

## Transportation Engineering II

### BEG 365 CI

**Year: III**

**Semester: II**

Teaching Schedule Hours/week			Examination Scheme						Total Marks
			Final				Internal Assessments		
			Theory		Practical		Theory	Practical	
L	T	P	Duration	Marks	Duration	Marks			
3	3	2/2	3	80	-	-	20	25	125

#### Course Objective:

After the completion of the course, students will be able to design, construct, supervise repair and maintain the roads. They will be familiar with the traffic design, control and operation. The course provides glimpses on the bridge and tunnel as well.

#### Course Contents:

- 1.0 Introduction and Scope of Traffic Engineering (3 hrs)**
  - 1.1 Definition of traffic engineering
  - 1.2 Scope of Traffic Engineering
  - 1.3 Traffic characteristics
    - 1.3.1 Driver Characteristics
    - 1.3.2 Pedestrian Characteristics
    - 1.3.3 Vehicle Characteristics
- 2.0 Traffic Studies (7 hrs)**
  - 2.1 Traffic volume studies
  - 2.2 Traffic speed studies
  - 2.3 Origin and destination studies
  - 2.4 Traffic flow and capacity studies
  - 2.5 Parking studies
  - 2.6 Accident studies
- 3.0 Road Intersection and Traffic control Devices (6 hrs)**
  - 3.1 Basic requirements of intersections
  - 3.2 Types of intersections and their configuration
  - 3.3 Channelized and Unchannelized intersections
  - 3.4 Rotary Intersection
  - 3.5 Grade separated intersections
  - 3.6 Warrants for signalization and choice of traffic control devices
  - 3.7 Traffic signals, signal design and signs
  - 3.8 Road marking and traffic island
- 4.0 Road lighting (2 hrs)**
  - 4.1 Importance of road lighting
  - 4.2 Factors influencing night visibility
  - 4.3 Requirements of level of illumination in roads
  - 4.4 Design of the lighting system: selection of height of lamps, spacing between light poles, height and overhang of light poles, lateral placement, etc.

- 5.0 Road Pavement (10 hrs)**
- 5.1 Definition and types of pavements
  - 5.2 Differences between flexible and rigid pavement structures
  - 5.3 Loads and other factors controlling pavement
  - 5.4 Design methods for flexible pavements-Road notes 29, 31, CBR, AASTHO.
  - 5.5 Details of the asphalt institute method of design of flexible pavements
  - 5.6 Design methods for rigid pavements and Westergaard's theory
  - 5.7 Stresses due to load, temperature differential and subgrade friction
  - 5.8 Details of the IRC method of design of rigid pavements for highways
- 6 Road Construction Technology (7 hrs)**
- 6.1 Activities and techniques used in road construction
  - 6.2 Tools, equipment and plants used in road construction
  - 6.3 Preparation of road bed: excavation, fill compaction, soil stabilization, etc.
  - 6.4 Construction of low cost roads
  - 6.5 Construction of asphalt concrete layers, including prime coats, tack coats and seal coats
  - 6.6 Construction of surface dressing
  - 6.7 Construction of otta-seal
  - 6.8 Construction of grouted or penetration macadam
  - 6.9 Construction of different types of bituminous premixes
  - 6.10 Construction of cement concrete pavement
- 7.0 Highway Maintenance, Repair and Rehabilitation (6 hrs)**
- 7.1 Classification of maintenance activities for road pavement and road facilities
  - 7.2 Inspection, prioritization and planning of maintenance operations
  - 7.3 Evaluation of pavement distress and pavement condition
  - 7.4 Types of road failure and its causes
  - 7.5 Types and methods of pavement repair
  - 7.6 Types of overlays and strengthening of existing pavements
- 8.0 Introduction to Bridge and Tunnel Engineering (4 hrs)**
- 8.1 Choice of location of bridge site
  - 8.2 Classification of bridges and component parts of a bridge
  - 8.3 Introduction to river bank and protection structures
  - 8.4 Component parts of tunnels and tunnel cross-section
  - 8.5 Type of road and railway tunnel
  - 8.6 Survey for tunnel alignment

**Laboratories:**

A practical assignment of highway and pavement design that includes data collection will be included in this course. The following studies will be conducted:

- (i) Determination of CBR in the laboratory.
- (ii) Measurement of spot speed and data analysis.
- (iii) Measurement of deflection of pavement surface.

