6. BIS. *PLAIN AND REINFORCED CONCRETE – CODE OF PRACTICE (IS456:2000).* New Delhi: Bureau of Indian Standards.
7. BIS. *Design Aids for Reinforced Concrete to IS:456-1978.* New Delhi: Bureau of Indian Standards.

Engineering Economics (3-2-0)

Evaluation:

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

Course Objective:

After completing this course, students will be able to

- understand and describe the basic concept of economics, engineering economics, cost accounting and time value of money,
- assist in the valuation of engineering projects in the public and private sector to take investment decisions,
- analyze the project risk and understand the concept of ecological limit and economic development,
- calculate depreciation, taxation and its application in analysis and
- identify different financing options and general accounting procedures.

Course Contents:

1. **Basics of Engineering Economics** **(3 hrs)**
   - 1.1. Definition of Economics, Demand, the Law of Demand, Law of Diminishing Utility, Marginal Utility, Supply, Law of Supply, Law of Supply and Demand
   - 1.2. Engineering Economics, Principles of Engineering Economy and its application

2. **Cost Concept and Fundamentals of Cost Accounting** **(3 hrs)**
   - 2.1. Cost Terminology: Manufacturing Cost and Non-Manufacturing Cost
   - 2.2. Cost for Business Decision: Differential Cost and Revenue; Opportunity Cost,Sunk Cost and Marginal Cost

3. **Time Value of Money** **(4 hrs)**
   - 3.1. Interest, Simple Interest, Compound Interest, Nominal Rate of Interest, Effective Rate of Interest
   - 3.2. Economic Equivalence: Present Worth, Future Worth and Annual Worth
   - 3.3. Development of Formulas for Equivalence Calculation

4. **Basic Methods of Engineering Economic Studies** **(7 hrs)**
   - 4.1. Minimum Attractive Rate of Return - MARR
   - 4.2. Payback Period Method – Simple and Discounted
   - 4.3. Equivalent Worth Methods; Present Worth Method, Future Worth Method and Annual Worth Method
   - 4.4. Rate of Return Methods: Internal Rate of Return (IRR) MethodandExternal/Modified Rate of Return(ERR/MIRR) Method
   - 4.5. Benefit Cost Ratio Method

5. **Comparative Analysis of Alternatives** **(6 hrs)**
   - 5.1. Comparing Mutually Exclusive Alternatives having Same useful life by Payback Period Method, Equivalent Worth Method; Rate of Return Methods and Benefit Cost Ratio Method
   - 5.2. Comparing Mutually Exclusive Alternatives having different useful lives byRepeatability Assumption, Co-terminated Assumption, Capitalized Worth Method
   - 5.3. Comparing Mutually Exclusive, Contingent and Independent Projects in Combination.

6. **Risk Analysis** **(4 hrs)**
   - 6.1. Origin/Sources of Project Risks.
   - 6.2. Methods of Describing Project Risks; Sensitivity Analysis, Breakeven Analysis, Scenario Analysis

7. **Ecological Limits and Economic Development** **(3 hrs)**
   - 7.1. Economic Theory and Ecological Limit,
   - 7.2. Concept of sustainable development,
   - 7.3. Ecological Footprint and
   - 7.4. Overcoming Ecological Limits

8. **Depreciation and Corporate Income Taxes** **(5 hrs)**
   - 8.1. Depreciation and its causes, Asset Depreciation and Accounting Depreciation
   - 8.2. Basic Methods of Depreciation; Straight line method, Declining Balance Method, Sinking Fund Method, Sum of the Year Digit Method, Unit of Production Method, Modified Accelerated Cost Recovery System (MACRS)
   - 8.3. Introduction to Corporate Income Tax. Taxation Law, Depreciation Rates Personal Tax, Corporate Tax, VAT
   - 8.4. After Tax Cash flow Estimate, General Procedure for Making After Tax Economic Analysis

9. **Enterprise Financing and Capital Investment** **(4 hrs)**
   - 9.1. Method of Financing: Equity Financing, Debt Financing and Capital Structure
   - 9.2. Cost of Capital: Cost of Equity, Cost of Debt and calculating cost of capital
   - 9.3. Project Funding Mechanism: Government budget, Public Private Partnership and Private Investment
   - 9.4. FIRR, EIRR and Return on Equity

10. **Basic Accounting Procedure** **(6 hrs)**
   - 10.1. Accounting Terminologies; Asset and liabilities: Fundamental equation of accounting
   - 10.2. Financial statements: The Balance Sheet, Income Statement and Cashflow Statements
   - 10.3. Using Ratios to make Decisions: Debt Ratio, Current Ratio, Quick Ratio – Acid Test Ratio, Inventory Turnover Ratio, Total Asset Turnover, Profit Margin on Sales, Return on Total Assets, Price Earnings Ratio and Book Value per Share

Tutorials:

Two assignments and 1 case study.

