B.E. DEGREE
IN
CIVIL ENGINEERING

Year : III

Part : II

Teaching Schedule							Examination Scheme							
							Theory			Practical			Total	Remark
S. N.	Course Code	Course Title	L	T	P	Total	Assesment Marks	Final		Assesment Marks	Final			
								Duaration hours	Marks		Duaration hours	Marks		
1	SH 651	Communication English	3	1	2	6	20	3	80	25			125	
2	CE 651	Design of Steel & Timber Structure	4	2		6	20	3	80				100	
3	CE 652	Building Technology	3	1		4	20	3	80				100	
4	CE 655	Engineering Economics	3	1		4	20	3	80				100	
5	CE 656	Sanitary Engineering	3	1		4	20	3	80				100	
6	CE 653	Transportation Engineering	3	1	1	5	20	3	80	25			125	
7	CE 654	Irrigation and Drainage Engineering	3	2		5	20	3	80				100	
		Total	**22**	**9**	**3**	**34**	**140**	**21**	**560**	**50**			**750**	

COMMUNICATION ENGLISH

SH651

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 2

Course Introduction

This course is designed for the students of engineering with the objective of developing all four skills of communication applicable in professional field.

Course Objectives:

To make students able to:

a. comprehend reading materials both technical and semi-technical in nature
b. develop grammatical competence
c. write notice, agenda, minutes
d. write proposals
e. write reports
f. write research articles
g. listen and follow instruction, description and conversation in native speakers' accent
h. do discussion in group, deliver talk and present brief oral reports

Unit I: Reading **(15 hours)**

1. Intensive Reading **(8 hours)**

1.1 Comprehension
1.2 Note-taking
1.3 Summary writing
1.4 Contextual questions based on facts and imagination
1.5 Interpreting text

2. Extensive Reading **(5 hours)**

2.1 Title/Topic Speculation
2.2 Finding theme
2.3 Sketching character

3. Contextual Grammar **(2 hours)**

3.1 Sequence of tense
3.2 Voice
3.3 Subject-Verb agreement
3.4 Conditional Sentences
3.5 Preposition

Unit II: Introduction to technical writing process and meeting **(4 hours)**

1. Editing, MLA/APA **(2 hours)**

1.1 Composing and editing strategies
1.2 MLA and APA comparison

2. Writing notices with agenda and minutes **(2 hours)**

2.1 Introduction
2.2 Purpose
2.3 Process

Unit III: Writing Proposal **(6 hours)**

1. Introduction

1.1 Parts of the proposal
- 1.1.1 Title page
- 1.1.2 Abstract/Summary
- 1.1.3 Statement of Problem
- 1.1.4 Rationale
- 1.1.5 Objectives
- 1.1.6 Procedure/Methodology
- 1.1.7 Cost estimate or Budget
- 1.1.8 Time management/Schedule
- 1.1.9 Summary
- 1.1.10 Conclusion
- 1.1.11 Evaluation or follow-up
- 1.1.12 Works cited

Unit IV: Reports **(18hours)**

1. Informal Reports **(6 hours)**

1.1 Memo Report
- 1.1.1 Introduction
- 1.1.2 Parts

1.2 Letter Report
- 1.2.1 Introduction
- 1.2.2 Parts

2. Project/Field Report **(3 hours)**

2.1 Introduction
2.2 Parts

3. Formal report **(9 hours)**

3.1 Introduction
3.2 Types of Formal Reports
- 3.2.1 Progress Report

3.2.2 Feasibility Report
3.2.3 Empirical/ Research Report
3.2.4 Technical Report
3.2.5 Parts and Components of Formal Report
3.2.5.1 Preliminary section
1.1.1.1.1. Cover page
1.1.1.1.2. Letter of transmittal/Preface
1.1.1.1.3. Title page
1.1.1.1.4. Acknowledgements
1.1.1.1.5. Table of Contents
1.1.1.1.6. List of figures and tables
1.1.1.1.7. Abstract/Executive summary
3.2.5.2 Main Section
1.1.1.1.8. Introduction
1.1.1.1.9. Discussion/Body
1.1.1.1.10. Summary/Conclusion
1.1.1.1.11. Recommendations
3.2.5.3 Documentation
1.1.1.1.12. Notes (Contextual/foot notes)
1.1.1.1.13. Bibliography
1.1.1.1.14. Appendix

Unit V: Writing Research Articles **(2 hours)**

1. Introduction

2. Procedures

Language lab		30 hours
Unit I: Listening		12 hours
Activity I	General instruction on effective listening, factors influencing listening, and note-taking to ensure ttention. (Equipment Required: Laptop, multimedia, laser pointer, overhead projector, power point, DVD, video set, screen)	2 hours
Activity II	Listening to recorded authentic instruction followed by exercises. (Equipment Required: Cassette player or laptop)	2 hours
Activity III	Listening to recorded authentic description followed by exercises. (Equipment Required: Cassette player or laptop)	4 hours
Activity IV	Listening to recorded authentic conversation followed by exercises (Equipment Required: Cassette player or laptop)	4 hours
Unit II: Speaking		18 hours
Activity I	General instruction on effective speaking ensuring audience's attention, comprehension and efficient use of Audio-visual aids. (Equipment Required: Laptop, multimedia, laser pointer, DVD, video, overhead projector, power point, screen)	2 hours