**References:**

- S.B.Sehgal and K.I. Bhanot. A Text-book on Highway Engineering and Airports, S. Chand and Co. Publishers Ltd., New Delhi
- S.K. Sharma, Principles, Practice and Design of Highway Engineering, S. Chand and Co. Publishers Ltd., New Delhi
- Dr. S.K. Khanna and Dr. C.E.G.Justo, Highway Engineering, Nem Chand & Bros Roorkee (U.P.)

## Sanitary Engineering BEG 364 CI

**Year: III**

**Semester: II**

Teaching Schedule Hours/week			Examination Scheme						Total Mark
			Final				Internal Assessments		
			Theory		Practical		Theory	Practical	
L	T	P	Duration	Marks	Duration	Marks			
3	1	2/2	3	80	-	-	20	25	125

### Course Objective:

The course aims at providing the students with a fairly advanced knowledge of the sewerage system, sludge treatment and its disposal

### Course Contents:

#### 1.0 Introduction

(2 hrs)

- 1.1 Importance of waste water and solid waste management
- 1.2 Objects of sewage disposal
- 1.3 Sanitation systems: conservancy system and water carriage system
- 1.4 Types of sewerage systems: combined, separate and partially separate systems

#### 2.0 Quantity of waste water

(3 hrs)

- 2.1 Sources of sanitary sewage
- 2.2 Factors affecting sanitary sewage
- 2.3 Determination of quantity of sanitary sewage
- 2.4 Methods of determination the quantity of storm water: tangent method; limitation of rational method

#### 3.0 Characteristics and Examination of Sewage

(5 hrs)

- 3.1 Sewage sampling
- 3.2 Different characteristics of sewage: physical, chemical and biological.
- 3.3 Decomposition of sewage, aerobic and anaerobic reactions
- 3.4 Biochemical oxygen demand (BOD) and chemical oxygen demand (COD)
- 3.5 Tests, of solids, DO, pH-value, brief review of, water supply, BOD, COD, Nitrogen, chloride demand, chloride

#### 4.0 Design and Construction of Sewers

(5 hrs)

- 4.1 Typical design periods, flow velocity, flow diagrams, hydraulic formulae and gradients
- 4.2 Shape of sewers
- 4.3 Sewer materials: requirements, salt glazed stoneware, C.I. and cement concrete pipes
- 4.4 Design of the sewer for separate and combined systems
- 4.5 Construction of sewer: excavation, laying, joining of sewer testing of sewer: water test, air-test

- 5.0 Sewer Appurtenances (4 hrs)**
- 5.1 Manholes, drop-manholes and lamp-holes
  - 5.2 Street inlets
  - 5.3 Catch basins
  - 5.4 Flushing devices
  - 5.5 Sand, Grease and oil traps
  - 5.6 Inverted siphons
  - 5.7 Sewer outlets
  - 5.8 Ventilating shaft
- 6.0 Sewage Disposal (6 hrs)**
- 6.1 Meaning and objects of sewage disposal
  - 6.2 Disposal of sewage by dilution: Process, essential conditions for dilution, Self-purification of streams, factors affecting self-purification, oxygen sag curve, Streeter-Phelps equation
  - 6.3 Disposal of sewage by land treatment: process, suitability of land treatment, methods of land treatment irrigation, over land flow and rapid filtration
- 7.0 Sewage Treatment (10 hrs)**
- 7.1 Objects of treatment and different treatment methods: physical, chemical, biological
  - 7.2 Preliminary treatment processes: racks or screens, skimming tanks, grit chamber, sedimentation, and chemical precipitation
  - 7.3 Secondary treatment processes and their types
  - 7.4 Principles of biological treatment, principal of suspended and attached growth process
  - 7.5 Sewage filtration, intermittent sand filter, contact bed trickling filters, bio filters and design of trickling and bio-filters
  - 7.6 Activated sludge process: theory, design and aeration, advantages and disadvantages of the activated sludge process
  - 7.7 Oxidation ponds: functions, theory and design
- 8.0 Sludge Treatment and Disposal (4 hrs)**
- 8.1 Sources of sludge and need of treatment
  - 8.2 Aerobic and anaerobic digestion
  - 8.3 Methods of sludge treatment: grinding and blending, thickening, stabilization, dewatering, drying, composting and incineration
  - 8.4 Methods of sludge disposal: spreading on land, lagooning, dumping, and land filling
- 9.0 Disposal of Sewage from Isolated Buildings (4 hrs)**
- 9.1 Privies: Pit privy, ventilation improved pit latrine, and pour-flush latrine
  - 9.2 Septic Tank: design, construction, working and maintenance
  - 9.3 Disposal of septic tank effluent: drain field, soak pits, watching, Evapotranspiration mounds
- 10.0 Solid Waste Cesspools and Evapotranspiration Mounts (2 hrs)**
- 10.1 Types and characteristics of solid waste
  - 10.2 Collection and disposal