Text Book:

1. Chan S. Park. *Contemporary Engineering Economics.* PHI Learning Private Limited.

References:

1. E. Paul De Garmo, William G. Sullivan and James A. Bontadelli. *Engineering Economy.* MC Milan Publishing Company.
2. James L. Riggs, David D.Bedworth and Sabah U. Randhawa.*Engineering Economics.* Tata MCGraw Hill Education Private Limited.
3. N.N. Borish and S. Kaplan.*Economic Analysis for Engineering and Managerial Decision Making.* MC Gran Hill Publishing Company.
4. Adhikari, D.*Principle's of Engineering Economic Analysis.* Nepal: Global Publication.
5. SenGupta, Ramprasad.*Ecological Limits and Economic Development.* Oxford University Press.

Estimating and Valuation (3-2-0)

Evaluation:

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

Course Objectives:

The main objective of this course is to give the students, the knowledge of estimating, costing, valuation and specifications of civil engineering works. After completion of this course, students will be able to:

- calculate the quantities of different items of works of building structure and other civil engineering works,
- analyze the rates of various items of construction works,
- prepare valuation report of building structures,
- develop specifications of civil works, water supply and sanitary works and electrical works of building construction.

Course Contents:

1. **Introduction and Methods of Estimating** **(4 hrs)**
   - 1.1 Introduction and Importance of estimation
   - 1.2 System of Units
   - 1.3 Units of Measurement and Payments for Items of Work and Materials
   - 1.4 Requirements of Estimating
   - 1.5 Methods of Measurements of Building and Civil Engineering Works
   - 1.6 Subheads of Various Items of Work
   - 1.7 Various Methods of Taking Out Quantities : Center Line Method, Long and Short Wall Method, Crossing Method
   - 1.8 Abstracting Bills of Quantities

2. **Types of Estimates** **(4 hrs)**
   - 2.1 Approximate Estimates
   - 2.2 Detailed Estimates
   - 2.3 Revised Estimates
   - 2.4 Supplementary Estimates
   - 2.5 Annual Repair and Maintenance Estimates
   - 2.6 Extension and Improvement Estimates
   - 2.7 Complete Estimates
   - 2.8 Split up of Cost of Building Works

3. **Analysis of Rates** **(6 hrs)**
   - 3.1 Introduction
   - 3.2 Purposes of Rate Analysis
   - 3.3 Importance of Rate Analysis
   - 3.4 Cost of items,Transportation Cost, Other Expenses and Overhead, Contingency
   - 3.5 Requirements of Rate analysis
   - 3.6 Factor affecting the Rate Analysis

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

4. Detailed Estimate **(16 hrs)**

4.1 Estimate of Walls
4.2 Estimate for Single Room Building
4.3 Estimate for Two Room Building (Load Bearing structure)
4.4 Estimate of Framed structure Building
4.5 Estimate of an Aqueduct
4.6 Estimate of R. C. C. Slab Culvert
4.7 Estimate of R. C.C T-Beam Decking
4.8 Estimate of Septic Tank and Soak Pit
4.9 Mode of measurements based on codes (NBC and Indian codes)
4.10 Estimate of Earthwork by Three Methods
4.11 Estimate of Earth work of Hill road

5. Valuation **(5 hrs)**

5.1 Introduction
5.2 Purpose of Valuation
5.3 Terms Used in Valuation
5.4 Methods of Determining Value of Property
5.5 Methods of Valuation Report Writing

6. Specification **(10 hrs)**

6.1 Introduction
6.2 Necessity of Specification
6.3 Types of Specification:General and Detailed Specification
6.4 Specification writing Technique
6.5 Specification writing: Civil works, Water supply and Sanitary works and Electrical works

Tutorials:

1. Estimate for a single Room Building (Load Bearing Wall and Frame Structure)
2. Estimate for a two room building (load bearing wall and frame structure)
3. Estimate of earth work by three method.
4. Estimate of 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
10. Specification writing of civil works, Water supply and Sanitary works and Electrical works of building construction.

Text Book:

1. Chakraborti, M. (1986).*Estimating, Costing, Specification and Valuation in Civil Engineering.*

References:

1. Aggarwal, Amarjit (1985).*Civil Estimating Quantity Surveying and Valuation.* Ludhiana:Katson Publishing House.
2. Dutta, B.N. *Estimating and Costing in Civil Engineering.* Delhi: USB Publishers distributers Ltd.
3. Berger, Seymour &Godel, Jules B. (1977).*Estimating Project Management for Small Construction Firms.*New York: Van Nostrand Reinhold Publishing Company.
4. Upadhya, A.K.*Civil Estimating & Costing Valuation Engineering.*
5. Patil, B.S. *Contract and Estimation.*
6. Norms and Rate analysis of GoN
7. Standard Specification of GoN.