Activity II	Making students express their individual views on the assigned topics (Equipment Required: Microphone, movie camera)	2 hours
Activity III	Getting students to participate in group discussion on the assigned topics	4 hours
Activity IV	Making students deliver talk either individually or in group on the assigned topics (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	8 hours
Activity V	Getting students to present their brief oral reports individually on the topics of their choice. (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	2 hours

Evaluation Scheme

Units	Testing Items	No. of Questions	Type of Questions	Marks Distribution	Total Marks	Remarks
I	Reading	3	For grammar = objective and for the rest = short	2 Short questions 5+5 Interpretation of text 5 Note + Summary 5+5 Grammar 5	30	For short questions 2 to be done out of 3 from the seen passages, for interpretation an unseen paragraph of about 75 words to be given, for note + summary an unseen text of about 200to 250 to be given, for grammar 5 questions of fill up the gaps or transformation type to be given
II	Introduction to technical writing process and meeting	3	MLA/APA = objective, Editing and Meeting = short	MLA/APA = 4 Editing = 5 Meeting = 5	14	For APA/MLA 4 questions to be given to transform one from another or 4 questions asking to show citation according to APA/ MLA technique, For meeting minute alone or notice with agendas to be given
III	Proposal Writing	1	Long	10	10	A question asking to write a very brief proposal on any technical topic to be given
IV	Report writing	2	Informal report = short, Formal report = long	Informal report = 6 Formal report = 10	16	A question asking to write very brief informal report on technical topic to be given, for formal report a question asking to write in detail on any three elements of a formal report on technical topic to be given

V	Research article	1	Long	10	10	A question asking to write a brief research article on technical topic to be given

Evaluation Scheme for Lab

Units	Testing items	No. of Questions	Type of questions	Marks Distribution	Remarks
I	Listening · instruction · description · conversation	2	objective	5+5	listening tape to be played on any two out of instruction, description and conversation followed by 10multiple choice type or fill in the gaps type questions
II	Speaking · group/ round table discussion · presenting brief oral report · delivering talk	2	subjective	Round table discussion 5, talk or brief oral report =10	Different topics to be assigned in groups consisting of 8 members for group discussion and to be judged individually, individual presentation to be judged through either by talk on assigned topics or by brief oral reports based on their previous project, study and field visit.

Prescribed books

1. Adhikari, Usha, Yadav, Rajkumar, Yadav, Bijaya, ; " A Course book of Communicative English", Trinity Publication, 2012.
2. Adhikari, Usha, Yadav, Rajkumar, Shrestha, Rup Narayan ; "Technical Communication in English", Trinity Publication, 2012.

   (Note: 50 marks excluding reading to be covered on the basis of first book and reading part (i.e. 30 marks) to be covered on the basis of second book)
3. Khanal, Ramnath, "Need-based Language Teaching (Analysis in Relation to Teaching of English for Profession Oriented Learners)", Kathmandu: D, Khanal.
4. Konar, Nira, "Communication Skills for Professional", PHI Learning Private Limited, New Delhi.
5. Kumar, Ranjit, "Research Methodology", Pearson Education.
6. Laxminarayan, K.R, "English for Technical Communication", Chennai; Scitech publications (India) Pvt. Ltd.
7. Mishra, Sunita et. al. , "Communication Skills for Engineers", Pearson Education First Indian print.
8. Prasad, P. et. al , "The functional Aspects of Communication Skills", S.K. Kataria & sons.
9. Rutherfoord, Andrea J. Ph.D, "Basic Communication Skills for Technology", Pearson Education Asia.
10. Rizvi, M. Ashraf), "Effective Technical Communication", Tata Mc Graw Hill.

11. Reinking A James et. al, "Strategies for Successful Writing: A rhetoric, research guide, reader and handbook", Prentice Hall Upper Saddle River, New Jersey.
12. Sharma R.C. et al., "Business Correspondence and Report Writing: A Practical Approach to Business and Technical communication", Tata Mc Graw Hill.
13. Sharma, Sangeeta et. al, "Communication skills for Engineers and Scientists", PHI Learning Private Limited, New Delhi.
14. Taylor, Shirley et. al., "Model Business letters, E-mails & other Business documents", Pearson Education.

DESIGN OF STEEL AND TIMBER STRUCTURES
CE 651

Lecture : 4 **Year : III**
Tutorial : 2 **Part : II**
Practical : 0

Course Objectives:

- To make students capable to design ordinary steel and timber structures.
- To prepare students for advanced knowledge on design of complex steel and timber structures.

PART A: STEEL STRUCTURES

1. Steel Structures and their Analysis and Design **(4hours)**

1.1 Introduction to Steel Structures
1.2 Structural Steel and Classification of Steel Sections
1.3 Method of Analysis and Design
1.4 Design Process and Basis for Design

2. Working Stress Design Method **(2hours)**

2.1 Basic Assumptions in Working Stress Design
2.2 Service Load and Permissible Stresses
2.3 Design in Tension, Compression, Bending and Shear

3. Limit State Design Method **(3hours)**

3.1 Safety and Serviceability Requirements of Structure
3.2 Different Limit States for Steel Design
3.3 Design Strength of Materials and Design Loads
3.4 Limit State of Strength
3.5 Limit State of Serviceability

4. Connections in Steel Structures **(10hours)**

4.1 Types of Connections
4.2 Welded Connections
  4.2.1 Welds and Welding
  4.2.2 Design of Simple Welded Connections
  4.2.3 Design of Eccentric Welded Connections
4.3 Bolted Connections
  4.3.1 Bolts and Bolting
  4.3.2 Design of Simple Bolted Connections
  4.3.3 Design of Eccentric Bolted Connections
4.4 Introduction to Riveted Connection