### 10.3 Methods of solid waste disposal: dumping, sanitary landfill, incineration and composting

**Laboratories:**

- (i) BOD and COD tests.
- (ii) Bacteriological: Membrane filter, most probable number.

**Field Visit:**

Field visit of a sewerage treatment plant, group presentation and submission of individual report to the respective teacher.

**References:**

- B.C. Punmiya, Sanitary Engineering, ,Laxmi publisher
- P.N Modi, Sanitary Engineering, Standard book house
- G.S. Bridie, Water Supply and Sanitary Engineering, Dhanpat Rai and Sons Publishers

# Irrigation Engineering

## BEG363CI

**Year: III**

**Semester: II**

Teaching Schedule Hours/week			Examination Scheme						Total Marks
			Final				Internal Assessments		
			Theory		Practical		Theory	Practical	
L	T	P	Duration	Marks	Duration	Marks			
3	2	-	3	80	-	-	20	-	100

### Course Objective:

The objective of the course is to provide fundamental knowledge of irrigation engineering. After completing this course students are expected to address the irrigation problems properly.

### Course Contents:

#### 1.0 Introduction

(2 hrs)

- 1.1 Definition of irrigation
- 1.2 Functions, advantages and disadvantages of irrigation
- 1.3 Status of irrigation development in Nepal

#### 2.0 Soil Water Relationship

(5 hrs)

- 2.1 General classification of soil for agricultural purposes
- 2.2 Soil-Moisture / Crop-water requirement
- 2.3 Factors affecting Crop-Water Requirements
- 2.4 Crop-Water requirement calculation by Penman method and computer software (CROPWAT-8)
- 2.5 Principal crops, their seasons and water requirements
- 2.6 Method of applying water to irrigation field as surface, sub-surface and Sprinkler methods
- 2.7 Techniques of surface irrigation and their suitability
- 2.8 Advantage and disadvantage of surface, sub-surface and sprinkler irrigation
- 2.9 Design of sprinkler irrigation system

#### 3.0 Canals

(4 hrs)

- 3.1 Classification of canals according to function, discharge, alignment
- 3.2 Components of the canal system, head works, major Canal, Branch Canal, distributary and water Courses
- 3.3 Canal alignment
- 3.4 Canal losses due to seepage and evaporation
- 3.5 Assessment of water requirement in canals and command Area
- 3.6 G. C. A., C. C. A., N. C. A., Duty, delta and their relationships
- 3.7 Base period, kor period and kor depth

#### 4.0 Design of Canals

(7 hrs)

- 4.1 Manning's uniform flow equation
- 4.2 Semi-theoretical approaches of canal design
- 4.3 Design of stable canal in alluvium
- 4.4 Silt theory of Kennedy and Lacy and their comparison
- 4.5 Lined canals, various types of lining, advantages and economics of Lining
- 4.6 Design of lined Canals