Hydropower Engineering (3-2-1)

Evaluation:

	Theory	Practical + Field Report	Total
Sessional:	30	20	50
Final:	50	-	50
Total:	80	20	100

Course Objective:

After completing this course the student will be able to:

- describe the hydropower development and opportunities in Nepal,
- take part in study, selection and planning of hydropower projects,
- design head-works, water-conveyance structures, spillways and energy dissipaters of hydropower plant and
- select and describe different electro-mechanical and hydro-mechanical components of hydropower plant.

Course Contents:

1. Introduction to Hydropower Development (2 hrs)

1.1 Sources of energy and importance of hydropower.

1.2 Hydropower development in Nepal: historical background, present development, challenges and opportunities.

1.3 Hydropower potential in Nepal: gross, technical and economic potential.

1.4 Introduction to some large hydropower plants in the world.

1.5 A brief introduction to government policy and major institutions related to hydropower development in Nepal: hydropower development policy, ministry of energy, WECS, electricity tariff fixation commission, DoED, Nepal electricity authority, IPPAN and NMHDA (private sector).

2. Planning and Investigation of Hydropower Projects (6 hrs)

2.1 Hydropower project planning stages: reconnaissance, pre-feasibility & feasibility studies.

2.2 Hydrological data processing: mass curve and flow duration curve (Weibull method), their characteristics and its uses in hydropower planning.

2.3 Reservoir planning and regulations: classification, site selection, need of reservoir regulation, life of reservoirs.

2.4 Environmental study policy based on type & size (IEE/EIA).

2.5 Climate change and ecology: river engineering, social costs, population displacement, change in lifestyle, global worry, clean energy alternatives

3. Power and Energy Potential Study (4 hrs)

3.1 Gross, net, operating and design head.

3.2 Plant and installed capacity.

3.3 Energy flow diagram (related to FDC), firm & secondary power and energy.

3.4 Economic consideration in HP system: marginal cost-benefit approach and introduction to optimization approach.

3.5 Estimation of power and energy potential and its demand prediction methods.

3.6 Load curve (mean and peak load), load factor, utilization and diversity factors.

3.7 Power demand variation: daily, weekly, monthly and annual variations of power.

3.8 Power grid: introduction and components of power grid system.

4. **Storage Type of Hydropower Projects** **(7 hrs)**

4.1 General layout of components in a typical storage power plant: dam body, spillway, bottom outlets or under sluices, intakes with examples.

4.2 Dams and their appurtenant works:

4.2.1 Classification based on function, material, head and mode of structural load transfer.

4.2.2 Forces acting on dams and their combination.

4.2.3 Site selection for dams and selection of type of dam.

4.2.4 Principal variant of embankment and concrete dams.

4.2.5 Failure modes of Embankment and concrete dams and their prevention measures; foundation treatment, grouting and their necessity.

4.2.6 Design of gravity (concrete) dams: general considerations, cross-sectional profiles, stability analysis (safety factor against overturning, sliding), stress and material failure (crushing), limiting height of concrete dam.

4.2.7 Design of earthen (embankment) dams: general considerations, safety against slope stability, phreatic line, seepage flow discharge, drainage.

4.3 Intakes: general arrangement and types of dam intakes, location, function, hydraulic consideration in intakes.

4.4 Gates: types and their location in dam.

4.5 Reservoir sedimentation issues and sedimentation management in brief.

5. **Run-of-River types of Hydropower Projects** **(6 hrs)**

5.1 General layout of components in a typical power plant: dam body, weir, spillway, under sluices and intakes with examples.

5.2 Different types of intakes, importance, location and types, design concept of intake structure, head loss calculation in intake structure (trash rack losses).

5.3 Performance standards of headworks: control of bed load and floating debris in intakes, himalayan intake and hydraulic design of gravel trap.

5.4 Sediment handling measures: types, location & design criteria of settling basin, its design and estimation of sediment volume.

5.5 Flushing of settling basin: flushing frequency (periodical and continuous).

6. **Water Conveyance Structures** **(6 hrs)**

6.1 Introduction to power canal, its suitability in hydropower project.

6.2 Hydraulic tunnels: definition, geometrical shape, pressure and non-pressure tunnels, rock stress, hardness coefficient of rocks, hydraulic design of tunnel (velocity and sizing), introduction to tunneling methods, supports in tunnel, tunnel lining, steps of tunneling procedure.

6.3 Forebay and surge tank: importance, location, condition of application and hydraulic design of forebay structure; different types of surge tank and hydraulic design a surge tank (height & cross sectional area).