5. Tension Members **(4hours)**

5.1 Types of Tension Member

5.2 Sectional Area of Tension Members
5.3 Design of Tension Members of Simple and Built-Up Sections
5.4 Design of Lug Angles
5.5 Tension Splices

6. Compression Members **(10hours)**

6.1 Types of Compression Member
6.2 Buckling Behavior of Column
6.3 Design of Column of Simple and Built-Up Sections
6.4 Design of Lateral Bracings of Compression Members
6.5 Design of Eccentrically Loaded Columns
6.6 Design of Column Bases
  6.6.1 Axially Loaded Column Bases
  6.6.2 Eccentrically Loaded Column Bases
6.7 Design of Column Splices

7. Flexure Members **(13hours)**

7.1 Types of Beams
7.2 Design of Simple Beams
7.3 Design of Built-Up Beams
7.4 Design of Plate Girders
  7.4.1 Elements of a Plate Girder
  7.4.2 Preliminary Design
  7.4.3 Design for Bending, Shear, Deflection and Lateral Stability
  7.4.4 Curtailment of Flange Plates
  7.4.5 Design of Web and Flange Splices

8. Design of Roof Trusses **(4hours)**

8.1 Types of Roof Truss and Components of Roof Truss
8.2 Loads on Roof Truss
8.3 Design of Roof Components

PART B: TIMBER STRUCTURES

9. Timber Structures and Design Methods **(2hours)**

9.1 Introduction to Timber Structures
9.2 Structural Timber and Factors Affecting the Strength of Timber
9.3 Design Methods and Basis for Design

10. Joints in Timber Structures **(2hours)**

10.1 Types of Joints
10.2 Design of Bolted Joints
10.3 Design of Nailed Joints

11. Design of Compression Members **(3hours)**

11.1 Types of Timber Column

11.2 Design of Timber Columns
11.3 Introduction to Column Bases

12. Design of Flexure Members **(3hours)**

12.1 Types of Beam
12.2 Design of Timber and Flitched Beams

Course Project:

- A Course project on integrated design of a building/industrial structure.

References:

1. S.K. Duggal, "Limit State Design of Steel Structures" Tata McGraw-Hill Publishing Com.
2. K.S. Sai Ram, "Design of Steel Structures" PEARSON Education
3. L.S. Negi, "Design of Steel Structures" Tata McGraw-Hill Publishing Com.
4. Ram Chandra, "Design of Steel Structures" Standard Book House

BUILDING TECHNOLOGY
CE 652

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 0

Course Objectives:

To introduce: Functional requirements of buildings, Factors affecting comfort to the occupant in the building, Elements of building, Construction details of building components, Services in building and Causes & prevention of cracks in buildings.

1. Functional Requirements of Buildings **(7 hours)**

1.1 Buildings and their types
1.2 Heat phenomena in Building (thermal performance of building components, thermal comfort, thermal design)
1.3 Ventilation (requirements, standards, design) & air conditioning
1.4 Lighting (illumination requirements, daylight, artificial lighting)
1.5 Sound and Acoustics (sound & noise, acoustic defects, sound insulation)
1.6 Orientation & planning of buildings (principles, site-selection, economy, setting-out)
1.7 Moisture & its movement through building components and damp proofing

2. Foundations **(5 hours)**

2.1 Soil exploration (methods, improving bearing capacity, load test)
2.2 Foundation and its types (deep, shallow)
2.3 Earthwork excavation of foundations (soft soil, hard rock, wet excavation)
2.4 Excavation of trenches for pipes, cables etc. and refilling works
2.5 Some common problems with existing foundations

3. Mortars & Masonry Works **(4 hours)**

3.1 Mortars (Types, properties, preparation process, Estimating mortar requirement)
3.2 Brick masonry (types, specifications)
3.3 Stone masonry (random rubble, course rubble, ashlar)
3.4 Walls: retaining walls, cavity walls, parapet walls

4. Roofs **(4 hours)**

4.1 Roofs & their types
4.2 Timber roofs (Single/double/ multiple timber roofs)
4.3 Steel trusses and their components (Angle & tubular truss)
4.4 Roof coverings

5. Stair, Lifts and Escalators **(3 hours)**

5.1 Stair and its Elements
5.2 Essential requirements & Types of stair
5.3 Ladders, ramps, Lifts & Escalators

6. Doors and Windows **(2 hours)**

6.1 Doors: frames, shutters and their fixing details
6.2 Windows & ventilators: types and their fixing details

7. Flooring **(3 hours)**

7.1 Flooring and its types
7.2 Special types of floor finishing
7.3 Floor and wall ties

8. Temporary Construction **(4 hours)**

8.1 Scaffolding and its types
8.2 Formwork for excavations & trenches and Formworks for RCC construction
8.3 Shoring and its types
8.4 Underpinning and its procedures

9. Finishing Works **(4 hours)**

9.1 Cladding (types, fixing process)
9.2 Partitions & Suspended ceilings
9.3 Plastering & Pointing (types and process of application)
9.4 Painting works in wooden, metal and masonry surfaces

10. Causes and Prevention of Cracks in Buildings **(2 hours)**

10.1 Cracks in different components of buildings (walls, roofs, floors, plasters, windows, RCC, joints etc.)
10.2 Causes of cracks and Remedial measures to cracks