- 4.7 Cross-Section of Canal, berms, banks, roadways and spoil banks, balance depth
- 5.0 Headwork's and Distribution System (7 hrs)**
- 5.1 Function and components of head works, their types
  - 5.2 Principle of design for surface flow, (Location, waterway, shapes, crest level, length and thickness of impervious flow )
  - 5.3 Principle of design for sub-surface flow of structure: Bligh's, Lane's and Khosla's seepage theory.
  - 5.4 Different types of canal outlets, design of pipe outlet (free and submerged)
  - 5.5 Design consideration of distribution system
- 6.0 Hydraulic Structures for Canals (7 hrs)**
- 6.1 Different types of hydraulic structures
  - 6.2 Types of cross drainage structures, conditions of applications and their designs (Aqueduct and siphon aqueducts)
  - 6.3 Distributary heads regulator and cross regulator and their design
  - 6.4 Escapes and their types
  - 6.5 Falls, their types and design of vertical drop fall (crest, length and thickness of impervious floor)
- 7.0 Water Logging and Drainage (4 hrs)**
- 7.1 Causes and effects of water logging
  - 7.2 Preventive measures of water logging
  - 7.3 Surface drainage, sub-surface drainage and their design.
  - 7.4 Reclamation of water logged areas by different methods
- 8. River Training (4 hrs)**
- 8.1 River training and its necessity
  - 8.2 Stages of rivers and their meandering processes
  - 8.3 Methods of river training,
  - 8.4 Design of guide bund and launching apron
  - 8.5 Design of spurs (layout geometry, length, spacing and cross-section)
  - 8.6 Effects of degradation on the hydraulic structures
- 9.0 Planning and Management of Irrigation System (3 hrs)**
- 9.1 General irrigation system planning
  - 9.2 Organization and irrigation management
  - 9.3 Operation and maintenance of irrigation systems
  - 9.4 Institutional aspects of irrigation system management
- 10.0 Introduction to Farmer managed irrigation system (2 hrs)**
- 10.1 Introduction of FMIS in Asian & Nepalese context
  - 10.2 Introduction to water resources act, policy, water plan, water strategy and irrigation regulation and legislation, environment act & guidelines, formation and management of FMIS organization (by participatory approach)
  - 10.3 Water right issues – statutory & customary right, water allocation & arrangement, water related disputes & resolutions, use of Uphoff's matrix on irrigation management



**Field Visit:**

Three days field visit of irrigation system, group presentation and submission of individual report to the respective teacher.

**References:**

- R. S. Varshney, S. C. Gupta and R. L. Gupta, Theory and Design of Irrigation Structures, Nem Chand and Bros., Roorkee, 2010.
- Bharat Singh, Fundamentals of Irrigation Engineering, Nem Chand and Bros., Roorkee, 2008.
- Design Manual for Irrigation Projects in Nepal, PDSP Manuals, February, 1990.
- S. N. Poudel, Irrigation Development in Nepal, Kathmandu, 1986.
- S. K. Garg, Irrigation Engineering and Hydraulic Structures, Delhi, 1983.
- Design Guidelines for Surface Irrigation in Terai and Hills of Nepal, Volume I and II, WECS, Kathmandu, 1988.
- Choudhari, L.N.: A course manual on FMIS (Farmer Managed Irrigation System), nec publication (2004)
- Guidelines for Predicting Crop water Requirements, FAO Irrigation and Drainage paper 24 (1977)
- Pradhan, Prachanda, (1989): Partners of Irrigation Organization in Nepal: Country paper-Nepal No. 1: Comparative Study of 21 farmer managed irrigation system, Colombo Srilanka
- Uphoff, Norman (1986): Improving Irrigation management with farmer participation, Boulder, Colorado and London, West view Press.

## Foundation Engineering BEG 362 CI

**Year: III**

**Semester: II**

Teaching Schedule Hours/week			Examination Scheme						Total Marks
			Final				Internal Assessments		
			Theory		Practical		Theory	Practical	
L	T	P	Duration	Marks	Duration	Marks			
3	3	-	3	80	-	-	20	-	100

### Course objective:

The objective of this course is to provide the basic knowledge, concept and introduction of tools that can be used to determine soil structure interaction. This course includes a review of principles of soil mechanics and deal with a variety of foundations and retaining walls.