6.4 Penstock and pressure shaft: importance, location, condition of their application, water hammer, water hammer pressure computation by RWCT & EWCT, wall thickness of penstock /pressure shaft (steel), economic diameter of penstock (optimization study in brief).

6.5 Headloss calculation in conveyance system.

7. **Spillways and Energy Dissipaters** **(5 hrs)**

7.1 Spillway: definition, purpose, types, design specifics (Ogee shape), cavitations and prevention measures.

7.2 Method of energy dissipation below the dam structure: types of energy dissipaters (ski-jump, flip bucket, stilling basin) and their necessity, natural type of energy dissipater, role of tailwater depth.

7.3 Design of stilling basin.

8. Hydro-mechanical & Electro-mechanical Equipments (5 hrs)

8.1 Hydro-mechanical installation in powerhouse:

8.1.1 Types of turbines: Pelton, Francis, Kaplan turbines and their performance characteristics, introduction to Bulb turbine.

8.1.2 Specific speed, synchronous speed and runaway speed.

8.1.3 Selection of turbines.

8.1.4 Design of Francis and Pelton turbines.

8.1.5 Scroll case, draft tube and tailrace canal and their importance.

8.2 Electro-mechanical installation:

8.2.1 Introduction to generator and their types.

8.2.2 Working principle of governors in Pelton and Francis turbines.

8.3 Pumps:

8.3.1 Introduction to centrifugal and reciprocating pumps.

9. Powerhouse Planning (2 hrs)

9.1 Classification, general arrangement and layout plan of powerhouse.

9.2 General dimension calculation of powerhouse.

10. Micro Hydropower Plant (2 hrs)

10.1 Introduction, scope and applications.

10.2 Introduction to policy of MHP development in Nepal.

10.3 Advantages and relevance of MHP in Nepal.

10.4 General Layout of basic components of MHP.

Laboratories:

1. Performance characteristics of a Pelton/Francis/Kaplan turbine.
2. Working principle and characteristics of centrifugal/reciprocating pump.

Field Observation:

One observation tour of a hydropower plant in the vicinity and each student should prepare a brief report in prescribed format on the basis of their field visit.

Text Books:

1. Dandekar, M. M. and Sharma, K. N. (2010). *Water Power Engineering*. New Delhi: Vikas Publishing House Ltd.
2. Garg, S. K. (2007). *Hydrology and Water Resources Engineering*. New Delhi: Khanna Publishers.
3. Novak, P., Moffat, A. I. B., Nalluri, C. & Narayan, R. (2007). *Hydraulic Structures*. London: Taylor & Francis.

Reference Books:

1. Baral, S. (2013). *Text book of Hydropower Engineering*. Kathmandu: Engineering and Education Services Pvt. Ltd.
2. Varshney, R. S. (2001). *Hydro Power Structures*. India: New Chand & Bros.
3. Mosonyi, E. (1965). *Water Power Development Vol.2 High Head Power Plants, Mitget Stations and Pumped Structure Schemes*. Budapest: Akademiai, Kiado Publishing House of the Hungerian Academy of Sciences.
4. Layman's (1998). *Guidebook On How To Develop A Small Hydro Site*. European Small Hydropower Association (ESHA).
5. DoED, MoWR (2006). *Design Guidelines for Headworks of Hydropower Projects*.

Transportation Engineering I (3-2-2)

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:

- understand the basic concepts on the highway planning and survey,
- design geometric elements and drainage system for highways,
- design specific highway elements for roads in hilly areas and
- select the suitable material for highway construction.

Course Contents:

1. **Introduction to Transportation Planning and Engineering** **(4 hrs)**
   - 1.1. Introduction
   - 1.2. Modes of Transportation
   - 1.3. Comparison between various Modes of Transportation
   - 1.4. Historical Development of Roads : Roman, Tresaguet, Telford, Macadam
   - 1.5. Road Construction in Nepal
   - 1.6. Transport Planning including Objectives of Road Planning
   - 1.7. Classification of Roads: Strategic Road Network, Rural/Local Road Network, Urban Road

2. **Highway Alignment and Engineering Survey** **(4 hrs)**
   - 2.1 Highway Alignment
     - 2.1.1 Introduction
     - 2.1.2 Requirements of Highway Alignment
     - 2.1.3 Factors Controlling Highway Alignment
   - 2.2 Engineering Survey and its Stages
     - 2.2.1 Route Location Process
     - 2.2.2 Engineering Survey: Map Study, Reconnaissance, Preliminary and Detailed Survey