11. Earthquake Protection & Retrofitting in Building **(3 hours)**

11.1 Earthquake Protection of Buildings
11.2 Techniques of Retrofitting and Retrofitting materials
11.3 Destructive and non-destructive tests in buildings

12. Other Services in Building **(4 hours)**

12.1 Water supply & sanitation
12.2 Electrification, CCTV and Telephone network
12.3 Fire Protection
12.4 Rainwater harvesting

Assignments: **(10 marks)**

1. Drawings of site plan, foundation trench plan, section and timbering of foundation trench.

2. Detailed drawings of foundation structures. Bonding details of junction of walls.
3. Detailed drawings of important building components (foundation, plinth, and superstructure).
4. Detailing of frames and shutters of doors and windows;
5. Drawing plan and section of dog legged stair case.
6. Isometric view, plan and sections of scaffolding, shoring and underpinning.
7. Septic tank, soak pit and isometric view of pipe layout.
8. Layout drawing of power, light circuit and other networks.

Tutorial: **(15 hours)**

In tutorial class students will be taught to design a residential/office building and prepare complete working drawings with essential details.

Note:

Student will be assigned to prepare a building plan to work out detailed drawings for tutorial exercises.

References:

1. WB Mckay, "Building Construction", ELBS Publication.
2. Goyal, M. M.,"Handbook of Building Construction: The essential source of standard construction practices", Thomson Press.
3. Chudey&Greeno, "Building Construction Handbook", Butterworth & Heinemann.
4. Reid E.,"Understanding Buildings", MIT press.
5. Pahari, B., "Passive Building: Concept & Design", ISBN: 99933-34-24-3.
6. Building code (NS, IS).
7. S.C.Rangawala, "Building Construction"
8. Ching, FDK, "Building construction Illustrated"

ENGINEERING ECONOMICS
CE 655

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 0

Course Objectives:
To provide concept and knowledge of economic studies that will be useful for the evaluation engineering projects and make decisions related to investment.

1. Introduction **(3 hours)**

1.1 Origin of Engineering Economy
1.2 Principles of Engineering Economy
1.3 Role of Engineers in Decision Making
1.4 Cash Flow Diagram

2. Interest and Time Value of Money **(6 hours)**

2.1 Introduction to Time Value of Money
2.2 Simple Interest
2.3 Compound Interest
  2.3.1 Nominal Interest Rate
  2.3.2 Effective Interest Rate
  2.3.3 Continuous Compounding
2.4 Economic Equivalence
2.5 Development of Interest Formulas
  2.5.1 The Five Types of Cash Flows
  2.5.2 Single Cash Flow Formulas
  2.5.3 Uneven Payment Series
  2.5.4 Equal Payment Series
  2.5.5 Linear Gradient Series.
  2.5.6 Geometric Gradient Series.

3. Basic Methodologies of Engineering Economic Analysis **(8 hours)**

3.1 Determining Minimum Attractive (Acceptable) Rate of Return (MARR).
3.2 Payback Period Method
3.3 Equivalent Worth Methods
  3.3.1 Present Worth Method
  3.3.2 Future Worth Method
  3.3.3 Annual Worth Method
3.4 Rate of Return Methods
  3.4.1 Internal Rate of Return Method.
  3.4.2 External/Modified Rate of Return Method
3.5 Public Sector Economic Analysis (Benefit Cost Ratio Method)
3.6 Introduction to Lifecycle Costing
3.7 Introduction to Financial and Economic Analysis

4. Comparative Analysis of Alternatives **(6 hours)**

4.1 Comparing Mutually Exclusive Alternatives having Same Useful Life by
- 4.1.1 Payback Period Method and Equivalent Worth Method
- 4.1.2 Rate of Return Methods and Benefit Cost Ratio Method

4.2 Comparing Mutually Exclusive Alternatives having Different Useful Lives by
- 4.2.1 Repeatability Assumption
- 4.2.2 Co-terminated Assumption
- 4.2.3 Capitalized Worth Method

4.3 Comparing Mutually Exclusive, Contingent and Independent Projects in Combination

5. Replacement Analysis **(6 hours)**

5.1 Fundamentals of Replacement Analysis
- 5.1.1 Basic Concepts and Terminology
- 5.1.2 Approaches for Comparing Defender and Challenger

5.2 Economic Service Life of Challenger and Defender

5.3 Replacement Analysis When Required Service Life is Long
- 5.3.1 Required Assumptions and Decision Framework
- 5.3.2 Replacement Analysis under the Infinite Planning Horizon
- 5.3.3 Replacement Analysis under the Finite Planning Horizon

6. Risk Analysis **(6 hours)**

6.1 Origin/Sources of Project Risks

6.2 Methods of Describing Project Risks
- 6.2.1 Sensitivity Analysis
- 6.2.2 Breakeven Analysis
- 6.2.3 Scenario Analysis

6.3 Probability Concept of Economic Analysis

6.4 Decision Tree and Sequential Investment Decisions

7. Depreciation and Corporate Income Taxes **(6 hours)**

7.1 Concept and Terminology of Depreciation

7.2 Basic Methods of Depreciation
- 7.2.1 Straight line method
- 7.2.2 Declining Balance Method
- 7.2.3 Sinking Fund Method
- 7.2.4 Sum of the Year Digit Method
- 7.2.5 Modified Accelerated Cost Recovery System (MACRS)

7.3 Introduction to Corporate Income Tax

7.4 After Tax Cash Flow Estimate

7.5 General Procedure for Making after Tax Economic Analysis

8. Inflation and its Impact on Project Cash Flows **(4 hours)**

8.1 Concept of Inflation

8.2 Measuring Inflation

8.3 Equivalence Calculation Under Inflation
8.4 Impact of Inflation on Economic Evaluation

Tutorial:

1. Assignments
2. Quizzes and 1Case study

References:

1. Chan S.Park,"Contemporary Engineering Economics", Prentice Hall, Inc.
2. E. Paul De Garmo, William G. Sullivan and James A. Bontadelli, "Engineering Economy", Mc Milan Publishing Company.
3. James L. Riggs, David D. Bedworth and Sabah U. Randhawa, "Engineering Economics", Tata McGraw Hill Education Private Limited.