### Course Contents:

#### 1.0 Introduction (2 hrs)

- 1.1 Soil/foundation interaction
- 1.2 Function of foundation and its types
- 1.3 Factors influencing the choice of a foundation

#### 2.0 Site Investigation (5 hrs)

- 2.1 Objectives, stages and methods of site investigation
- 2.2 Sampling of soils, samplers, sample area
- 2.3 Field measurement of consistency and relative density
- 2.4 Plate loads test and In-situ permeability test
- 2.5 Ground water observation
- 2.6 Bore Hole logs
- 2.7 Preservation, transportation and storage of samples
- 2.8 Laboratory tests on soils
- 2.9 Preparation of site investigation reports

#### 3.0 Earth pressure and Retaining Structures (9 hrs)

- 3.1 Types of earth pressure
- 3.2 Steady state equilibrium and earth pressure at elastic and plastic equilibrium
- 3.3 Active and passive conditions
- 3.4 Modified failure envelope of line
- 3.5 Rankine state of plastic equilibrium
- 3.6 Strains associated with Rankine's states
- 3.7 Local state of plastic equilibrium, deformation and boundary conditions
- 3.8 Rankine's earth pressure theory
- 3.9 Active earth pressure on cohesion less backfill
- 3.10 Active and passive earth pressure on backfill
- 3.11 Active thrust by trial wedges and limitations of the method
- 3.12 Influence of wall friction
- 3.13 Coulomb's earth pressure theory and its graphical solution
- 3.14 Limitations of Coulomb's wedge theory
- 3.15 Selection of soil parameters for earth pressure computations
- 3.16 Stability analysis of an earth retaining structure

- 4.0 Bearing capacity and Settlement of Shallow Foundations (6 hrs)**
- 4.1 Types of failures
  - 4.2 Types of bearing capacity, and influencing factors
  - 4.3 Panker, Ranking and Bells theories
  - 4.4 Modes of foundation failure
  - 4.5 Pandlt's theory
  - 4.6 Terzaghi's general bearing capacity theory
  - 4.7 Extension of Terzaghi's theory
  - 4.8 Introduction to recent bearing capacity theories
  - 4.9 Ultimate bearing capacity of cohesion less and cohesive soils
  - 4.10 Effects of various factors on bearing capacity
  - 4.11 Types of settlement and relationship
  - 4.12 Limitations of the methods for predicting settlement
  - 4.13 Bearing capacity from In-situ tests
- 5.0 Design of Spread foundation (3 hrs)**
- 5.1 Common types of spread footings and their uses
  - 5.2 Depth of footings
  - 5.3 Design procedure
  - 5.4 Bearing capacity and settlement of spread footings
  - 5.5 Permissible settlement
  - 5.6 Proportioning of spread footing for uniform settlement
  - 5.7 Stresses on lower strata
  - 5.8 Design of spread footings on firm soil above soft layers
  - 5.9 Construction of spread footing
- 6.0 Mat Foundations (3 hrs)**
- 6.1 Types of mat foundation and their uses
  - 6.2 Bearing capacity and settlement of mat foundation
  - 6.3 Design of mat foundation in sand and clay
  - 6.4 Construction of mat foundations
- 7.0 Pile Foundation (6 hrs)**
- 7.1 Types of piles, advantages and disadvantages
  - 7.2 Classification of piles and their selection
  - 7.3 Soil-pile interaction
  - 7.4 Carrying capacity of piles in clay and sand
  - 7.5 Pile driving formulae
  - 7.6 Group action of pile
  - 7.7 Bearing capacity and settlement of pile group
  - 7.8 Negative skin friction
  - 7.9 Piles resisting uplift
  - 7.10 Piles resistance under the action of inclined loading
  - 7.11 Pile load test
  - 7.12 Construction of pile foundation
  - 7.13 Damage, alignment and effect of pile driving

**8.0 Pier Foundations (2 hrs)**

- 8.1 Function of piers and their types
- 8.2 Bearing capacity and settlement of piers
- 8.3 Skin friction on pier shafts
- 8.4 Design of piers in sand and clay
- 8.5 Construction of pier foundations

**9.0 Well or caisson Foundation (2 hrs)**

- 9.1 Use of caisson foundation and their types
- 9.2 Bearing capacity of caissons in sand and clay
- 9.3 Design of caissons
- 9.4 Sinking of caissons

**10.0 Sheet piles and coffer Dams (5 hrs)**

- 10.1 Common types of sheet piles and their uses
- 10.2 Classification of sheet piled walls
- 10.3 Design of Cantilever and Anchored sheet piled walls
- 10.4 Construction of sheet piled walls
- 10.5 Common types of coffer dams and their uses
- 10.6 Design of braced coffer dams
- 10.7 Construction of braced coffer dams

**11.0 Geo-technical processes (2 hrs)**

- 11.1 Ground water in excavation and methods of its control
- 11.2 Foundation stabilisation and underpinning

**Field Visit:**

One day local site visit based on site investigation.