3. **Geometric Design of Highway** **(18 hrs)**
   - 3.1 Definition and Scope of Geometric Design
   - 3.2 Introduction to Road Standards in Nepal (Strategic Roads, Local Roads and Urban Roads)
   - 3.3 Design Controls and Criteria
   - 3.4 Elements of Cross-section: Urban roads, Rural roads
   - 3.5 Elements of Horizontal Alignment
     - 3.5.1 Definition and Types of Horizontal Curve
     - 3.5.2 Design of Horizontal Curve including Night Visibility Consideration
     - 3.5.3 Sight Distance: Stopping Sight Distance, Overtaking Sight Distance, Set-back from Obstructions
     - 3.5.4 Super-elevation
     - 3.5.5 Extra-widening
     - 3.5.6 Transition Curve: Definition and types of Transition Curve, Design of Transition Curve

3.6 Elements of Vertical Alignment
- 3.6.1 Definition and Types of Gradient
- 3.6.2 Grade Compensation
- 3.6.3 Definition and Types of Vertical Curve
- 3.6.4 Design of Vertical Summit Curve
- 3.6.5 Design of Vertical Valley Curve

4. Highway Drainage **(4 hrs)**

4.1 Introduction and Importance of Highway Drainage System

4.2 Causes of Moisture Variation in Sub-grade Soil

4.3 Surface Drainage System
- 4.3.1 Different Types of Road Side Drain
- 4.3.2 Cross Drainage Structures (Culverts and others)
- 4.3.3 Different Types of Energy Dissipating Structures

4.4 Sub-surface Drainage System
- 4.4.1 Drainage of Infiltrated Water
- 4.4.2 Control of Seepage Flow
- 4.4.3 Lowering of Water Table
- 4.4.4 Control of Capillary Rise

5. Hill Road **(5 hrs)**

5.1 Introduction

5.2 Special Considerations in Hill Road Design
- 5.2.1 Alignment of Hill Road Design: General Consideration, Route Location in Hills, Gradient, Design and Types of Hair Pin Bends
- 5.2.2 Types of Cross Sections

5.3 Special Structures in Hill Road
- 5.3.1 Types of Retaining Structures
- 5.3.2 River Training Structures
- 5.3.3 Slope Stabilization Structures and Gully Control Structures
- 5.3.4 Road Safety Measures in Hill Roads: Barriers and Delineation

6. Highway Materials **(10 hrs)**

6.1 Introduction and Classification of Highway Materials

6.2 Sub-grade Soil
- 6.2.1 Characteristics of Sub-grade Soil
- 6.2.2 Desirable Properties of Sub-grade Soil
- 6.2.3 California Bearing Ratio Test

6.3 Road Aggregates
- 6.3.1 Definition and Classification of Road Aggregates
- 6.3.2 Desirable Properties of Road Aggregates
- 6.3.3 Tests on Road Aggregates and their Significance
- 6.3.4 Comparing Gradation Specification
- 6.3.5 Proportioning of the Road Aggregates

6.4 Bituminous Road Binders
- 6.4.1 Definition and Classification of Road Binders
- 6.4.2 Liquid Bitumen: Cut-back Bitumen and Bitumen Emulsion

6.5 Tests on Bituminous Binders: Penetration, Viscosity, Ductility, Softening point

6.6 Bituminous Mixes
- 6.6.1 Definition and Classification
- **6.6.2** Marshal Method of Bitumen Mix Design

Laboratories:

1. Tests on aggregates: Crushing Value and Impact Value
2. California Bearing Ratio Test
3. Tests on Bitumen: Penetration Value, Viscosity, Softening Point and Ductility
4. Asphalt Mix Design: Marshall Stability Test
5. Extraction of Bitumen from Mix

References:

1. Sharma, S.K. *Principles, Practice and Design of Highway Engineering.* New Delhi: S. Chand and Co. Publishers Ltd.
2. Khanna, S.K. & Justo, C.E.G. *Highway Engineering*. Roorkee (U.P.): Nem Chand & Bros.
3. Flaherty, C.A. *Highway Engineering.* Edward Arnold (Publishers) Ltd.
4. Kadiyali, L.R. *An Introduction to Highway Engineering.* Delhi: Khanna Publishers.
5. Relevant Publications by Department of Roads and Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR).

Construction Project Management (3-2-0)

Evaluation:

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

Course Objectives:

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

- describe the fundamental concepts of project,
- handle construction project administration and
- plan, monitor and control construction projects by choosing appropriate tools.