SANITARY ENGINEERING
CE 656

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 0

Course Objectives:

To provide a complete knowledge of wastewater on collection, conveyance, treatment, disposal methods and design including knowledge of sludge and solid waste management

1. Introduction **(2 hours)**

- 1.1 Definitions of common terms - Sewage/Wastewater, Domestic sewage, Industrial sewage, Sanitary sewage, Storm water, Sullage, Sewer, Sewerage, Rubbish, Garbage, Refuse/Solid waste
- 1.2 Importance of Wastewater and Solid Waste Managements
- 1.3 Wastewater and Solid waste management methods - Collection, Conveyance, Treatment and Disposal
- 1.4 Objectives of sewage disposal
- 1.5 Sanitation systems
  - 1.5.1 Conservancy system with merits and demerits
  - 1.5.2 Water carriage system with merits and demerits
- 1.6 Sewerage systems and types
  - 1.6.1 Separate system
  - 1.6.2 Combined system
  - 1.6.3 Partially separate system
  - 1.6.4 Comparison between separate and combined systems

2. Quantity of Wastewater **(4 hours)**

- 2.1 Dry Weather Flow (DWF) and Wet Weather Flow (WWF)
- 2.2 Sources of sanitary sewage
  - 2.2.1 Private and public water supplies
  - 2.2.2 Groundwater infiltration
  - 2.2.3 Unauthorized connections
- 2.3 Factors affecting quantity of sanitary sewage
  - 2.3.1 Population
  - 2.3.2 Rate of water supply
  - 2.3.3 Groundwater infiltration
  - 2.3.4 Unauthorized connections
- 2.4 Determination of quantity of sanitary sewage, peak factor, peak flow
- 2.5 Determination of quantity of storm water
  - 2.5.1 Rational method and its limitation
  - 2.5.2 Overall runoff coefficient
  - 2.5.3 British ministry of Health formula for intensity of rainfall
  - 2.5.4 Time of concentration

2.6 Numerical on determination of quantity of wastewater for separate, combined and partially separate systems

3. Design and Construction of Sewers **(4 hours)**

3.1 Design criteria of sewers
- 3.1.1 Specific gravity of wastewater
- 3.1.2 Design period
- 3.1.3 Minimum and Maximum velocities, Self-cleansing velocity
- 3.1.4 Sewer size range
- 3.1.5 Sewer gradient
- 3.1.6 Hydraulic formulae for design - Manning's, Chezy's and Hazen Williams formulae
- 3.1.7 Hydraulic elements of sewers for partial flow condition
- 3.1.8 Partial flow diagrams

3.2 Shapes of sewers - Circular and non-circular sections with merits and demerits

3.3 Sewer Materials
- 3.3.1 Requirements of sewer materials
- 3.3.2 Types of sewer materials - salt glazed stoneware, cement concrete, cast iron

3.4 Design of sewers of separate and combined systems

3.5 Numerical on design of sewers

3.6 Construction of sewers
- 3.6.1 Setting out
- 3.6.2 Alignment and gradient
- 3.6.3 Excavation of trench
- 3.6.4 Timbering of trench
- 3.6.5 Dewatering of trench
- 3.6.6 Laying and jointing
- 3.6.7 Testing of sewer - Straightness, Obstruction, Water and Air tests
- 3.6.8 Backfilling of trench

4. Sewer Appurtenances **(3 hours)**

4.1 Necessity of sewer appurtenances

4.2 Construction of sewer appurtenances
- 4.2.1 Manhole
- 4.2.2 Drop manhole
- 4.2.3 Lamp hole
- 4.2.4 Street inlets
- 4.2.5 Catch basin
- 4.2.6 Flushing device
- 4.2.7 Sand, grease and oil traps
- 4.2.8 Inverted siphon
- 4.2.9 Sewer outlet
- 4.2.10 Ventilating shaft

5. Characteristics and Examination of Wastewater **(5 hours)**

5.1 Characteristics of wastewater
- 5.1.1 Physical characteristics - colour, odour, temperature and turbidity
- 5.1.2 Chemical characteristics - pH, organic and inorganic solids, nitrogenous compounds
- 5.1.3 Biological characteristics – bacteria

5.2 Sampling of wastewater
- 5.2.1 Grab and composite samples
- 5.2.2 Preservation and storing

5.3 Decomposition of wastewater-process, Aerobic and anaerobic decomposition, Stale sewage

5.4 Biochemical Oxygen Demand (BOD)
- 5.4.1 Definition of BOD and its significance
- 5.4.2 Derivation of BOD equation
- 5.4.3 Rate reaction, ultimate BOD and relation with temperature
- 5.4.4 Numerical on BOD

5.5 Chemical oxygen Demand (COD) - Definition and significance

5.6 Examination of wastewater
- 5.6.1 Necessity of wastewater examination
- 5.6.2 Examination of volatile, fixed and total solids, settleable and non-settleable solids,BOD with and without dilution, COD