**References:**

1. "Soil Mechanics and Foundation Engineering", K.R. Arora, CBS Publishers and Distributors, New Delhi, 1988.
2. "Soil Mechanics in Engineering practice", Terzaghi, K and Peck, R.B. John Wiley, 2nd Edition, New York, 1967.
3. "Foundation Engineering" B.M. Das.

## Engineering Economics BEG 395 MS

**Year: III**

**Semester: II**

Teaching Schedule Hours/week			Examination Scheme						Total Marks
			Final				Internal Assessments		
			Theory		Practical		Theory	Practical	
L	T	P	Duration	Marks	Duration	Marks			
3	1	-	3	80	-	-	20	-	100

### Course Objective:

The objective of this course is to provide the students knowledge of the basic tools and methodology of economic studies for evaluation engineering project in private industry, in the public sector and in the utilities area.

### Course Contents:

- 1.0 Introduction (3 hrs)**
  - 1.1 Business and accounting terminology
  - 1.2 Cash flow
  - 1.3 Economic systems
- 2.0 Cost Classification and Analysis (5 hrs)**
  - 2.1 The elements of cost
  - 2.2 Classification of cost: overhead cost, prime cost
  - 2.3 Cost variance analysis
  - 2.4 Job and process costing
- 3.0 Interest and the Time Value of Money (6 hrs)**
  - 3.1 Simple interest, compound interest, interest tables, interest charts
  - 3.2 Present worth
  - 3.3 Nominal and effective interest rates
  - 3.4 Continuous compounding and continuous compounding formula
  - 3.5 Interest calculations for uniform gradient
- 4.0 Basic Methodologies of Engineering Economic Studies (7 hrs)**
  - 4.1 Present worth and annual worth methods
  - 4.2 Future worth method
  - 4.3 Internal rate of return method
  - 4.4 Drawbacks of the internal rate of return method
  - 4.5 External rate of return method
  - 4.6 Minimum attractive rate of return
  - 4.7 The payback (pay-out) period method
- 5.0 Cost/Benefit Analysis (4 hrs)**
  - 5.1 Conventional cost/benefit ratio
  - 5.2 Modified cost/benefit ratio
  - 5.3 Break-even analysis
- 6.0 Investment Decisions: (8 hrs)**
  - 6.1 Comparison of alternatives having same useful life
  - 6.2 Comparison of alternatives having different useful life
  - 6.3 Comparison of alternatives including and excluding the time value of money
  - 6.4 Comparison of alternatives using the capitalized worth method
  - 6.5 Definition of mutually exclusive investment alternatives in terms of combinations of projects

- 6.6 Comparison of mutually exclusive alternative
- 7.0 Risk Analysis: (4 hrs)**
- 7.1 Projects operating under conditions of certainty
  - 7.2 Projects operating under conditions of uncertainty
  - 7.3 Decision tree
  - 7.4 Sensitivity analysis
- 8.0 Taxation System in Nepal: (3 hrs)**
- 8.1 Taxation law in Nepal
  - 8.2 Depreciation rates for buildings, equipment, furniture, etc
  - 8.3 Recaptured depreciation
  - 8.4 Taxes on normal gains
  - 8.5 Taxes on capital gains
  - 8.6 Value Added Tax (VAT)
- 9.0 Demand Analysis and Sales Forecasting (5 hrs)**
- 9.1 Demand analysis
  - 9.2 Correlation of price and consumption rate
  - 9.3 Multiple correlation of price and consumption rate
  - 9.4 Market research
  - 9.5 Sales forecasting
  - 9.6 Criteria for desirable sales forecasting procedures
  - 9.7 Factors affecting accuracy of forecasting

**References:**

- E.P. DeGarmo, W.G. Sullivan and J.A. Bontadelli, 8<sup>th</sup> Edition, Macmillan Publishing Company, 1988
- N.N. Borish and S.Kaplan, "Economic Analysis: For Engineering and Managerial Decision Making", McGraw-Hill.