Course Contents:

1. Introduction **(2 hrs)**

1.1 Project and program definition
1.2 Characteristics of projects and programs
1.3 Project life cycle
1.4 Phases in construction project lifecycle

2. Project Planning, Monitoring and Control **(8 hrs)**

2.1 Introduction to planning, monitoring and control
2.2 Introduction to project planning tools –Gantt chart, milestone chart, linked bar-chart, CPM, PERT, line of balance
2.3 Use of Gantt chart and CPM network for project planning and monitoring
2.4 Resource planning and leveling by using Gantt chart
2.5 Preparing construction schedule, labor schedule, material schedule and equipment schedule by using Gantt chart
2.6 Earned value analysis (EVA)
2.7 Time-cost trade off
2.8 Introduction to cost-control and technical auditing

3. Contract Administration **(6 hrs)**

3.1 Method of work execution
3.2 Contract-definition
3.3 Types of construction contract
3.4 Tender and tender document
3.5 Tender notice
3.6 Preparation before inviting tender
3.7 Consultant's/Contractor's pre-qualification
3.8 Bid evaluation and selection of a consultant and contractor
3.9 Contract agreement
3.10 Conditions of contract (PPMO and FIDIC)
3.11 Public Procurement Act and Public Procurement Regulation
3.12 Duties and responsibilities of a site supervisor
3.13 Supervising work of a contractor
3.14 Site order books
3.15 Procedure to prepare a bill – running bills and final bill
3.16 Muster roll, Measurement books

3.17 Progress reporting

4. Construction Plant and Equipment **(8 hrs)**

4.1 Introduction to construction tools, machines, plants and equipment
4.2 Advantages of using construction equipment
4.3 Equipment for excavation, transportation and compaction
4.4 Aggregate handling equipment
4.5 Concrete batching, mixing and compacting equipment
4.6 Pile foundation construction equipment
4.7 Equipment for construction of caisson foundation
4.8 Equipment for lifting of materials and parts
4.9 Tunneling equipment
4.10 Equipment for hydraulic construction
4.11 Equipment for highway pavement construction
4.12 Criteria for selection of equipment

5. Quality Control / Assurance **(4 hrs)**

5.1 Introduction to quality control / assurance
5.2 Objectives of QC/QA
5.3 Factors affecting quality of construction
5.4 Quality control technique
5.5 Preparing QC plan, approval of material source, material sampling and testing at on-site laboratory and off-site laboratory
5.6 Quality control of works – checking, setting out, earth work, form work, reinforcement, concrete construction, masonry construction, curing
5.7 Preparing quality assurance plan (QAP)
5.8 Quality control tools – checklists for checking various activities at work site
5.9 Role of specification

6. Material Management **(3 hrs)**

6.1 Importance of material management
6.2 Classification of materials
6.3 Purchase management
6.4 Inventory management
6.5 Construction garbage
6.6 Surplus materials

7. Construction Site Preparation **(2 hrs)**

7.1 Factors affecting construction site planning
7.2 Layout of site-office, material storage, POL storage and garbage storage
7.3 Layout of fabrication yard
7.4 Fencing and barricading
7.5 Access to work place
7.6 Labor camp and resting area

8. Environmental Health and Safety at Construction Site **(4 hrs)**

8.1 Introduction to EHS at construction site
8.2 Causes of accidents in construction projects
8.3 Minimizing the construction accidents
8.4 Safety planning
8.5 PPE as a safety measure at site

8.6 Training to improve safety standard at construction site – induction, tool-box talk, skill training
8.7 Role of safety engineer and safety steward

9. Project Maintenance **(2 hrs)**

9.1 Meaning and importance of maintenance
9.2 Objective of maintenance management
9.3 Types of maintenance
9.4 Maintenance planning
9.5 Issues of project maintenance with special reference to projects/systems under operation in Nepal

10. Organization and Management **(6 hrs)**

10.1 Definition of organization and management
10.2 Principles of management
10.3 Types of organization – line organization, line and staff organization, functional organization and project organization
10.4 Leadership and motivation
10.5 Project communication
10.6 Meaning and importance of HRM
10.7 Recruitment & selection
10.8 Training
10.9 Trade union in Nepal

Assignment:

Students are required to prepare a project report related to construction project planning or administration (on group basis).

Tutorials:

1. Prepare a work schedule of a given project by using Gantt chart and CPM network.
2. Prepare a quality control procedure by using PPMO conditions of contract.
3. Use standard specification for civil works (yellow book) to prepare list of IS and BS codes that is required in quality control process.
4. Prepare a site layout plan for the construction of 100 meter long RCC bridge.
5. Prepare a quality assurance plan (QAP) for a given project.