5.7 Numerical on BOD test

6. Wastewater Disposal **(6 hours)**

6.1 Necessity and objectives of wastewater disposal

6.2 Wastewater disposal methods - Dilution and Land treatment

6.3 Wastewater disposal by Dilution process and essential conditions fordilution

6.4 Self-purification of rivers/streams

6.5 Factors affecting self-purification - Dilution, Current, Sunlight, Sedimentation, Temperature, Oxidation, Reduction

6.6 Oxygen sag curve

6.7 Streeter Phelp's equation (Derivation not required)

6.8 Numerical on self-purification of rivers/streams

6.9 Wastewater disposal by land treatment
- 6.9.1 Suitability of land treatment
- 6.9.2 Methods of land treatment - irrigation, overland flow and rapid infiltration
- 6.9.3 Broad irrigation and sewage farming
- 6.9.4 Methods of application of sewage on land - flooding, surface irrigation, ridge and furrow method, subsurface irrigation and spray irrigation
- 6.9.5 Sewage sickness and its prevention

7. Wastewater Treatment **(12 hours)**

7.1 Objectives of wastewater treatment

7.2 Treatment process types and impurity removal

7.3 Primary treatment process
- 7.3.1 Racks and Screens - purpose and types (Bar, Coarse andFine screens)
- 7.3.2 Skimming tank - purpose and construction
- 7.3.3 Grit chamber - purpose, construction and design criteria
- 7.3.4 Sedimentation - purpose, types and design criteria
- 7.3.5 Chemical precipitation - purpose, mixing and flocculation (introduction only)
- 7.3.6 Numerical on design of Grit chamber and Sedimentation tank

7.4 Biological (Secondary) treatment process
- 7.4.1 Objectives of biological treatment process
- 7.4.2 Principles of biological treatment process - Attached andSuspended growth processes
- 7.4.3 Types of biological treatment process

7.5 Sewage filtration
- 7.5.1 Filter types
- 7.5.2 Intermittent sand filter - purpose, construction,working and cleaning with merits anddemerits
- 7.5.3 Contact bed - purpose, construction, working and cleaning with merits and demerits
- 7.5.4 Trickling filter - purpose, construction, working andcleaning with merits and demerits,types (high rate and standard rate), recirculation, two stage filters, design criteria
- 7.5.5 Numerical on design of trickling filters

7.6 Activated sludge process
- 7.6.1 Principles of activated sludge process
- 7.6.2 Construction and process description
- 7.6.3 Aeration methods
- 7.6.4 Design criteria
- 7.6.5 Advantages and disadvantages
- 7.6.6 Sludge volume index
- 7.6.7 Numerical on activated sludge process

7.7 Oxidation ponds
- 7.7.1 Purpose of oxidation ponds
- 7.7.2 Theory of oxidation ponds
- 7.7.3 Construction of oxidation ponds
- 7.7.4 Commissioning
- 7.7.5 Operation and maintenance
- 7.7.6 Design criteria
- 7.7.7 Advantages and disadvantages
- 7.7.8 Numerical on oxidation ponds

8. Sludge Treatment and Disposal **(4 hours)**

8.1 Sources of sludge
8.2 Necessity of sludge treatment
8.3 Characteristics of sludge
8.4 Determination of sludge volume, volume - moisture relation

8.5 Sludge treatment methods
- 8.5.1 Grinding and blending
- 8.5.2 Thickening - Gravity thickener, purpose, constructionand loading criteria
- 8.5.3 Digestion - Aerobic and anaerobic digestion, digestionprocess, control of digestion,construction and design criteria of digester
- 8.5.4 Dewatering - Vacuum filtration (purpose and construction)
- 8.5.5 Drying - Sludge drying beds (purpose and construction)
- 8.5.6 Composting - purpose, principles, types (windrow and mechanical)
- 8.5.7 Incineration - purpose and construction

8.6 Numerical on sludge volume determination and design of digester

8.7 Sludge disposal methods
- 8.7.1 Dumping
- 8.7.2 Land filling
- 8.7.3 Lagooning
- 8.7.4 Spreading on land

9. Disposal of Sewage from Isolated Buildings **(3 hours)**

9.1 Necessity

9.2 On site sanitation - Definition and types

9.3 Pit privy - purpose and construction

9.4 Ventilated Improved Pit (VIP) latrine - purpose, construction,design criteria, types (single pit, double pits and multiple pits), advantagesand disadvantages

9.5 Pour flush latrine - purpose, construction and design criteria

9.6 Septic tank - purpose, construction, design criteria, working and maintenance

9.7 Septic tank effluent disposal methods
- 9.7.1 Drain field - purpose, construction and design criteria
- 9.7.2 Soak pit - purpose, construction and design criteria
- 9.7.3 Evapotranspiration mound - purpose and construction
- 9.7.4 Leaching cesspool - purpose and construction

9.8 Numerical on design of VIIP latrine, Pour flush latrine, Septic tank,Drain field and Soak pit

10. Solid Waste Disposal **(2 hours)**

10.1 Characteristic of solid waste

10.2 Quantity of solid waste

10.3 Collection and transportation of solid waste

10.4 Solid waste disposal methods
- 10.4.1 Dumping
- 10.4.2 Sanitary landfill
- 10.4.3 Incineration
- 10.4.4 Composting

Tutorial:

1. Quantity of Wastewater **(2 hours)**

Definitions, Numerical on determination of sanitary sewage and storm water, determination on quantity of wastewater for separate, combined and partially

separate systems

2. **Design and Construction of Sewers / Sewer Appurtenances (2 hours)**
   Design criteria of sewers, partial flow conditions in sewers, Numericalon design of sewers for separate and combined systems
3. **Characteristics and Examination of Wastewater (2 hours)**
   Definitions, Numerical on BOD and BOD testing
4. **Wastewater Disposal (2 hours)**
   Definitions, Streeter-Phelp'sequation description, Numericalonpurificationofrivers/streams and degree of treatment required
5. **Wastewater Treatment (3 hours)**
   Definitions, Numerical on grit chamber, sedimentation tank,trickling filter, activated sludgeprocess and oxidation pond
6. **Sludge Treatment and Disposal (2 hours)**
   Definitions, Numerical on sludge volume determination, volume-moisture relation and design ofdigesters
7. **Disposal of Sewage from Isolated Buildings/ Solid Waste Disposal (2 hours)**
   Definitions, Numerical on design of VIP latrine, Pour flush latrine, Septic tank, Drain fieldand Soak pit

References:

1. B. C. Punmia and Ashok Jain, "Wastewater Engineering", Laxmi Publications (P) Ltd., New Delhi.
2. P.N. Modi, "Sewage Treatment & Disposal and Wastewater Engineering",Standard Book House, Delhi.
3. G.S. Birdie and J,S, Birdie, "Water Supply and Sanitary Engineering", DhanpatRai Publishing Company (P) Ltd., New Delhi.
4. K.N. Duggal, "Elements of Environmental Engineering", S.Chand and Company Ltd., New Delhi.

TRANSPORTATION ENGINEERING I

CE 653

Lecture : 3
Tutorial : 1
Practical : 2/2

Year : III
Part : II

Course Objectives:

To provide knowledge of road development and its planning based on Nepalese context so that students will be able to plan, survey and design the road projects.

1. Introduction to Transportation Planning and Engineering (4 hours)

- 1.1 Introduction
- 1.2 Modes of Transportation
- 1.3 Comparison between Various Modes of Transportation
- 1.4 Historical Development of Roads and Road Construction in Nepal
- 1.5 Transport Planning including Objective of Road Planning, National Network Planning, Urban Road Network Planning and Ring Roads
- 1.6 Classification of Roads (NRS)

2. Highway Alignment and Engineering Survey (4 hours)

- 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 Structure of the Route Location Process
  - 2.2.2 Physical Surveys: Map Study, Reconnaissance, Preliminary and Detailed Surveys

3. Geometric Design of Highway (18 hours)

- 3.1 Definition and Scope of Geometric Design
- 3.2 Basic Design Controls and Criteria for Design
- 3.3 Elements of Cross-section
- 3.4 Elements of Horizontal Alignments
  - 3.4.1 Definition and Types of Horizontal Curve
  - 3.4.2 Design of Horizontal Curves including Night Visibility Consideration
  - 3.4.3 Sight Distance: Stopping Sight Distance, Overtaking Sight Distance, Set-back from Obstructions
  - 3.4.4 Super Elevation
  - 3.4.5 Extra Widening
  - 3.4.6 Transition Curves: Definition and Types of Transition Curve, Design of Transition Curve
- 3.5 Elements of Vertical Alignment
  - 3.5.1 Definition and Types of Gradient

3.5.2 Momentum Grade
3.5.3 Grade Compensation
3.5.4 Definition and Types of Vertical Curve
3.5.5 Design of Vertical Summit Curve
3.5.6 Design of Vertical Valley Curve
3.5.7 Lowest and Highest Point of Vertical Curve

4. Highway Drainage **(4 hours)**

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 Subsurface 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 Roads **(5 hours)**

5.1 Introduction
5.2 Special Consideration 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, Different Types of Hill Road Cross Sections
5.3 Special Structures in Hill Road
5.3.1 Types of Retaining Structures, River Training Structures, Land Slide Stabilization Structures and Gully Control Structures

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

6.1 Introduction and Classification of Road Materials
6.2 Sub-grade Soil
6.2.1 General
6.2.2 Characteristics of Sub-grade Soil
6.2.3 Desirable Properties of Sub-grade Soil
6.3 Road Aggregate
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 and Method of Translating Specification
6.3.5 Combining of the 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

6.4.3 Tests on Bituminous Binders

6.5 Bituminous Mixes

6.5.1 Definition and Classification

6.5.2 Marshal Method of Bitumen Mix Design

Tutorial:

There shall be related tutorials exercised in class and given as regular homework exercises.

Practical:

1. Los Angeles Abrasion Value and Crushing Value of Aggregates
2. Penetration Value; Viscosity; Softening Point and Ductility of Bitumen
3. Skid Resistance Test on Road Surface
4. Marshall Stability Test and Asphalt Mix Design
5. Extraction of Bitumen from Mix and Gradation of Aggregate after Extraction

References:

1. S.B.Sehgal and K.I. Bhanot, "A Text-book on Highway Engineering and Airports", S. Chand and Co. Publishers Ltd., New Delhi
2. S.K. Sharma, "Principles, Practice and Design of Highway Engineering", S. Chand and Co. Publishers Ltd., New Delhi
3. Dr. S.K. Khanna and Dr. C.E.G.Justo, "Highway Engineering" Nem Chand & Bros Roorkee (U.P.)
4. C.A. Flaherty, "Highway Engineering" Edward Arnold (Publishers) Ltd.
5. P.M. Parajuli, "Course Manual on Transportation Engineering" Department of Civil Engineering, Pulchowk Campus

IRRIGATION AND DRAINAGE ENGINEERING

CE 654

Lecture : 3 **Year :III**
Tutorial : 2 **Part : II**
Practical : 0

Course Objectives:

To provide knowledge to students for the planning, design, development, operation, maintenance & management and demand analysis of irrigation, methods of irrigation, components of an irrigation system and layout of irrigation structures.

1. Introduction **(4 hours)**

1.1 Definition, advantages and disadvantages of irrigation
1.2 Status and need of irrigation development in Nepal
1.3 Crops, their seasons and periods (Cropping pattern & intensity)
1.4 Commanded areas and Irrigation intensity
1.5 Methods of field irrigation and their suitability
1.6 Planning of irrigation projects

2. Irrigation Water Requirements **(4 hours)**

2.1 Relation between Duty, Delta and crop periods
2.2 Crop Water Requirements (Penman's method)
2.3 Operational water requirements
2.4 Water losses due to seepage and evaporation
2.5 Effective Rainfall
2.6 Irrigation Water Requirements
2.7 Soil-Moisture-Irrigation Relationship
2.8 Depth and Frequency of Irrigation
2.9 Irrigation efficiencies
2.10 Design discharges for canals

3. Canal Irrigation System **(3 hours)**

3.1 Classification of canals
3.2 Components of a canal irrigation system
3.3 Alignment of canals
3.4 Alluvial and Non-alluvial canals
3.5 Canal standards and Balancing canal depth
3.6 Canal distribution system

4. Design of Canals **(6 hours)**

4.1 Design capacity of canals
4.2 Sediment transport in canals
4.3 Tractive Force approach of canal design

4.4 Design of stable canals
4.5 Design of Alluvial canals (Kennedy's &Lacey's Theory)
4.6 Design of lined canals with economic analysis

5. Diversion Headworks **(8 hours)**

5.1 Component parts of Weir/Barrage (Detail drawing)
5.2 Bligh's, Lane's and Khosla's seepage theory
5.3 Design of sloping glacies weir bay (crest, length & thickness of impervious floor)
5.4 Design of Undersluice and Silt excluder
5.5 Design of Silt ejector
5.6 Design of Head Regulator (Crest, length & thickness of impervious floor)

6. River Training Works **(4 hours)**

6.1 River stages and Need of river training
6.2 Types of river training works
6.3 Design of Guide bunds and Launching apron
6.4 Design of Spurs (Layout geometry, length, spacing and cross-section)

7. Regulating Structures **(6 hours)**

7.1 Alignment of the off-taking channels
7.2 Function of Head regulator, Cross regulator, Outlet, Drop and Escapes
7.3 Design of Regulators & Escapes (Crest, length and thickness of impervious floor)
7.4 Types of Outlet, Design of pipe outlet (free and submerged)
7.5 Types of Drop, Design of Vertical drop (Crest, length and thickness of impervious floor)

8. Cross-Drainage Structures **(4 hours)**

8.1 Types (Drawing and Selection)
8.2 Design of Siphon Aqueduct (Detail drawing, Drainage waterway & barrel, Canal waterway & Transition, Length & thickness of impervious floor and Protection works)

9. Water Logging and Drainage **(6 hours)**

9.1 Causes, effects and preventive measures of water logging
9.2 Water logging and drainage of irrigated land
9.3 Surface drainage systems and their design
  9.3.1 Layout planning for Drainage
  9.3.2 Internal drainage of Bunded fields
  9.3.3 External drainage
  9.3.4 Drain design (water level, maximum & minimum slopes and cross-sections)
  9.3.5 Remodeling of existing natural drains
9.4 Subsurface drainage systems and their design
  9.4.1 Layout of subsurface drainage system

9.4.2 Flow of ground water to drains and spacing of tile drains

Tutorial: **(30 hours)**

1. Duty, Delta and Period Relation (1 hour)
2. Irrigation Water Requirements (2 hours)
3. Soil-Moisture-Irrigation Relation and Irrigation Interval (2 hours)
4. Balancing depth for excavating canals (1 hour)
5. Design of stable canals (1 hour)
6. Design of Alluvial canals (2 hours)
7. Design of lined canals (1 hour)
8. Design of Guide Bunds and Launching Apron (2 hours)
9. Design of hydraulic structures using Khosla's Seepage Theory (4 hours)
10. Design of sloping glacies Weir bay (2 hours)
11. Design of Cross & Head Regulators (3 hours)
12. Design of pipe outlet (1 hour)
13. Design of Vertical Drop (2 hours)
14. Design of Siphon Aqueduct (4 hours)
15. Design of surface and sub-surface drains (2 hours)

Assignment& Field Visit:

1. Individual assignment on Irrigation Water Requirement using CROPWAT Software
2. Field visit of an Irrigation System, group presentation and submission of individual report

References:

1. R S Varshney, S C Gupta and R L Gupta, "Theory and Design of Irrigation Structures Volume I and II", , Nem Chand and Bros., Roorkee.
2. S K Garg, "Irrigation Engineering and Hydraulic Structures", Delhi.
3. Gurcharan Singh, " Irrigation Engineering",
4. "Design Manuals for Irrigation projects in Nepal", PDSP Manuals, M.9 Drainage Manual
5. P. Novak et.al., "Hydraulic Structures", SPON PRESS.