# Design of Steel and Timber Structure

## BEG 361 CI

**Year: III**

**Semester: II**

Teaching Schedule Hours/week			Examination Scheme						Total Marks
			Final				Internal Assessments		
			Theory		Practical		Theory	Practical	
			L	T	P	Duration	Marks	Duration	
3	3	-	3	80	-	-	20	-	100

### Course Objective:

This course is aimed to make students capable to design ordinary steel and timber structures and also prepare students for advanced knowledge on design of complex steel and timber structure.

### Course Content:

- 1.0 Introduction to Steel Structures and Design Concepts (4 hrs)**
  - 1.1 Types of structural steel
  - 1.2 Properties of structural steel (Stress-strain characteristics, allowable stresses and other mechanical properties)
  - 1.3 Use of steel as structural members
  - 1.4 Standards, codes and specifications for design of steel structures
  - 1.5 Advantages and disadvantages of steel structures.
  - 1.6 Allowable stress, ultimate strength and limit state
- 2.0 Types of Joints and Design (6 hrs)**
  - 2.1 Types of riveted / bolted and welded joints
  - 2.2 Strength of riveted / bolted joints
  - 2.3 Rivet value and efficiency
  - 2.4 Design of riveted / bolted joints under axial and eccentric forces
  - 2.5 Details of riveted / bolted joints
  - 2.6 Design of welded joints under axial and eccentric forces
  - 2.7 Details of welded joints
- 3.0 Design of Tension Members (4 hrs)**
  - 3.1 Various forms of tension members
  - 3.2 Net sectional area and permissible stress
  - 3.3 Design of angles, tee and channel sections
  - 3.4 Concepts of tension splice
- 4.0 Axially Loaded Compression Member (4 hrs)**
  - 4.1 Strength of an axially loaded compression member
  - 4.2 End conditions and effective length
  - 4.3 Radius of gyration and slenderness ratio
  - 4.4 Angle, tubular and built-up strut members
  - 4.5 Design of compression members
  - 4.6 Design of lacings and battens
  - 4.7 Column splices
  - 4.8 Design of bases for axially loaded columns

<b>5.0</b>	<b>Eccentrically Loaded Compression Members</b>	<b>(3 hrs)</b>
5.1	Stress calculation	
5.2	Design of members	
<b>6.0</b>	<b>Design of Beams</b>	<b>(6 hrs)</b>
6.1	Beams under transverse and axial loading	
6.2	Bending, axial and shear stresses	
6.3	Deflection criteria	
6.4	Design of laterally supported and unsupported beams	
6.5	Web crippling, buckling and stiffening	
<b>7.0</b>	<b>Design of Composite and Built-Up Beams</b>	<b>(2 hrs)</b>
7.1	Difference between composite and built-up beams	
7.2	Types of built-up beams	
7.3	Design of cover plates	
7.4	Design of rivets / bolts connecting cover plates with flanges	
<b>8.0</b>	<b>Design of Plate Girders</b>	<b>(3 hrs)</b>
8.1	Elements of plate girder and economical depth	
8.2	Flange design with curtailment	
8.3	Design of web plates and stiffeners	
8.4	Design of web and flange splices	
<b>9.0</b>	<b>Design of Roof Trusses</b>	<b>(5 hrs)</b>
9.1	Angular and Tubular Sections	
9.2	Loads on roof trusses – Wind load, live load, dead load	
9.3	Forces in truss elements	
9.4	Design of purlins	
9.5	Design and detailing of roof truss members and joints	
<b>10.0</b>	<b>Timber Structures</b>	<b>(3 hrs)</b>
10.1	Types and properties of timber	
10.2	Advantage and disadvantage of timber structures	
10.3	Various types of sections	
10.4	Use of timber as a structural member	
10.5	Permissible stresses in solid and laminated timber	
10.6	Codes of practice for design of timber structures	
10.7	Bamboo as a timber structure - Recent trends	
<b>11.0</b>	<b>Design of Timber Structures</b>	<b>(5 hrs)</b>
11.1	Design of compression member	
11.2	Design of beams	



**References:**

- L. S. Negi, Design of Steel Structures, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1997.
- M. Raghupathi, Design of Steel Structures, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1997.
- S. Arya, J. L. Azmani, Design of steel Structures, Nem Chand & Bros, Roorkee, Fifth Edition, 1996
- Ramarutham, Design of Steel Structures
- Ramchandra, Design of Steel Structures
- Dayaratnam, Design of Steel Structures