Textbooks:

1. Chitkara, K.K. *Construction Project Management.* Tata McGraw Hill Education Limited.

References:

1. Bhattarai, D. *Construction Plant Management.* Nepal Engineering College.
2. Adhikari, Rajendra. *Construction Management.*
3. Barrie, Donald, S. and Paulson Jr., Boyd C. *Professional Construction Management.* USA: McGraw Hill Book Company.
4. Modi, P.N., Rajeev and Modi, Sanjeev. *PERT and CPM.* Delhi: Standard Book House.
5. Bhattarai, Deepak. *An Introduction to Construction Management practices in Nepal.*
6. Shrestha, Santosh K. &Adhikari, Ishwor. *A text book of Project Engineering.*
7. Panta, Khem R.*Organization Behaviour in Nepal.*

Engineering Professional Practice (2-0-0)

Evaluation:

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

Course Objectives:

The main objective of this course is to introduce the students to the professional, ethical and legal environment in engineering practice.After successful completion of this course the students are expected to be able to:

a) analyze the role of engineers in a society,
b) analyze ethical and unethical behaviors in professional practice,
c) make professional decisions by following existing regulatory and professional frameworks,
d) select appropriate dispute and conflict resolution methods, and
e) analyze professional engineering issues related to ethics, code of conduct, conflict of interest, norms and standards and to render decisions on appropriateness of steps taken and assign degree of responsibility in specific cases.

Course Contents:

1. Society and Technology (6 hrs)

1.1 Definition, types, and essential elements of a society
1.2 Factors and classical theories of social change (cyclical, evolution, functional and conflict)
1.3 Impacts and consequences of technology on socio-economic parameters (agriculture, communication, construction methods, information storage, generation and dissemination, dispute resolution, family structure, culture and livelihood)
1.4 Effects of major technological developments (2D and 3D printing, dynamite, automation, mechanization, organic chemistry, transportation, internet, communication, and satellites) on practice of engineering profession
1.5 Role of engineers in society

2. Ethics and Professionalism (3 hrs)

2.1 Moral, ethics and professionalism
2.2 Characteristics of ethical decision making
2.3 Liability of engineers in design, construction and implementation of projects
2.4 Loss of professionalism
2.5 Ethical issues in professional engineering in dealing with other professions (accounting, banking, law, journalism and management)

3. Roles of Professional Organizationsin Regulation and Professional Development (4 hrs)

3.1 Regulation of the practice of engineering profession
3.2 Objectives of NEC and its licensing provision
3.3 Codes of ethics and guidelines for professional engineering practice – the NEC code of conduct
3.4 Roles of professional organizations in induction of new entrants into the profession
3.5 Upgrading and maintaining the professional and technical competence of members of professional associations

3.6 Providing technical expertise to public authorities in developing policies, acts, standards, project implementation procedures and international agreements and negotiations
3.7 Ensuring occupational health, safety and general welfare of the public
3.8 Role of professional societies in environmental protection

4. Legal Aspects of Professional Engineering in Nepal (9 hrs)

4.1 Introduction to Nepalese legal system
4.2 Essentials of a valid contract
4.3 Void and voidable contracts
4.4 Significance of a contract
4.5 Factors to be considered in preparing a contract document
4.6 Interpretation of contractual clauses
4.7 Liability under contract, criminal law and tort
4.8 Duties and Liabilities of designers and professionals
4.9 Conditions for establishment of professional negligence (duty, breach, proximity cause and damage)
4.10 Types of business enterprises: sole, partnership, and limited company
4.11 Intellectual property right (Copy right, patent,design and trademark)

5. Conflict and Dispute Management (2 hrs)

5.1 Levels and sources of conflict
5.2 Conflict resolution methods: avoidance, diffusion, containment, confrontation, conciliation, mediation, arbitration and litigation
5.3 Dispute resolution methods: adjudication and arbitration

6. Case Studies Related to Practice of Engineering Profession (6 hrs)

6.1 Cases involving public safety, industrialization and protection of environment
6.2 Cases involving conflict of interest, personal integrity and personal privacy
6.3 Cases involving professional negligence (duty, breach, proximate cause and damage)
6.4 Cases involving breach of duty, criminal law and tort
6.5 Cases involving breach of NEC's code of conduct
6.6 Cases involving breach of Public Procurement Act and Public Procurement Regulation
6.7 Cases involving breach of intellectual property rights and copyrights
6.8 Cases involving abuse of position and authority

Textbook:

1. Whitbeck, C.*Ethics in Engineering Practice and Research*.Cambridge University Press.

References:

1. Shrestha, S. K. and Shrestha, R. K.*Engineering Professional Practice*. Heritage Publishers and Distributers Pvt. Ltd.
2. Adhikari, R. P.*Engineering Professional Practice*.Pashupati Publishing House, ISBN: 978-9937-8249-03
3. Galami, T. B.*Engineering Professional Practice*.AkshalokPrakashan, ISBN: 978-99946-779-1-7
4. Morrison, Carson and Hughes, Philip. *Professional Engineering Practice - Ethical Aspects*. Toronto: McGraw-Hill Ryerson Ltd.

Transportation Engineering II (3-2-1)

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:

- conduct traffic studies;
- design traffic control devices, road intersections, lighting systems;
- design pavement structure for highways;
- supervise the construction, maintenance and rehabilitation works of highway project;
- understand basic knowledge of the bridge and tunnel.

Course Contents:

1. Traffic Engineering **(15 hrs)**

1.1. Introduction and Scope of Traffic Engineering
- 1.1.1 Definition and Scope of Traffic Engineering
- 1.1.2 Traffic Characteristics

1.2. Traffic Studies
- 1.2.1 Traffic Volume Study
- 1.2.2 Speed Study
- 1.2.3 Origin and Destination Study
- 1.2.4 Traffic Flow Characteristics
- 1.2.5 Traffic Capacity Study
- 1.2.6 Parking Study
- 1.2.7 Accident Study

1.3. Traffic Control Devices
- 1.3.1 Traffic Signs
- 1.3.2 Traffic Signals
- 1.3.3 Road Markings
- 1.3.4 Traffic Islands

1.4. Road Intersections
- 1.4.1 Basic Requirements of Intersections
- 1.4.2 Types of Intersections and their Configuration
- 1.4.3 Channelized and Unchannelized Intersections
- 1.4.4 Rotary Intersection
- 1.4.5 Grade Separated Intersections: Types with Sketches

1.5. Road Lighting
- 1.5.1 Importance of Road Lighting
- 1.5.2 Factors Influencing Night Visibility
- 1.5.3 Requirements of Level of Illumination in Roads
- 1.5.4 Lighting System: Selection of Height and Spacing of Light Poles and Layouts

2. Pavement **(10 hrs)**

2.1 Definition and Types of Pavements
2.2 Factors Controlling Pavement Design
2.3 Differences between Flexible and Rigid Pavement Structure

2.4 Design Methods of Flexible Pavements: Overseas Rode Notes - 31, IRC 37-2001, AASHTO, Asphalt Institute; DoR Guidelines
2.5 Westergaard's Theory for rigid pavement
2.6 Stress due to Load, Temperature and Sub-grade Friction
2.7 Design of Rigid Pavement: IRC, DoR Guidelines

3. Road Construction Technology (8 hrs)

3.1 Activities and Techniques used in Road Construction
3.2 Tools, Equipment and Plants used in Road Construction
3.3 Execution of Earth Work
3.4 Construction of Low Cost Roads: Earthen, Gravel and Water Bound Macadam
3.5 Construction of Prime Coat, Tack Coat and Seal Coat
3.6 Construction of Surface Dressing
3.7 Construction of Otta-seal
3.8 Construction of Grouted or Penetration Macadam
3.9 Construction of Different Types of Bituminous Premixes: Premix Carpet, Bituminous Bound Macadam, Asphalt Concrete
3.10 Construction of Cement Concrete Pavement

4. Highway Maintenance, Repair and Rehabilitation (5 hrs)

4.1 Classification of Maintenance Activities
4.2 Planning of Maintenance Operations
4.3 Evaluation of Pavement Distress and Pavement Condition
4.4 Types of Road Failure and its Causes
4.5 Types and Methods of Pavement Repairs
4.6 Types of Overlay and Strengthening of Existing Pavement

5. Green Road Concept (2 hrs)

5.1 Basic Principles
5.2 Steps of Green Road Construction

6. Introduction to Bridge and Tunnel Engineering (5 hrs)

6.1 Bridge Site Selection
6.2 Classification of Bridges and Components
6.3 River Bank Protection Structures
6.4 Introduction to Tunnel
6.5 Component Parts of Tunnel and Tunnel Cross-Section
6.6 Survey for Tunnel Alignment
6.7 Requirements for Tunnel: Drainage, Lighting, Dust Control and Ventilation
6.8 Tunneling in Firm Soil, Soft Soil and Hard Rock

Laboratories:

1. Spot Speed and Data Analysis
2. Deflection of Pavement Surface: using Benkelman Beam
3. Skid Resistance
4. Roughness Index

References:

1. Kadiyali, L.R. *Traffic Engineering and Transport Planning.* Delhi: Khanna Publishers.
2. Sharma, S.K. *Principles, Practice and Design of Highway Engineering.* New Delhi: S. Chand and Co. Publishers Ltd.
3. Khanna, S.K. & Justo, C.E.G. *Highway Engineering.* Roorkee (U.P.): Nem Chand & Bros.
4. Flaherty, C.A. *Highway Engineering.* Edward Arnold (Publishers) Ltd.

5. Huang, Yang H. (2012). *Pavement Analysis and Design.* Pearson Publication.
6. Relevant publications by Department of Roads and Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR)