COMPUTATIONAL TECHNIQUES IN CIVIL ENGINEERING
CE …

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

Course Objective:
The knowledge of numerical solutions of various civil engineering problems is essential to the analysis and design of the structures. This course includes the fundamentals of computational techniques required for those problems which cannot be solved by manually and ordinary methods. It teaches the steps required to solve the equations using algorithms and computer programs.

1. Introduction (4 hours)
- 1.1. History of numerical computations of civil engineering problems
- 1.2. Brief description of solution techniques
  - 1.2.1. Finite element method
  - 1.2.2. Finite difference method
  - 1.2.3. Boundary element method
  - 1.2.4. Discrete element method
  - 1.2.5. Smoothed particle hydrodynamics
- 1.3. Review of programming methods: (C or FORTRAN or Matlab)

2. Solutions of linear equations (6 hours)
- 2.1. System of linear equations
- 2.2. Banded matrices
- 2.3. Data storage and memory optimization
- 2.4. Conjugate gradient method
- 2.5. Fourier Integral
  - 2.5.1. Discrete Fourier Transform
  - 2.5.2. Fast Fourier Transform

3. Elasticity in solids (6 hours)
- 3.1. Stress displacement relationship
- 3.2. Stress-strain (constitutive) relations
  - 3.2.1. 3D state of solid, Lame constants
  - 3.2.2. Plane stress and plane strain condition
  - 3.2.3. Axi-symmetric stresses
- 3.3. Equilibrium equations

4. Finite element method (14 hours)
- 4.1. Direct stiffness method
  - 4.1.1. Stiffness matrices for bar, truss and beam element matrices
  - 4.1.2. Transformation matrices for 2D and 3D cases and assembly
  - 4.1.3. Example of a truss
- 4.2. Coordinate system - local, global, natural
- 4.3. Interpolation functions
  - 4.3.1. Pascal triangle
  - 4.3.2. Polynomial function
  - 4.3.3. Lagragian element
  - 4.3.4. Hermite interpolation for beam element
  - 4.3.5. Serendipidity element
- 4.4. Application in solid and frames
  - 4.4.1. Formulation of stiffness matrices for bars, truss, beams and area (triangle) elements
  - 4.4.2. Isoparametric formulation (linear displacement field only) – 2D triangle and quadrilateral
  - 4.4.3. Example of dam: Calculate stresses giving pressure loads using computer programs
  - 4.4.4. Example on wall: Calculate stresses giving vertical loads using computer programs
  - 4.4.5. Example on wall: Calculate stresses giving vertical loads using computer programs
- 4.5. General introduction to pre and post processing

5. Finite difference method (7 hours)
- 5.1. Finite differences
- 5.2. Explicit scheme and Implicit Scheme
- 5.3. Governing equations of movement of fluid(Momemtum and continuity equations)
- 5.4. Discretization of Kinematic wave Equation (linear and non linear)
- 5.5. Order of accuracy of the scheme and its applications
- 5.6. Numerical diffusion, dispersion and stability of scheme
- 5.7. Applications of the schemes in hydraulic channel routing
- 5.8. Implicit dynamic wave model
- 5.9. Finite difference scheme for Saint-Venant equations

6. Method of Characteristics (4 hours)
- 6.1. Introduction
- 6.2. Characteristics
- 6.3. Initial and boundary conditions
- 6.4. Solution to unsteady flow in pipes

7. Simulation of Ground water flow (4 hours)
- 7.1. Steady state flow nets and finite difference grid

7.2. Simulation of seepage under a dam
7.3. One dimensional Implicit Model
7.4. Application in river-Groundwater system

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

1. **Introduction** **(2 hrs)**
   Theory, definition and concept type questions
   Practical: Home work to make programs in C or FORTRAN or Matlab languages

2. **Solutions of linear equations** **(6 hrs)**
   Theory, definition and concept type questions
   Practical examples, and numerical examples types questions
   Write algorithm and computer programs to solve the problems

3. **Elasticity in solid** **(2 hrs)**
   Theory, definition and concept type questions
   Practical examples of various conditions of stresses

4. **Finite element method (FEM)** **(10 hrs)**
   Theory, definition and concept type questions
   Practical examples, numerical examples and derivation type questions
   Analyze beams and simple frames

5. **Finite difference method** **(4 hours)**
   Theory, definition and concept type questions,
   Practical examples, numerical examples and derivation type questions, excercises on Hydraulic channel routing

6. **Method of Characteristics** **(2 hours)**

   Theory, definition and concept type questions, Solution of unsteady flow

7. **Simulation of Ground water flow** **(4 hours)**
   Theory, definition and concept type questions , excercises on Seepage under dam and River stage –Water table evaluation

Assignments
1. Analyze a 2D dam to find stresses giving water pressure and surcharge
2. Analyze a 2D wall panel to find stresses giving vertical loads
3. Analyze 2 storey 2 bay frame and draw bending moments and shear force diagrams
4. Write source codes to solve Saint-Venant equations marks distribution.

References:

1 P. Karasudhi, Foundation of Solid Mechanics, Kluwer Acedemic Publishers, 1991.
2 O. C. Zienkiewicz, R. L. Taylor, Finite Element for Structural, Vol. 1, 2 & 3, Elsevier, 2000.
3 D. V. Huttan, Fundamentals of Finite Element Analysis, TATA McGRAW-HILL, 2004.
4 T. R. Chandrapatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, PHI, 2000.
5 W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second Edition, Cambridge University Press.
6 W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, Numerical Recipes in Fortran, The Art of Scientific Computing, Second Edition, Cambridge University Press.
7 Ralph A.Wurbs, Wesley p.James, Water Resources Engineering, Prentice-Hall India.
8 M. Hanif Chaudhry, Open Channel Flow, Prentice-Hall India.
9 Ven Te Chow, D.R. Maidment, L.W. Mays, Applied Hydrology, McGraw-Hill

Evaluation Scheme:
The questions will cover all the chapters in the Syllabus. The evaluation scheme will be as indicated in the table below.

Chapter	Hours	Marks Distribution*
1	4	8
2	6	8
3	6	10
4	14	16
5	7	12
6	4	8
7	4	8
Total	45	80

* There may be minor deviation in marks distribution.

ENGINEERING PROFESSIONAL PRACTICE
CE ……

Lecture : 2 **Year : IV**
Tutorial : 0 **Part : II**
Practical : 0

Course Objective:
To familiarize the students with their roles in the society, ethical and legal environment in which engineering is practiced, contract administration, regulatory environment and contemporary issues in Engineering.

1. **History of Engineering Practices** [3 **hours]**
   - 1.1. Man and Society
   - 1.2. Technology and Society
   - 1.3. History of Engineering Practice in Eastern Society
   - 1.4. History of Engineering Practice in Western society
   - 1.5. Engineering Practices in Nepal

2. **Profession and Ethics** **[6 hours]**
   - 2.1. Profession: Definition and Characteristics
   - 2.2. Professional Institutions
   - 2.3. Relation of an Engineer with Client, Contractor and Fellow Engineers
   - 2.4. Ethics, Code of Ethics and Engineering Ethics
   - 2.5. Moral Dilemma and Ethical Decision Making
   - 2.6. Detailed Duties of an Engineer and Architect
   - 2.7. Liability and Negligence

3. **Professional Practices in Nepal** **[3 hours]**
   - 3.1. Public Sector practices
   - 3.2. Private Sector Practices
   - 3.3. General Job Descriptions of Fresh Graduates in both Public and Private Sector

4. **Contract Management** **[6 hours]**
   - 4.1. Methods of work execution/contracting
   - 4.2. Types of Contracts
   - 4.3. Tendering Procedure
   - 4.4. Contract agreement

5. **Regulatory Environment** **[5 hours]**
   - 5.1. Nepal Engineering Council Act
   - 5.2. Labor Law
   - 5.3. Intellectual Property Right
   - 5.4. Building Codes and Bylaws
   - 5.5. Company Registration

6. **Contemporary Issues in Engineering** **[3 hours]**
   - 6.1. Globalization and Cross Cultural Issues
   - 6.2. Public Private Partnership
   - 6.3. Safety, Risk and Benefit Analysis
   - 6.4. Development and Environment
   - 6.5. Conflict and Dispute Management

7. **Case Studies based on Engineering Practices** **[4 hours]**

References:

1. Carson Morrison and Philip Hughes “Professional engineering Practice – Ethical Aspects”, McGraw-Hill Ryerson Ltd.’ Toronto 1982
2. Dr Rajendra Adhikari, “Engineering Professional Practice – Nepalese and international Perspectives” Pashupati Publishing House, Kathmandu Nepal 2010
3. M. Govindarajan; S Natarajan and V.S. Senthikumar., “ Engineering Ethics” – PHI Learning Pvt. Ltd. New Delhi 2009
4. Nepal Engineering Council Act
5. Contract Act
6. Labor Act
7. Company Act
8. Copyright Act
9. Public Procurement Act
10. Building By-Laws

Evaluation Scheme:

The questions will cover all the chapters in the Syllabus. The evaluation scheme will be as indicated in the table below.

Chapter	Hours	Marks distribution*
1	3	4
2	6	8
3	3	4
4	6	8
5	5	6
6	3	4
7	4	6
Total	30	40

* There may be minor deviation in marks distribution.

TECHNOLOGY ENVIRONMENT AND SOCIETY
CE ..

Lectures : 2 **Year : IV**
Tutorials : 0 **Part : II**
Practical : 0

Course Objectives:

The course has been devised to provide knowledge of environment, technology and its impact on society. It would be helpful to the students to understand the global, national and local environmental issues and challenges of the information society.

1. Technology (8hours)

1.1. Definition,
1.2. Impact of technology on environment & society,
1.3. Benefits of technology due to new inventions,
1.4. Conflict of technology, technology creates opportunity for society to change
1.5. Appropriate technology,
1.6. Intermediate technology, labor based and labor intensive technology,
1.7. Shifts in employment due to technological advancement,
1.8. Role of technology to unmask old social problems, society's control of technology,
1.9. Impact of technology on culture, tradition and social values,
1.10. Technology is irreversible,
1.11. Agricultural age, industrial age and information age,
1.12. Characteristics of information society,
1.13. Information as power and wealth

2. Development approach: (6 hours)

2.1. LEP (labor based, environment friendly and participatory),
2.2. Community management, engineers role as facilitator,
2.3. Key features of infrastructure development policies of Nepal,
2.4. Ethnographic approach to collect information ,
2.5. Participatory approach as community empowerment ,
2.6. Participatory tools, focus group discussions, key informants interview,
2.7. Participatory observation, structured questionnaire,
2.8. Resource mapping, wealth ranking, poverty definition

3. Brief history of human civilization (4 hours)

3.1. Early civilization,
3.2. Great renaissance of Europe,
3.3. Early part of industrial revolution,
3.4. Transformation of industrial society into information society,
3.5. Impact of world war 1 & 2, Population explosion,
3.6. Rise of environmental issues,
3.7. Climate change as a threat to human civilization

4. Environment (3 hours)

4.1. Definition,
4.2. Importance, ecology & ecosystem,
4.3. Conservation of environment,
4.4. Optimum utilization of natural resources,
4.5. Renewable and non renewable resources,
4.6. Conflict of resources,
4.7. Global environmental issues,
4.8. Environmental issues of Nepal

5. Water and air pollution (6 hours)

5.1. Fecal -oral infection transmission route
5.2. Preventive measures,
5.3. On site sanitation(including eco -sanitation),
5.4. Importance of health education,
5.5. Organic pollution,
5.6. Inorganic pollution(nitrate, fluoride, iron, manganese, calcium arsenic, heavy metals), water pollution due to insecticides and pesticides
5.7. Sources, causes & impacts of airpolution
5.8. Mitigation measures,
5.9. Indoor air pollution,
5.10. Severity of its problems in Nepal

6. Climate change (3 hours)

6.1. Definition, causes, impacts,
6.2. Mitigation measures,
6.3. International efforts to mitigate its problems,
6.4. Bio –gas, organic farming,
6.5. Deforestation and its consequences,
6.6. Importance of national parks, conservation areas and forestation programs in Nepal

References:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Environmental Engineering", Laxmi Publications (P) Ltd., New Delhi, 1998
2. H.G. Wells, "Brief History of Civilization"
3. J. Neharu, "Glimps of World History"

Examination scheme

The question will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	8	10
2	6	8
3	4	4
4	3	4
5	6	10
6	3	4
Total	30	40

* **There may be minor deviation in marks distribution.**

CONSTRUCTION MANAGEMENT

CE …

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

Course Objective:

- To provide basic knowledge on management of construction works
- To make able to plan and schedule of resources required in construction project.
- To provide basic knowledge of procurement/contract management
- To make able to monitor and evaluate construction projects.
- To provide basic knowledge on maintenance, specification and valuation.

1. Construction Management Framework [3 hours]

1.1. Construction Landmarks
1.2. Scope of Construction Management
1.3. Construction Project Characteristics.
1.4. Construction Project Life Cycle Phases.
1.5. Construction Project Management.
1.6. Relation between Client, Consultant and Contractor

2. Construction Planning and Scheduling [5 hours]

2.1. Construction Planning – Introduction
2.2. Steps and Stages of Planning
2.3. Planning by Contractor and Clients in Different Stages
2.4. Preparing Schedule
2.5. Time Cost Trade Off

3. Planning Construction Material. [5 hours]

3.1. ABC Classification of Construction Materials
3.2. Material Wastage Standards.
3.3. Material Provisioning Process
3.4. Material Inventory Basics
3.5. Inventory Planning Process
3.6. Application Of Value Engineering in the Procurement of Materials

4. Familiarization with Construction Equipments [7 hours]

4.1. Advantages and Disadvantages of using Equipments.
4.2. Equipments for Excavation, Transporting and Compaction; Aggregate Production and Handling; Concrete Construction; Cranes for Lifting; Tunnel Construction; Highway and Pavement Construction; Hydraulic Structure Construction
4.3. Selection of Appropriate Equipment

5. Contract Management [6 hours]

5.1. Method of Work execution
5.2. Types of Contract
5.3. Tendering Process – Preparation before Tendering; Tender Notice; Tender Document; Conditions of Contract; Prequalification; Tender; Evaluation; Selection and Award

6. Construction Process [3 hours]

6.1. Site Surveying and Preparation
6.2. Arrangement of Facilities and Shops/ Job Layout
6.3. Material Handling System
6.4. Financial Management and Cash flow Management

7. Controlling Project Integration and Work [5 hours]

7.1. Work Scope Control
7.2. Product Quality Control
7.3. Labor Productivity Control
7.4. Equipment Productivity Control
7.5. Material Productivity Control
7.6. Work Schedule Control
7.7. Performance Control Using Earned Value Analysis

8. Site Management [3 hours]

8.1. Responsibility of Site Engineer
8.2. Supervising Work of Contractor
8.3. Record Keeping
8.4. Site Order Book
8.5. Procedures to Prepare Bills
8.6. Measurement Book
8.7. Muster Roll

9. Project Maintenance [4 hours]

9.1. Maintenance Basics
9.2. Types of Maintenance
9.3. Planning and Scheduling of Maintenance
9.4. Estimating Maintenance Cost
9.5. Management of Maintenance and Financing

10. Personnel Management [4 hours]

10.1. Management principles: Administration and Organization principles
10.2. Centralization and Decentralization
10.3. Supervisory and Leadership styles
10.4. Importance of communication
10.5. Information System for decisions
10.6. Motivating and directing: human elements, evaluation and merit ranking
10.7. Personnel selection, testing and training
10.8. Trade unions and relation with management

11. Regulatory Requirements [2 hours]

11.1. Safety Requirements
11.2. Workman's compensation board
11.3. Fire regulations and Insurance
11.4. Environment concern and protection
11.5. Building codes and quality control.

12. Specification [6 hours]

12.1. Purpose of Specifications
12.2. Types of Specifications: General and Detailed Specifications
12.3. Specification Writing: technique, use of international and local Standards, Codes of Practice
12.4. Importance of Specifications

13. Valuation [7 hours]

13.1. Introduction
13.2. Cost and Value
13.3. Purpose of Valuation and Principle of Valuation
13.4. Factors affecting the Value of the Property
13.5. Value Classification
13.6. Sinking Fund
13.7. Capitalized value
13.8. Obsolescence
13.9. Depreciations
13.10. Qualification of a Valuer
13.11. Valuation of Land
13.12. Various Methods of valuation of Properties
13.13. Role of Computers in Valuation.
13.14. Report Writing

Tutorials:

1. Time Cost Trade off [2 hours]
2. ABC Classification of Materials [2 hours]
3. Job Layout exercise [1hour]
4. Earned Value analysis [3 hours]
5. Writing Specification [3 hours]
6. Valuation [4 hours]

Field visit of construction site – 2 days.

References:

1. Chitkara, K. K, Construction Project Management; McGraw Hill.
2. Gupta, B.L, Gupta, Amit; Construction Management and Machinary; Standard Publishers Distributors
3. Peurifoy, R L. Construction Planning, Equipment and Methods, McGraw Hill.
4. Harris, Frank , Construction Plant Excavating and Materials handling equipment and Methods, Granada Publishing, London
5. Adhikari, R. P. , Construction Management
6. G S Birdie, Estimating, Valuation and Specifications

Evaluation Scheme:

The question will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark Distribution *
1	3	5
2	5	8
3	5	6
4	7	12
5	6	8
6	3	3
7	5	4
8	3	4
9	4	8
10	4	8
11	2	2
12	6	6
13	7	6
Total	60	80

* **There may be minor deviation in marks distribution.**

PROJECT WORK II
CE …

Lecture : 0 **Year : IV**
Tutorial : 0 **Part : II**
Practical : 6

Course Objective:
Project Work II is the continuation of Project Work –I. In Project-II students are required to complete following works in carry-over of project –I falling under different categories of project works:

1. Design type project
   1.1. Design of the system and their alternatives
   1.2. Detail drawings
   1.3. Cost Estimation
   1.4. Economic and financial analysis
   1.5. References
2. Dissertation type project
   2.1. Model Formulation
   2.2. Model application
   2.3. Results and discussions
   2.4. Larger Implications
   2.5. Conclusion and recommendations
   2.6. References
3. Experimental type project
   3.1. Formulation of hypotheses or model
   3.2. Analysis of results and model application
   3.3. Results and discussions
   3.4. Larger Implications
   3.5. Conclusion and recommendations
   3.6. References

In the initial phase the faculty may conduct a number of lectures and discussions as to the approach of the project. In the later phase the student will be left on his own to pursue his work and to consult the faculty whenever any problem crops up. He should then compile project work –I and project work II write ups and submit a draft report prior to the final report so that the supervisor can correct the mistakes. The final report should be submitted to the Department Head in duplicate.

Elective II

WATER QUALITY MANAGEMENT
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
Upon the completion of the course the students shall be able to understand the importance of aquatic ecology, water pollution, water quality standards, water quality assessment and its management.

1. Introduction: (2 hours)
- 1.1. Water resources and its usage including livelihood
- 1.2. Water cycle and water budget,
- 1.3. Fresh water
- 1.4. Competitive uses of water.

2. Aquatic Ecology: (4 hours)
- 2.1. Ecology and eco-system
- 2.2. River and lake ecology,
- 2.3. Stratification and structure of water masses,
- 2.4. Aquatic plants and animals.

3. Water Pollution: (6 hours)
- 3.1. Types and sources of water pollution,
- 3.2. Point and non-point pollution sources,
- 3.3. Effects of pollution (river, lake and reservoir),
- 3.4. Pollution of ground water

4. Water Quality Standards: (14 hours)
- 4.1. Domestic (drinking, cooking bathing and washing , watering of lawns and gardens, heating and air condition system)
- 4.2. Agriculture
- 4.3. Street washing
- 4.4. Fire fighting
- 4.5. Swimming pools , fountains and cascade
- 4.6. Steam power and other industrial process
- 4.7. Commercial
- 4.8. Public use: parks, street washing, sewer cleaning
- 4.9. Developing animal husbandry
- 4.10. Transporting sewage
- 4.11. Recreation
- 4.12. Various uses of water maintaining ecological balance.

5. Water Quality Assessment: (14 hours)
- 5.1. Waste loads and assimilative capacity of receiving waters (surface and ground)
- 5.2. River water quality, stream flow
- 5.3. DO sag curve, its model and application
- 5.4. Lake water quality
- 5.5. Eutrophication control,
- 5.6. Ground-water contamination and its movement,
- 5.7. Ground water plumes.

6. Management: (5 hours)
- 6.1. Strategies for water pollution control.
- 6.2. Water quality monitoring, management planning, and
- 6.3. River catchment management.

Tutorials:
1. Introduction (1 hour)
   Definitions, water cycle , schematic diagrams of water cycle,
2. Aquatic ecology (1 hour)
   Definitions, point and non-point pollution sources, effects of pollution (river, lakes and reservoir),
3. Water pollution: (2 hours)
   - 3.1. Definition, point and non-point pollution levels in river, lakes and reservoir and its effects,
   - 3.2. Level of pollution of ground water at various places

4. Water quality standards: (4 hours)
   Definitions, WHO guidelines and national standards for various purposes.
5. Water quality assessment: (4 hours)
   - 5.1. Definitions, plotting DO sag curve and its model application for river and lake.
   - 5.2. Ground water pollution and its movement
6. Management: (3 hours)
   - 6.1. Development of strategies for water pollution control.
   - 6.2. Checklist making for water quality monitoring, management

Practical / Project works:

1. Point and non-point pollution sources
2. Water Quality Standards and functional standards
3. Determination of DO Sag curve
4. Surface/ground-water and contamination and its movement
5. Water quality monitoring and management

Referees:

- Andrew D. Eaton, Lenore S. Clesceri, and Arnold E. Greenberg, "Standard methods for the examination of water and wastewater", 1995
- A.K. Deo, "Environmental chemistry"
- C. S. Rao, Environmental pollution control Engineering", Wiley eastern ltd., 1995
- Robert V. Thomann, John A. Mueller, " Principles of Surface quality modeling and control"
- WHO Guidelines for Drinking-water Quality

Examination Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	2	6
2	4	8
3	6	14
4	14	20
5	14	20
6	5	12
Total	45	80

* There may be minor deviation in marks distribution.

DOMESTIC WATER & WASTE WATER ENGINEERING AND MANAGEMENT
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
Upon the completion of the course the students shall be able to understand the importance of domestic water and wastewater management, household tank capacity design, water treatment for domestic use and waste water management.

1. Introduction: (4 hours)
- 1.1. Water sources and use of water in domestic purposes, domestic (drinking, cooking bathing, washing , watering of lawns and gardens, heating and air condition systems)
- 1.2. Impact of using polluted and contaminated water in domestic use,
- 1.3. Existing scenario on polluted and contaminated water.
- 1.4. Wastewater quantity and disposal

2. Quantity and source selection: (4 hours)
- 2.1. Quantity determination
- 2.2. Source selection- supplied water, ground water, rainwater harvesting
- 2.3. Determination of household tank capacity,
- 2.4. Use of separate tanks for different purpose

3. Quality of water for domestic use: (8 hours)
- 3.1. Types and sources of water pollution,
- 3.2. Point and non-point pollution locations,
- 3.3. Effects of pollution
- 3.4. River water quantity and collection
- 3.5. Water sampling and examination of water

4. Treatment : (16 hours)
- 4.1. Screening
- 4.2. Aeration including protection works
- 4.3. Plain sedimentation
- 4.4. Sedimentation with coagulation
- 4.5. Filtration
- 4.6. Disinfection
- 4.7. Other chemical treatments
- 4.8. Storage system

5. Wastewater: (10 hours)
- 5.1. Wastewater quantity -grey water, black water, yellow water, rain water and sanitary sewage
- 5.2. Collection and use of wastewater in domestic use
- 5.3. Laboratory analysis of water and wastewater sample BOD, COD, TS, VSS and FS
- 5.4. Wastewater treatment
- 5.5. Components: traps, manholes, grit and grease chamber
- 5.6. Constructed wetland
- 5.7. Reed bed treatment (horizontal and vertical)
- 5.8. Vent pipe
- 5.9. Septic tank and soak pit

6. Solid waste management (3 hours)
- 6.1. Quantity generated and characteristics
- 6.2. Segregation
- 6.3. Composting and incineration
- 6.4. Use of waste as fertilizer within household
- 6.5. Biogas

Tutorials:
1. Introduction (1 hour)
   Definition, water in domestic purpose, existing scenario on polluted and contaminated water.
2. Quantity and source selection (2 hours)
   - 2.1. Quantity determination - supplied water, ground water, rainwater harvesting
   - 2.2. Numerical on determination of household tank capacity,
   - 2.3. Use of separate tanks for different purpose
3. Quality of water for domestic use : (2 hours)
   - 3.1. Definition
   - 3.2. Level of pollution of ground water at various places
   - 3.3. Water sampling and examination of water
4. Treatment : (5 hours)
   Design on screening, aeration, and its protection works, plain sedimentation, sedimentation with coagulation, filtration, disinfection and other chemical treatments, storage system.

5. Wastewater: (4 hours)
   5.1. Determination of grey water, black water, yellow water, rain water and sanitary sewage,
   5.2. Collection and use of wastewater in domestic use
   5.3. BOD, COD, TS, VSS and FS laboratory analysis
   5.4. Design of traps, manholes, grit and grease chamber
   5.5. Design of constructed wetland
   5.6. Design of reed bed treatment
6. Solid waste management: (1 hour)
   6.1. Design of composting and incineration
   6.2. Design of biogas

Practical / Project works:

1. Small scale household treatment plant
2. Reed bed treatment
3. Septic tank and soak pit
4. Constructed wetland
5. Compost plant

References:

1. Walter J. Webber Jr, Wiely-Interscience "Physicochemical Processes For Water Quality Control".

2. Larry D. Benefield and Clifford W. Randall, "Biological Process Design for Wastewater Treatment", Prentice-Hall Inc..

3. Metcalf & Eddy , "Wastewater Engineering Treatment and Reuse", Inc, McGraw Hill.

4. Crites and Tchobanoglous, "Small and Decentralized Wastewater Management Systems", McGraw Hill.

5. S.R. Qasim, E.M.Motley and G. Zhu, "Water Works Engineering Planning, Design & Operation", Prentice-Hall.

6. A.P. Sincero and G.A. Sincero, "Environmental Engineering", Prentice-Hall.

7. Soli J Arceivala, 2003, 'Waste water treatment for pollution control', Tata McGraw-Hill publishing company Limited.

8. Larry D. Benefield and Clifford W. Randall, "Biological Process Design for Wastewater Treatment", Prentice-Hall Inc..

9. George Tchobanoglous, Hilary Theisen, Samuel A. Vigil Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw-Hill International Editions

10. WHO Guidelines for drinking-water quality

Examination Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	4	4
2	4	8
3	8	12
4	16	24
5	10	20
6	3	12
Total	45	80

* There may be minor deviation in marks distribution.

POST DISASTER WATER AND SANITATION MANAGEMENT

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
To give students a comprehensive theoretical and practical knowledge of WatSan and hygiene promotion in the different phases of emergencies, including disease prevention and preparedness. By the end of the course the students shall be able to assess and priorities WatSan needs for a population in the emergency with foresight, and to take appropriate measures to prevent and control disease outbreak.

1. Introduction: (10 hours)
- 1.1. Types of disasters and their consequences;
- 1.2. Different stages in emergency
- 1.3. International legal system and guidelines regarding refugees and internally displaced persons,
- 1.4. Concepts and tools for initial situation analysis and other rapid participatory assessment approaches,
- 1.5. Introduction of sphere handbook
- 1.6. The local cultural, religious and socio-economic contexts influencing perceptions of water, sanitation and hygiene

2. Health and diseases transmission in emergency settings (5 hours)
- 2.1. Identify relevant water, sanitation, personal hygiene, food hygiene and housing related diseases such as diarrhoea, malaria, hepatitis etc.,
- 2.2. Identify prevention and control strategies, including surveillance of disease outbreak, and epidemic, consideration to classical threats in emergencies: thirst, hunger, trauma, heat and cold;
- 2.3. Design of hygiene campaigns

3. Technical aspects of WatSan: (14 hours)
- 3.1. Assess emergency water sources(surface water, ground and rainwater), their utilization, protection and disinfection;
- 3.2. Importance of sanitation and cleaning,
- 3.3. Disinfecting and construction of: wells, springs and pipe water schemes as well as water storage both in camps and within the household;
- 3.4. Practical knowledge of emergency sanitation (excreta, wastewater and solid waste), construction and maintenance of different latrines, disposal and treatment systems, hygienic handling of animal corpses, ethically and culturally appropriate disposal of human corpses.

4. Hand on experience: (6 hours)
- 4.1. Apply practical experience on how to construct a latrine, installation and maintenance of a pump and chlorination of water supply
- 4.2. Emergency water filtration and disinfection

5. Post emergency and rehabilitation: (10 hours)
- 5.1. Analyze whether Watsan strategies employed in emergency phase are sustainable in the post-emergency phase.
- 5.2. Risk assessment of mitigation strategies
- 5.3. Monitoring and evaluation

Tutorials:
1. Introduction (1 hour)
   Concept and tools for initial situation analysis and other rapid participatory assessment approaches
2. Health and diseases transmission in emergency settings: (2 hours)
   Identify prevention and control strategies, including surveillance of disease outbreak, and epidemic, Design of hygiene campaigns
3. Technical aspects of WatSan: (4 hours)
   Disinfecting and construction of: wells, springs and pipe water schemes as well as water storage both in camps and within the household;
4. Hand on experience: (4 hours)
   Design for construction of a latrine, installation and maintenance of a pump and chlorination of water supply.
5. Post emergency and rehabilitation: (3 hours)
   Risk assessments of mitigation strategies

Practical / Project works:
1. Concept and tools for initial situation analysis and other rapid participatory assessment
2. Identify prevention and control strategies, including surveillance of disease outbreak, and epidemic
3. Analyze Wat-san strategies employed in emergency phase
4. Risk assessment of mitigation strategies

References:

1. Wisner, B. and Adams, J. 2002. Environmental health in emergencies and disaster. WHO
2. Alexander, D. 2002. Principles of Emergency Planning and Management. Harpended: Terra Publishing.
3. Davis, J., Lambert, R. 2002. Engineering in emergencies. A practical guide for relief workers, 2nd edition. ITDG Publisher.
4. Del Porto, D., Steinfeld, C., 2000. The composting toilet system: a practical guide to choosing, planning and maintaining composting toilet systems, an alternative to sewer and septic systems. The center for ecological pollution prevention (CEPP), Massachusetts
5. Wisner, B., Blaikie, P., Cannon, T., Davis, I. 2004. At Risk-Natural Hazards, People's Vulnerability and Disaster. Wiltshire Routledge

Examination Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	10	12
2	5	6
3	14	28
4	6	10
5	10	24
Total	45	80

* There may be minor deviation in marks distribution.

PUBLIC HEALTH AND RISK ASSESSMENT
CE ...

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
This course broadens and deepens the concept of epidemiological studies and methodology, with a focus on environmental transmission. The students will work on cases related to diarrhoeal, parasitic and vector-borne diseases. The students will learn and be able to apply the Quantitative Microbial Risk Assessment (QMRA) concept. The students will be able to apply their knowledge in field projects as well as in system based management applications

1. Fundamentals of epidemiology (5 hours)
- 1.1. Infectious and noninfectious diseases
- 1.2. Infectious disease transmission routes
- 1.3. Organic and inorganic contaminants
- 1.4. Health and water quality

2. Pathogens (excreta bacteria, viruses protozoa, helminthes) and their control (10 hours)
- 2.1. Disease transmitted by arthropod vectors
  - 2.1.1. mosquito
  - 2.1.2. flies
  - 2.1.3. cockroaches
  - 2.1.4. ticks
  - 2.1.5. lice
  - 2.1.6. fleas
  - 2.1.7. rodents
  - 2.1.8. disease transmission mechanism and control
- 2.2. Water – related,
- 2.3. Excreta related
- 2.4. Refuse- related,
- 2.5. Housing –related,
- 2.6. Air-related diseases
- 2.7. Control HIV/AIDS.

3. Sample and questionnaire (8 hours)
- 3.1. Questionnaire based approaches,
- 3.2. Statistical handling and link to GIS based approaches
- 3.3. Surveys both in societies and in agricultural applications

4. Risk Assessment (2 hours) (8 hours)
- 4.1. Risk Assessment within an integrated system approach.
- 4.2. Quantitative microbial risk assessment (QMRA)
- 4.3. QMRA relate to risk reduction,
- 4.4. Treatment barriers, non-technical barriers.
- 4.5. Relationship to habits,
- 4.6. Handling practices

5. Relationship between public health and the risk assessment parts with the WHO guidelines for (8 hours)
- 5.1. Water,
- 5.2. Wastewater
- 5.3. Water safety plan to avoid fecal contamination.

6. Case studies (6 hours)
Case studies based on public health and the risk assessment

Tutorials:
1. Introduction of epidemiology (2 hours)
2. Disease transmitted by arthropod vectors (2 hours)
3. Risk Assessment within an integrated system approach. Quantitative microbial risk assessment (QMRA) (7 hours)
4. Case studies (4 hours)

Practical / Project works:
1. Concepts of epidemiology
2. Disease transmitted by arthropod vectors
3. Risk Assessment
4. Case studies

References:

1. Bennett, P., Calman, K. 2001. Risk Communication and Public Health, Oxford Medical Publications, London.
2. Fjeld, R. A., Eisenberg, N. A., Compton, K. L. 2007. Quantitative Environmental Risk Analysis for Human Health. John Wiley & Sons, NJ.
3. Lawson, A. B., Biggeri, A., Bohning, D., Lesaffre, E. 1999. Disease Mapping and Risk Assessment for Public Health, John Wiley & Sons, England.
4. Robson, M. G., Toscano, W. A. 2007. Risk Assessment for Environmental Health (Public Health/Environmental Health). Association of Schools of Public Health, John Willey & Sons, San Francisco.
5. Andy Cairncross and Richard G. Feachem, Environmental Health Engineering in the Tropics, second edition, 1993.
6. Christopher R. Schulz and Danial A. Okun, "Surface Water Treatment for Communities in Developing Countries", 1984.
7. City for Copenhagen, healthy city plan, 1994-1997 Copenhagen, Copenhagen Health Services, 1994 (ISBN 8798411187)
8. JICA, July 1991, Basic design study report on "The Project for Kathmandu Water Supply Facility Improvement in The Kingdom of Nepal"
9. Richard G. Feachem, David j. Bradley, Hemda Garelick and D. Duncan Mara, "Appropriate Technology for Water Supply and Sanitation", health aspects of excreta and sullage management- a state of art review, the world bank , June 1981.
10. RWSSFDB, 2002, A study on "Water Quality", Rural Water Supply and Sanitation Fund Development Board.
11. Tsouros, A., ed WHO healthy cities projects: a project becomes a movement (review of progress 1987 to 1990) Copenhagen, WHO/FADL.1990 and SOGESS, Milan.
12. WHO Guidelines for Drinking-water Quality.

Examination Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	10	16
2	15	24
3	8	15
4	8	15
5	4	10
Total	45	80

* There may be minor deviation in marks distribution.

CLIMATE CHANGE
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
This course broadens the knowledge on fundamentals of climate change with respect to climate change science; and its causes, effects and uncertainties about climate change. It broadens the idea on technology, technological options for mitigating climate change, adaptation measures , risk analysis, economics, policy options and their impact on outcomes

1. Climate change science (10 hours)

1.1. Introduction to climate change science
- 1.1.1. Radiation balance, atmospheric and ocean circulations. Historic climate change, El Nino.
- 1.1.2. Feedback effects, impacts of land use, albedo, clouds, ocean storage of CO2.
- 1.1.3. GHGs and energy use, inventory of GHGs, the carbon cycle.
- 1.1.4. Natural and anthropogenic actors

1.2. Key indicators of global climate change and evidence
- 1.2.1. Carbon dioxide concentration
- 1.2.2. Global surface temperature
- 1.2.3. Arctic sea ice
- 1.2.4. Land ice
- 1.2.5. Sea level

1.3. Causes
- 1.3.1. Effect of greenhouse gases: greenhouse gases, consequences of change in natural greenhouse gases,
- 1.3.2. The role of human activities: industrialization, combustion of fossil fuels, deforestation, forest fires, agricultural farming.
- 1.3.3. Solar irradiance: sun is the driver of climate system in Earth, role of solar radiance in climate change

1.4. Effects/impacts
- 1.4.1. More frequent wildfires,
- 1.4.2. Air pollution
- 1.4.3. Longer periods of drought in some regions
- 1.4.4. Extreme weather
- 1.4.5. Deforestation
- 1.4.6. Agriculture change
- 1.4.7. Ecosystem and biodiversity
- 1.4.8. Economic effects
- 1.4.9. Diseases
- 1.4.10. Water scarcity

1.5. Uncertainties about climate change
- 1.5.1. Forcings: Solar irradiance, Aerosols, dust, smoke, and carbon particles
- 1.5.2. Feedbacks: cloud, carbon cycle, ocean circulation, precipitation, sea-level rise,

2. Technology (15 hours)

2.1. Role of human activities
- 2.1.1. Combustion of fossil fuels in industry, transport, electricity generation, households, etc.
- 2.1.2. Deforestation
- 2.1.3. Agricultural farming

2.2. Climate change and Infrastructure
- 2.2.1. Buildings infrastructure
- 2.2.2. Transportation infrastructure
- 2.2.3. Energy infrastructure
- 2.2.4. Water and waste infrastructure

2.3. Technological options for mitigating climate change
Mitigation technologies and practices, environmentally effective policies, measures and instrument, key constraints and opportunities in the following sectors
- 2.3.1. Energy supply
- 2.3.2. Transport
- 2.3.3. Buildings
- 2.3.4. Industry
- 2.3.5. Agriculture
- 2.3.6. Forestry/forests
- 2.3.7. Waste

2.4. Adaptation measures
Adaptation options/strategy, underlying policy frame, key constraints and opportunities to implementation by sector
- 2.4.1. Water
- 2.4.2. Agriculture
- 2.4.3. Infrastructure and settlement
- 2.4.4. Human health
- 2.4.5. Tourism
- 2.4.6. Transport
- 2.4.7. Energy

2.4.8. Biodiversity and ecosystem

2.5. Risk analysis and climate change

2.5.1. Identify the impacts and the level of risk

2.5.2. Compare the risks posed by a climate change

2.5.3. Prioritize adaptation policy

2.5.4. Assess the costs and benefits of adaptation actions (quantitative risk analysis)

2.5.5. Preparation and planning

2.5.6. Integration with existing risk management practices

2.5.7. Integration with other activities

3. Economics (8 hours)

3.1. Population growth & economic growth as climate-change drivers

3.2. Costs of abatement, adaptation, and impacts

3.3. Consequences of alternative regimes of action & inaction for economic growth, employment, trade

3.4. Carbon trade. Economic analysis of CDM and other GHG mitigation projects

3.5. Socio-economic impacts of climate change in Nepal

3.6. Funding sources

4. Policies (8 hours)

4.1. The Montreal Protocol, agenda 21

4.2. UNFCC and The Kyoto Protocol

4.3. National adaptation program of action (NAPA) to climate change, Ministry of Environment, 2010

4.4. Hydropower Development Policies 1992 and 2001

4.5. Rural Energy Policy 2006

4.6. Climate Change Policy in Nepal 2011

5. Legal aspects (4 hours)

5.1. Water Resources Act 1992

5.2. Environment Protection Act 1997 & Rule 1997

5.3. Forest Act 1993

5.4. Forest regulation 1995

Tutorials:

1. Introduction (2 hours)
   impacts likely to be on farms, forests, fisheries, agriculture, water resources, health, property, ecosystems etc
2. Technology (2 hours)
   2.1. The role of humans & their technology in causing climate change
   2.2. Technological options for mitigating climate change
   2.3. Technological options for adapting to it
3. Economics (7 hours)
   3.1. Determination of costs of abatement, adaptation, and impacts
   3.2. Consequences of alternative regimes of action & inaction for economic growth, employment, trade
4. Policy (on climate change) (4 hours)
   4.1. Policy options and their impact on outcomes
   4.2. Actors and interests in the climate debate…and the evolution of perceptions & interests over time
   4.3. Finding a global climate-policy framework that is adequate, equitable, and attainable
   4.4. Uncertainty and prudence in public policy

Project works:

1. Concepts and development of cause and effect of greenhouse gases, consequences of change in natural greenhouse gases.
2. The role of humans & their technology in causing climate change.
3. Technological options for mitigating climate change.
4. Consequences of alternative regimes of action & inaction for economic growth, employment, trade.
5. Policy options and their impact on outcomes
6. Uncertainty and prudence in public policy on climate

References:

1. Holdren, 2007,

2. www.AAAS.org

Examination Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	10	16
2	15	24
3	8	15
4	8	15
5	4	10
Total	45	80

* There may be minor deviation in marks distribution.

ENVIRONMENTAL MANAGEMENT SYSTEM
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
The objective of the course is aimed at teaching the students the functions of the various aspects of environmental pollution, wastewater management, air pollution, solid waste management, different environmental management tools and techniques, Environmental Management System (EMS) and ISO 14001. The assignment and class work are expected to give students an in-depth analysis of the environmental management system.

1. Introduction (3 hours)
- 1.1. Concept of environment
- 1.2. Classification of environment
- 1.3. Introduction to environmental pollution
- 1.4. Pollution and pollutants
  - 1.4.1. Water pollution
  - 1.4.2. Air pollution
  - 1.4.3. Land/soil pollution
  - 1.4.4. Ground water pollution
  - 1.4.5. Noise pollution
  - 1.4.6. Visual pollution
- 1.5. Harmfulness of pollutants

2. Environment and health (4 hours)
- 2.1. Relation between environment and human health
- 2.2. Adverse effects of environmental pollution
  - 2.2.1. Effects of water pollution
  - 2.2.2. Effects of air pollution
  - 2.2.3. Effects of land pollution
- 2.3. Ecological risk assessment
  - 2.3.1. Introduction to eco-toxicology
  - 2.3.2. Risk assessment

3. Environment management (3 hours)
- 3.1. Introduction to environment management
- 3.2. Historical evolution
- 3.3. Environment management tools and techniques
- 3.4. Benefits of environment management

4. Wastewater management (3 hours)
- 4.1. Concept of wastewater management
- 4.2. Forms of wastewater management
  - 4.2.1. Off-site system
  - 4.2.2. On-site sanitation system
- 4.3. Types of wastewater treatment technologies
  - 4.3.1. Waste stabilization ponds
  - 4.3.2. Activated sludge process
  - 4.3.3. Constructed wetlands
- 4.4. Overview of wastewater management system in Nepal

5. Air Pollution (3 hours)
- 5.1. Concept of air pollution
- 5.2. Forms of air pollution
  - 5.2.1. Indoor air pollution
  - 5.2.2. Acid rain
  - 5.2.3. Ozone depletion
  - 5.2.4. Greenhouse gas effect
- 5.3. Air Pollution Management Techniques
  - 5.3.1. Cyclone
  - 5.3.2. Filters
  - 5.3.3. Liquid scrubbing
  - 5.3.4. Electrostatic precipitation (ESP)
- 5.4. Overview of air pollution in Nepal

6. Solid waste management (4 hours)
- 6.1. Concept of solid waste management
- 6.2. Collection
- 6.3. Transfer station Sanitary landfill site
- 6.4. Principles of 3R
- 6.5. Overview of solid waste management in Nepal
  - 6.5.1. River intakes
  - 6.5.2. Reservoir intakes
  - 6.5.3. Spring intakes

7. Cleaner Production (2 hours)
- 7.1. Concept of pollution prevention
- 7.2. Definition of Cleaner Production (CP)
- 7.3. CP techniques
- 7.4. Implementation procedure
- 7.5. Overview of CP intervention in Nepal

8. Energy Efficiency (2 hours)

8.1. Concept of energy efficiency
8.2. Areas for energy efficiency
  8.2.1. Electrical
  8.2.2. Thermal
8.3. Energy efficiency techniques
8.4. Stages of energy efficiency improvement
8.5. Overview of energy efficiency in Nepal

9. Clean Development Mechanism (2 hours)

9.1. Concept of global warming
9.2. Climate change
9.3. Kyoto Protocol
9.4. Flexible mechanism
  9.4.1. Carbon trading
  9.4.2. Joint implementation
  9.4.3. Clean Development Mechanism (CDM)
9.5. Principles of CDM
9.6. Overview of CDM in Nepal

10. Environmental Management System (12 hours)

10.1. Definition of environmental management system (EMS)
10.2. Basic concept of EMS
  10.2.1. Plan
  10.2.2. Do
  10.2.3. Check
  10.2.4. Act
10.3. Components of EMS
  10.3.1. Environmental review
  10.3.2. Environmental policy
  10.3.3. Environmental objectives and targets
  10.3.4. Environmental management programme (EMP)
  10.3.5. Internal audit
10.4. Types of EMS
  10.4.1. Local
  10.4.2. Country specific
  10.4.3. Regional
  10.4.4. ISO 14001
10.5. Benefits of EMS

11. ISO 14001 (3 hours)

11.1. Introduction to ISO 14001
11.2. Basic concept of ISO 14001
11.3. Scope of ISO 14001
11.4. Structure of ISO 14001

12. Environmental laws and regulations (4 hours)

12.1. Introduction to environmental laws and regulations
12.2. Overview of environmental laws and regulations in Nepal
12.3. Environment protection act & regulations
12.4. Solid waste management act Standards
  12.4.1. Wastewater standar
  12.4.2. Ambient air quality standard

Tutorials:

1. Introduction (1 hour)
Definitions, examples of pollution and pollutants
2. Environmental health (1 hour)
Health impacts of pollution,nNumericals on risk assessment, LD50 method
3. Environment management (1 hours)
Definitions, dilution, treatment, prevention, examples on different environment management tools and techniques
4. Wastewater management (1 hours)
Definitions, advantages and disadvantages of centralized and decentralized treatment systems, design criteria, pipe materials, examples of WWTPs numericals on network
5. Air pollution (1 hour)
Definitions, reactions of air pollutants, examples of air pollution control technologies
6. Solid waste management (1 hours)
Definitions, management systems, numericals on transportation, examples
7. Cleaner production (1 hours)
Definitions, examples of various techniques with figures
8. Energy efficiency (1 hour)
Definitions, typical figures of energy savings
9. Clean development mechanism (1 hour)
Definitions, typical figures of carbon trading
10. Environmental management system (4 hours)
Definitions, numerical on environmental review, targets and EMP
11. ISO 14001 (1 hour)
Definitions, Typical figures on certified companies
12. Environmental laws and regulations (1 hour)
Definitions, typical figures on standards

Practical:

1. Environmental impacts of pollutants
2. Environmental management tools & techniques
3. Environmental review
4. Environmental management program (EMP)

References:

1. M.L.Davis and D.A.Cornwell, "Introduction to Environmental Engineering", McGraw-Hill, 1998
2. Tchobanoglous, Theisin and Vigil, "Integrated Solid Waste Management – Engineering Principles and Management Issues", McGraw-Hill, 1993
3. R. Drostie, "Theory and practice of water and wastewater treatment", John Willey & Sons, Inc., 1997
4. ISO, "ISO 14001: Guidance for use", 2004.
5. MOEST, "EPA & Regulations, 2053", Kathmandu
6. SWMTSC, "Solid waste management act, 2011". 2011
7. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Water Supply Engineering", Laxmi Publications (P) Ltd., New Delhi, 1998
8. P.N. Modi, "Water Supply Engineering", Standard Book House, Delhi, 1998
9. G.S. Birdie and J,S, Birdie, "Water Supply and Sanitary Engineering", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2002
10. K.N. Duggal, "Elements of Environmental Engineering", S. Chand and Company Ltd., New Delhi, 1997

Examination Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	3	4
2	4	4
3	3	8
4	3	8
5	3	8
6	4	14
7	2	10
8	2	4
9	2	4
10	12	12
11	3	2
12	4	2
Total	45	80

* There may be minor deviation in marks distribution.

RURAL ROAD ENGINEERING
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
The objective of the course is to provide the student with the concept and the tools that can be used to incorporate in the field planning, design, construction and maintenance of rural roads. The course includes the details of practical considerations based on the socio-economic and technical aspect of rural areas of Nepal.

1. Introduction **[2 hours]**
- 1.1. General Background
- 1.2. Introduction to Green Road
- 1.3. Characteristics of Green Road
- 1.4. Objectives of Green Road
- 1.5. Green Road in context of Nepal

2. Rural Roads Planning **[4 hours]**
- 2.1. District Transport Planning
- 2.2. Goal
- 2.3. Objectives
- 2.4. Community/Stakeholders: 4 Key Actors
- 2.5. Legislative Body
- 2.6. Executive Body
- 2.7. Judicial Body
- 2.8. Implementing Agencies
- 2.9. Steps To Prepare DTMP Based on Best Practice Report
- 2.10. Actions To Prepare DTMP Based on DoLIDAR APPROACH
- 2.11. RAP Process
- 2.12. Planning Process
- 2.13. Technical Issues/Discussions

3. Geometric Design and Standards **[12 hours]**
- 3.1. Road classification, traffic and loading
- 3.2. Design
- 3.3. Design speed
- 3.4. Horizontal curves
- 3.5. Minimum radius of horizontal curve
- 3.6. Super elevation
- 3.7. Extrawidening on curves
- 3.8. Sight distance
- 3.9. Vertical curves
- 3.10. Minimum radius
- 3.11. Length and the ordinates of vertical curves
- 3.12. Hairpin bends
- 3.13. Vertical clearance
- 3.14. Lateral clearance
- 3.15. Right of way
- 3.16. Bypass
- 3.17. Formation width
- 3.18. Camber slope
- 3.19. Carriageway width
- 3.20. Cross section
- 3.21. Longitudinal gradient
- 3.22. Drainage
- 3.23. Retaining structures
- 3.24. Design standards for green roads

4. Implementation **[6 hours]**
- 4.1. Technical support
- 4.2. Management support
- 4.3. Lean management technology
- 4.4. Performance based work assignment
- 4.5. Decentralized institutional arrangement
- 4.6. Social mobilization support

5. Construction Technology **[6 hours]**
- 5.1. Alignment selection
- 5.2. Road survey, design and estimates
- 5.3. Construction methods
- 5.4. Training
- 5.5. Labor based construction
- 5.6. Rock cutting techniques
- 5.7. Haulage and transportation of excavated materials
- 5.8. Construction material
- 5.9. Use of flexible retaining and cross drainage structures
- 5.10. Natural compaction
- 5.11. Tools and equipment
- 5.12. Phased, staged, Sectoral construction

6. Environmental Conservation [5 hours]

6.1. Minimization of slope cutting and preservation
6.2. Mass balancing
6.3. Reuse of excavated materials
6.4. Bioengineering
6.5. Proper water management

7. Economic analysis of green roads [5 hours]

7.1. General Economic Consideration
7.2. Cost of Green Road
7.3. Construction Cost
7.4. Maintenance Cost
7.5. Rehabilitation Cost
7.6. Economic Justification
7.7. Resource Mobilization
7.8. Public Auditing

8. Maintenance and Rehabilitation [5 hours]

8.1. Minimization of maintenance requirements
8.2. Mitigation measures
8.3. Types of maintenance
8.4. Sustainable maintenance funding
8.5. Rehabilitation
8.6. Upgrading

Tutorial:

Three assignments that include the design of a rural road project, construction technology and maintenance arrangements

Practical:

One day field visit to a rural roads and study of anomalies, preparation of the report and its presentation

References:

1. "Principles of Urban transport planning" , B.C.Huchinson, McGraw Hill publishing company.,
2. " introduction to transportation engineering and planning", E. K. Morlok, international student edition, Mc Graw Hill publishing company, 1987,
3. "transportation Engineering" Volume I and II V. N. Vazirani and S.P.Chandola ,Khanna Publishers, Delhi, India

Evaluation Scheme

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	2	4
2	4	8
3	12	20
4	6	10
5	6	10
6	5	8
7	5	10
8	5	10
Total	45	80

* There may be minor deviation in marks distribution.

TRAFFIC AND TRANSPORT MODELING
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
The objective of this course is to get insight regarding mathematical models for the estimation of transport demand in the framework of transportation planning. The course is presented to provide the following contemporary concepts:

- Conceptual knowledge in transportation system
- Functions of models in transportation system analysis
- Types of models and their applications
- Aggregated models for trip generation, trip distribution, modal split and network assignment
- Estimation of model parameters and calibration

1. Introduction **[5 hours]**
- 1.1. Background: Traffic and Transportation Engineering
- 1.2. Introduction to Transportation planning
- 1.3. Models and model developing process
- 1.4. Characteristics of transport problems
- 1.5. Issues in transport planning and modeling

2. Mathematical prerequisites **[6 hours]**
- 2.1. Algebra and functions
- 2.2. Functions and graphs
- 2.3. Use of engineering statistics in transportation problems (Binomial distribution, Poisson distribution, Negative binomial distribution, negative exponential distribution, normal distribution, Regression analysis)

3. Data and Space **[4 hours]**
- 3.1. Basic sampling theory
- 3.2. Data collection methods
- 3.3. Network and Zoning System

4. Traffic Forecasting **[4 hours]**
- 4.1. Need for traffic forecasting
- 4.2. Forecast based on past trends
- 4.3. Mathematical models for traffic forecasting

5. Transportation Survey **[6 hours]**
- 5.1. Introduction and types of surveys
- 5.2. Home interview survey
- 5.3. Roadside interview survey
- 5.4. Inventory of transport facilities
- 5.5. Inventory of land-use and economic activities

6. Trip Generation Modeling **[5 hours]**
- 6.1. Introduction and definition
- 6.2. Trip classification
- 6.3. Factors affecting trip generation
- 6.4. Trip generation analysis: (Growth factor modeling, regression analysis, category analysis)

7. Trip Distribution Modeling **[5 hours]**
- 7.1. Introduction and definition
- 7.2. Growth factor methods (uniform, average growth factor, Fratar method, Furness method)
- 7.3. Gravity models

8. Modal Split Model **[5 hours]**
- 8.1. Introduction
- 8.2. Factors affecting mode choice
- 8.3. Types of modal split models, logit model and its application

9. Trip Assignment **[5 hours]**
- 9.1. Basic concepts
- 9.2. Application of trip assignment
- 9.3. Procedure of trip assignment (minimum path technique, minimum path with capacity restraint, BPR method, diversion curves, user equilibrium assignment, system optimization assignment, other assignment methods)

Tutorials:
1. Probability distribution, regression analysis [2 hours]
2. Sampling theory, Sample size estimation [1 hour]
3. Trip generation analysis [4 hours]
4. Trip distribution analysis [4 hours]
5. Modal split model [2 hours]
6. Trip assignment [2 hours]

Practical / Assignment:

1. Review of previous transportation study report (like Kathmandu valley transportation study)
2. Application of geo-informatics in transportation planning
3. Traffic and transport study

References

1. Traffic Engineering and Transport Planning. L.R. Kadiyali, Khanna Publishers, Delhi, 2000.
2. Transportation Engineering & Planning, Third Edition (Indian Reprint). C. S. Papacostas & P. D. Prevedouros. Prentice-Hall of India, New Delhi.2002.
3. Urban Transportation planning. Michael D. Meyer & Eric J. Miller. Mc Graw Hill, 2002.
4. Highway Engineering. S.K. Khanna & C. E. G. Justo. Nem CHAND & BROS; Roorkee, 2000.
5. Modeling Transport, Third Edition. Juan de Dios Ortuzar and Luis G. Willumsen. John Willey & Sons, USA, 2004.

Evaluation Scheme

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	5	8
2	6	8
3	4	8
4	4	
5	6	8
6	5	12
7	5	12
8	5	12
9	5	12
Total	45	80

* There may be minor deviation in marks distribution.

ROCK MECHANICS
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
The objective of the course is to provide the student with the concept and the tools that can be used to incorporate in the field of geotechnical engineering. The course includes the advanced techniques that are not dealt in the courses of soil mechanics and foundation engineering.

1. Scope of rock mechanics **[2 hours]**

2. Nature of rocks **[2 hours]**

3. Classification and index properties of rocks **[4 hours]**
- 3.1. Geological classification
- 3.2. Index properties of rock system
- 3.3. Porosity
- 3.4. Density
- 3.5. Permeability
- 3.6. Strength
- 3.7. Slaking and durability
- 3.8. Sonic velocity as an index to degree of fissuring

4. Rock strength and failure criteria **[7 hours]**
- 4.1. Modes of failures of rock
- 4.2. Common lab strength tests
- 4.3. σ-ε behavior in compression
  - σ-ε
  - hydraulic compression
  - deviatoric compression
  - effect of σ 3
- 4.4. meaning of rock strength
- 4.5. σ-ε curve
- 4.6. Mohr- Coulomb failure criteria
- 4.7. Effect of water
- 4.8. Empirical failure criteria
- 4.9. Effect of size on strength
- 4.10. Anistrophic rocks

5. Initial stresses in rocks and their measurement **[7 hours]**
- 5.1. Influence of the initial stresses
- 5.2. Estimating the initial stresses
  - horizontal stresses
  - vertical stresses
  - horizontal stresses direction
- 5.3. techniques for measurements of In-situ stresses
  - hydraulic fracturing
  - flat jack method
  - over coring

6. Planes of weaknesses in rock **[4 hours]**
- 6.1. joint orientation
- 6.2. joint testing
- 6.3. joint roughness
- 6.4. effect of water pressure

7. Deformability of rocks **[5 hours]**
- 7.1. elastic and non-elastic behavior
- 7.2. elastic constants
- 7.3. measurements of deformability
  - **lab compression test**
  - plate bearing test
  - borehole and gallery test
  - radial jacking test
  - flat jack test
  - dynamic measurement
  - fractured rocks

8. Application of rock mechanics to rock slope engineering **[8 hours]**
- 8.1. modes of failure of slope in hard rock
- 8.2. kinematic analysis of slopes
- 8.3. analysis of plane sliding of the stereographic projection
- 8.4. analysis of wedge sliding using stereographic projection
- 8.5. analysis of slides composed of two blocks

9. Application of rock mechanics to Rock slope engineering **[6 hours]**
- 9.1. modes of failure of slope in hard rock
- 9.2. kinematic analysis of sloes
- 9.3. analysis of plane
- 9.4. analysis of plane sliding of the stereographic projection

9.5. analysis of wedge sliding using stereographic projection
9.6. analysis of slides composed of two blocks

Tutorial:
Three assignments that include the determination of shear strength, displacement and analysis of slides using stereographic projection

Practical:
Rock strength test, different test for deformability

References:

1. Principles of Geotechnical Engineering" , B.M. Das, Boston PWS Engineering, 1985
2. Cook, N.G.W. et al. (1966) Rock Mechanics applied to Rockbursts – a synthesis of the results of rockburst research in South Africa up to 1965. J. S. African Inst. Min. Metall. Vol. 66, No. 10, 435-528.
3. Ortlepp, W.D. and Cook, N.G.W. (1965) The measurement and analysis of the deformation around deep, hard-rock excavations. Proc. 4th Intnl.Conf. on Rock Mech. And Strata Control. New York, 140-152.
4. Leeman, E.R. (1964) Remote measurement of rock stress under development in Rock Mechanics
5. Leeman, E.R. (1964) The measurement of stress in rock. Parts I to III. J. S. African Inst. Min. and Metall. Vol 65, No. 2, 48-114 and Vol 65, No. 4, 254-284.
6. Leeman, E.R. and Hayes, D.J. (1966) A technique for determining the complete stare of stress in rock using a single borehole. Proc. 1st Intnl. Cong. on Rock Mechanics. Lisbon.

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distributions*
1	2	4
2	2	4
3	4	8
4	7	12
5	7	12
6	4	8
7	5	10
8	8	12
9	6	10
Total	45	80

* There may be minor deviation in marks distribution.

TRAFFIC ENGINEERING AND MANAGEMENT
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course objective:
The main objective of this course is to introduce the concepts of characterizing traffic, various modeling approaches, and design of facilities to control and manage traffic. The course mainly focuses on urban vehicular movement.

1. Traffic stream characteristics [4 hours]
- 1.1. Introduction
- 1.2. Fundamental parameters and relations of traffic flow
- 1.3. Traffic stream models (Greenshield's model, Greenberg's logarithmic model, Underwood's exponential model, Pipe's model, multi regime model)

2. Traffic measurement [4 hours]
- 2.1. Volume measurement
- 2.2. Speed measurement
- 2.3. Travel time, density measurement
- 2.4. Automatic traffic measurement techniques

3. Traffic flow modeling [4 hours]
- 3.1. Car following models
- 3.2. Lane changing models
- 3.3. Vehicle arrival models
- 3.4. Traffic progression models

4. Uninterrupted traffic flow [8 hours]
- 4.1. Capacity and level of service concepts
- 4.2. Urban streets: classification, performance measurement (HCM method), congestion management
- 4.3. Multilane highways: characteristics, capacity and level of service
- 4.4. Capacity and level of service of basic freeway section
- 4.5. Ramp metering

5. Intersection Control [8 hours]
- 5.1. Principles of traffic control
- 5.2. Uncontrolled intersection
- 5.3. Traffic signs and road markings
- 5.4. Channelization
- 5.5. Rotary intersection
- 5.6. Grade separated intersections

6. Traffic signal design [10 hours]
- 6.1. Elements of traffic signal
- 6.2. Design principles of traffic signal
- 6.3. Delay models for signal evaluation
- 6.4. Capacity and level of service of signalized intersection
- 6.5. Coordinated traffic signal control
- 6.6. Actuated traffic signal control
- 6.7. Area traffic control

7. Specific traffic studies [7 hours]
- 7.1. Parking studies
- 7.2. Accident studies
- 7.3. Fuel consumption and emission studies
- 7.4. Congestion studies
- 7.5. Queuing analysis
- 7.6. Toll operation
- 7.7. Pedestrian studies
- 7.8. Intelligent transportation system

Tutorials:
1. Relation between traffic flow parameters [1 hour]
2. Time mean speed, space mean speed, density, headway, gap [1 hour]
3. Traffic flow modeling [2 hours]
4. Uninterrupted traffic flow [4 hours]
5. Conflict areas in intersection , Rotary intersection [1 hour]
6. Signal evaluation [1 hour]
7. Capacity and level of service of signalized intersection [2 hours]
8. Parking studies, Accident studies [1 hour]
9. Congestion studies, Queuing analysis (M/M/1) [1 hour]
10. Toll operation, pedestrian studies [1 hour]

Practical/Assignment:
1. Classified intersection traffic volume count
2. Traffic volume count at freeway section
3. Accident report
4. Parking supply survey

5. Pedestrian study
6. Intersection improvement proposals

References:

1. Roess, RP., McShane, WR. and Prassas, ES. (1998), Traffic Engineering, Prentice Hall.
2. Papacostas, C. S. (1987), Fundamentals of Transportation Engineering, Prentice Hall.
3. Kadiyali, LR (1987), Traffic Engineering and Transportation Planning, Khanna.
4. Highway Capacity Manual (2000), Transportation Research Board, USA.
5. Khanna, S. K. and Justo, C. E. G. (1991), Highway Engineering, Nemchand.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	4	8
2	4	8
3	4	8
4	8	16
5	8	12
6	10	16
7	7	12
Total	45	80

* There may be minor deviation in marks distribution.

ADVANCED GEOTECHNICAL ENGINEERING
EG …..

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
The objective of the course is to provide the student with the concept and the tools that can be used to incorporate in the field of geotechnical engineering. The course includes the advanced techniques that are not dealt in the courses of soil mechanics and foundation engineering.

1. Scope of advanced geotechnical engineering [2 hours]
- 1.1. Field of application of advanced geotechnical engineering
- 1.2. Different sectors of geotechnical engineering

2. Field instrumentation and monitoring [12 hours]
- 2.1. Types of field measurements and their uses
- 2.2. Monitoring displacements of foundations and structures: vertical and horizontal displacement
- 2.3. Monitoring slope\rock mass movement: slope movement using borehole extensometers, inclinometers and tiltmeters: rockmass displacement in underground excavations etc. using optical electro-optical methods of borehole extensometers
- 2.4. Monitoring **pressures\ loads in earth**: walls and structures; monitoring pressures in the body of earth structures
- 2.5. Monitoring In-situ stresses in rock; hydraulic fracture techniques, direct stress measurement techniques; and borehole methods
- 2.6. Monitoring pore water pressure: methods based on various types of piezometers, selection of piezometers to suit the ground condition
- 2.7. Recording and data handling

3. Geosynthesis [9 hours]
- 3.1. Types of geosynthesis
- 3.2. Application of geosynthesis drainage, filtration reinforcement and separation
- 3.3. Design consideration: physical properties, mechanical/hydraulic durability requirements
- 3.4. Construction requirements: site preparation, selection of equipment, placement and compaction requirements

4. Anchors, Rock Bolts and Shotcrete [9 hours]
- 4.1. Application and types of anchors and rock bolts
- 4.2. Design criteria: safety against uplift, overturning, tangential displacement, shear failure and caving in
- 4.3. Installation: drilling, insertion, grouting (anchoring) stressing and final grouting
- 4.4. Mechanism of load transfer in anchors
- 4.5. Testing of anchors
- 4.6. Protection from corrosion
- 4.7. Selection of materials and mix design of shotcrete
- 4.8. Engineering properties of shotcrete
- 4.9. Placement of shotcrete

5. Grouting [4 hours]
- 5.1. Purpose of grouting
- 5.2. Classification of grouting materials
- 5.3. Characteristics of good grouting materials: viscosity, setting time, permeability of grouting works
- 5.4. Planning of grouting works
- 5.5. Selection of grouting materials
- 5.6. Grouting methods
- 5.7. Control of grouting works

6. Geotechnical earthquake engineering [9 hours]
- 6.1. Earthquakes
- 6.2. Ground shaking
- 6.3. Liquefaction
- 6.4. Surface rupture
- 6.5. Other permanent Ground Deformatons
- 6.6. Tsunamis and Seiches
- 6.7. Seismic provisions in Building Codes

Tutorial:
Three assignments that include the design of anchor and planning of geo synthesis and grouting

Practical:
One day field study on the application of grouting, anchoring and geosysthetics and preparation of report.

References:

1. Principles of Geotechnical Engineering" , B.M. Das, Boston PWS Engineering, 1985
2. "Engineering Principles of Ground Modifications" , M. R. Housmann. Mc Graw-Hill Co. , 1990, New York
3. "Grouting in engineering practice" , R. Bowen, Allied Science Pub. , London, 1981

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distributions*
1	2	4
2	12	20
3	9	16
4	9	16
5	4	8
6	9	16
Total	45	80

* There may be minor deviation in marks distribution.

DESIGN OF BRIDGES
CE …

Lecture : 3 **Year IV**
Tutorial : 1 **Part II**
Practical : 1.5

Course objectives:

- Introduce bridge structures & their types and make capable to select appropriate bridge type
- Make capable to analyze and design simple reinforced concrete and steel bridge deck, bridge bearing and substructure of bridge
- Familiarize with the method of construction and maintenance of bridges

1. Introduction to Bridge Structures and Fundamentals of Bridge Design. [6 hours]
- 1.1. Bridge and its components
- 1.2. Types of bridges and their characteristics
- 1.3. Selection of bridge type
- 1.4. Essential design data and their acquisition
- 1.5. General design requirements

2. Bridge Loading and Responses [4 hours]
- 2.1. Bridge loads
- 2.2. Bridge responses

3. Bridge Deck Analysis and Method of Lateral Load Distribution [6 hours]
- 3.1. General principle and methods of bridge deck analysis
- 3.2. Effective Width Method
- 3.3. Courbon's Method
- 3.4. Distribution Coefficient Method
- 3.5. Hendry Jaeger Method
- 3.6. Longitudinal and lateral positioning of moving loads and response
  - 3.6.1. calculation

4. Design of Simple Reinforced Concrete Bridge [5 hours]
- 4.1. Design of RC Slab Bridge
- 4.2. Design of RC T-Beam Bridge

5. Design of Simple Steel Bridge [5 hours]
- 5.1. Design of plate girder and composite bridge
- 5.2. Design of truss bridge

6. Design of Bridge Substructure [10 hours]
- 6.1. Design of Pier
- 6.2. Design of Abutment
- 6.3. Introduction to Bridge Foundation

7. Bridge Bearing and Expansion Joint [5 hours]
- 7.1. Bridge bearing
  - 7.1.1. Types of bearing
  - 7.1.2. Design of metallic bearing
  - 7.1.3. Design of elastomeric bearing
  - 7.1.4. Expansion Joint
    - 7.1.4.1. Requirement to expansion joint
    - 7.1.4.2. Types of expansion joint and their design

8. Construction and Maintenance of Bridge [4 hours]
- 8.1. Introduction to construction of bridges
- 8.2. Introduction to maintenance of bridges

Tutorial:

1. Exercise on the design of RC slab bridge [1.5 hours]
2. Exercise on the application of Courbon's Method, Distribution Coefficient Method and Hendry Jaeger Method [3 hours]
3. Exercise on the Design of T-Beam bridge [2 hours]
4. Exercise on the Design of Composite Bridge [2 hours]
5. Exercise on the Design of Steel Truss Bridge [2 hours]
6. Exercise on the Design of Bearing [2 hours]
7. Exercise on the Design of Pier and Abutment [2.5 hours]

Practical:

Practical of the course consists of a minor project work and field work..

1. Every individual student is assigned with a minor project work on design of RCC/ Steel Bridge and student has to defend the project work at the end of academic semester.
2. One day field visit to bridge sites is organized. Student has to submit a visit report.

Reference

1. Essential of Bridge Engineering; Victor, D.J. Oxford and IBH Publishing Company, New Delhi
2. Design and Construction of Highway Bridges; Rakshit, R.S.

New Central Book Agency, New Delhi
3. Analysis and Design of Substructures; Swami Saran
Oxford and IBH Publishing Company, New Delhi
4. Bridge Analysis Simplified; Baidar Bakht and Leslie G. Jaeger,
Mc Graw Hill Book Company
5. Concrete Bridge Practice: Analysis, Design and Economics, V.K.Raina
Tata Mc Graw – Hill
6. Concrete Bridge Practice: Construction, Maintenance and Rehabilitation; V.K.Raina,
Tata Mc Graw – Hill
7. Standard Specifications and Codes of Practices for Road Bridges,
IRC 5, 6, 21, 22, 24, 40, 78, 83

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	6	8
2	4	6
3	6	12
4	5	12
5	5	12
6	10	14
7	5	10
8	4	6
Total	45	80

* There may be minor deviation in marks distribution.

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course objectives:
To understand the nature of earthquakes, behavior of structures under the ground motion, and learns the analysis and design of structures subjected to earthquake ground motions.

1. **Seismological aspects** **[4 hours]**
   - 1.1. Causes of earthquakes
   - 1.2. Theory of plate tectonics
   - 1.3. Faults and fault mechanism
   - 1.4. Seismic waves
   - 1.5. Measures of earthquake
   - 1.6. Seismic hazards
   - 1.7. Types of vibration
   - 1.8. Response of structures to vibration

2. Earthquake Ground Motion **[10 hours]**
   - 2.1. Attenuation Laws
   - 2.2. Ground motion parameters
   - 2.3. Local site effects
   - 2.4. Soil amplification
   - 2.5. Duhamel Integral for SDOF for earthquake ground motion
   - 2.6. Liquefaction effect
   - 2.7. Response Spectrums of Earthquakes
   - 2.8. Seismic zoning
   - 2.9. Seismic hazard analysis
   - 2.10. Review of random variables and probability theory
   - 2.11. Probability distribution functions
   - 2.12. Conditional probability and Baye's theorem
   - 2.13. Deterministic seismic hazard analysis (DSHA)
   - 2.14. Probabilistic seismic hazard analysis (PSHA)
   - 2.15. Seismic hazard curve and return period

3. Linear Dynamic analysis of structures **[8 hours]**
   - 3.1. Response of SDOF system to support movement/earthquake ground motion
   - 3.2. Vibration frequencies and mode shapes of MDOF system
   - 3.3. Mode superposition method
   - 3.4. Mode participation factors
   - 3.5. Effective modal mass
   - 3.6. Response spectrum analysis of MDOF system
   - 3.7. Pseudo Static Force in Each Mode of Vibration due to Earthquake
   - 3.8. Maximum responses due to effects of all modes

4. Lateral Load Resisting Systems for Buildings **[10 hours]**
   - 4.1. Different structural systems for lateral loads.
   - 4.2. Floor diaphragms
   - 4.3. Lateral load distribution with rigid floor diaphragms
   - 4.4. Moment resisting frames
   - 4.5. Lateral load distribution in frame buildings
   - 4.6. Shear walls
   - 4.7. Shear wall with openings
   - 4.8. Frame – shear wall dual system
   - 4.9. Building configuration implications

5. Methods of Analysis for Earthquake Resistant Design **[7 hours]**
   - 5.1. Principles of earthquake resistant design
   - 5.2. Equivalent lateral load procedure
   - 5.3. Dynamic analysis procedure
   - 5.4. Drift evaluation and verification
   - 5.5. Diaphragm effect
   - 5.6. Torsional response
   - 5.7. Other major code provisions

6. Design of Structures for Earthquakes **[6 hours]**
   - 6.1. Plastic design of structures for earthquakes
   - 6.2. Ductility and energy absorption in buildings
   - 6.3. Reinforced concrete for earthquake resistance
   - 6.4. Confinement of concrete for ductility
   - 6.5. Ductile detailing of reinforced concrete structures
   - 6.6. Effect of infill masonry walls on frames
   - 6.7. Problems of soft and weak stories
   - 6.8. Capacity design procedures
   - 6.9. Behavior of masonry buildings during earthquakes
   - 6.10. Failure mechanisms of masonry walls

6.11. Strength of masonry in shear and flexure
6.12. Concepts for earthquake resistant masonry buildings

Tutorial:
There shall be related tutorial exercised in class and given as regular home work exercises.

Practical:
The students shall work on a course project on earthquake resistant design of structures on agreement with the course coordinator. Generally the course project work will base on the prevalent national or international seismic codes. The report on the individual course project shall be submitted at the end of the semester, and will be scored based on the quality of the project report.

References:

1. Newmark, N. M., and Rosenblueth, E., **Fundamentals of Earthquake Engineering**, Prentice-Hall, Inc. Englewood Cliffs, N. J., 1971.
2. Kramer, S. L., **Geotechnical Earthquake Engineering**, Prentice -Hall, 1996.
3. Dowrick D., **Earthquake Resistant Design and Risk Reduction**, John Wiley & Sons, 2009.
4. Chopra A. K., **Dynamics of Structures: Theory and Applications to Earthquake Engineering,** Prentice Hall, 2007.
5. Clough R. W., Penzien J, **Dynamics of Structures**, 2nd edition: McGraw Hill 1993.

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	4	8
2	10	16
3	8	16
4	10	16
5	7	14
6	6	10
Total	45	80

* There may be minor deviation in marks distribution.

VULNERABILITY ASSESSMENT AND RETROFITTING TECHNIQUE
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
The course provides practical information on vulnerability assessment of existing buildings and retrofitting technique. This course deals with vulnerability assessment of existing buildings and in this part students will learn qualitative and quantitative assessment process and will be able to carry out the qualitative assessment and concept on detail structural assessment method and analysis. The students will also learn the testing methods to estimate the properties of material on existing structures- non destructive, semi destructive and destructive. The course deals with design technique on retrofitting and in these part students will learn design principles and various types of retrofitting technique along with construction detail. The students will be able to carry out the qualitative assessment, concept on detail analysis, testing methods and retrofitting technique.

1. Introduction [3 hours]
- 1.1. Earthquake and cause
- 1.2. Seismic Risk
- 1.3. Risk Reduction
- 1.4. Building Typology in Nepal

2. Procedure for buildings evaluation [10 hours]
- 2.1. General background
- 2.2. Evaluation methods
  - 2.2.1. Qualitative evaluation method
  - 2.2.2. Quantitative evaluation method

3. Level of seismic protection and seismic risk classes [4 hours]
- 3.1. Seismic design force according to NBC and IS

4. Performance Objectives [6 hours]
- 4.1. Level of Performance
- 4.2. Failure Mechanism
- 4.3. Building behavior during past earthquakes

5. Introduction on Evaluation methodology - Simplified Method and low rise building [8 hours]
- 5.1. Principle of the method
- 5.2. Evaluation of equivalent lateral seismic forces
- 5.3. Computation of the shear stresses in vertical elements
- 5.4. Verification conditions

6. Damage Assessment [6 hours]
- 6.1. Non Destructive test
- 6.2. Semi Destructive test
- 6.3. Destructive

7. Retrofitting Solution and techniques [8 hours]
- 7.1. Retrofitting of reinforced concrete frame structures
  - 7.1.1. Interventions that do not involve the alteration of the structural system
  - 7.1.2. Interventions that involve the transformation of the reinforced concrete structural frames
  - 7.1.3. Interventions on reinforced concrete wall structures
- 7.2. Interventions that do not involve the alteration of the structural system
  - 7.2.1. Interventions that involve the transformation of the reinforced concrete structural walls
- 7.3. Interventions for masonry structures

Tutorial /Practical:
1. Project
   - 1.1. Case study of building evaluation and retrofitting
   - 1.2. Seismic evaluation
   - 1.3. Checking of existing structure lateral stiffness
   - 1.4. Retrofitting solutions
     - 1.4.1. Retrofitting by reinforced concrete jacketing on the central span
     - 1.4.2. Retrofitting by introducing reinforced concrete shear walls
     - 1.4.3. Retrofitting by introducing steel braces
     - 1.4.4. Retrofitting by beams and columns RC jacketing
     - 1.4.5. Retrofitting by RC walls
     - 1.4.6. Retrofitting by steel bracing
2. Determination of compressive strength of existing concrete
3. Determination of steel bars in existing structures

References

1. Assessment and Improvement of Structural Performance of building in Earthquakes, NZSEE study group on Earthquake Risk building, 2006
2. Guideline for Seismic Retrofit of Existing Reinforced Concrete Buildings, 2001, The Japan Building Disaster Prevention Association
3. IS 1905/ SP 20
4. IS 383, 1970
5. IS 456, 2000
6. Manual On Vulnerability Assessment and Retrofitting of Existing School Buildings, Hari Darshan Shrestha et all, Prevention web
7. NEHRP Guidelines for the Seismic Rehabilitation of Buildings, FEMA 273
8. Nepal National Building Code (NBC) 109, 1994
9. Rehabilitation of Concrete Structures, Dr B . Vidivelli, Standard Punlisher and Distributors
10. Seismic Evaluation and Retrofit of Concrete Buildings, Volume 1 and 2, ATC 40
11. Standard for Seismic Evaluation of Existing Reinforced Concrete Buildings, 2001, The Japan Building Disaster Prevention Association
12. Technical Manual for Seismic Evaluation and Seismic Retrofit of Existing Reinforced Concrete Buildings, 2001, The Japan Building Disaster Prevention Association

Evaluation scheme

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	3	5
2	10	20
3	4	5
4	6	10
5	8	15
6	6	10
7	8	15
Total	**45**	**80**

* There may be minor deviation in marks distribution.

SEISMIC RISK ASSESSMENT
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course objectives:
The overall objective of the module is to provide make the students able to carry out probable hazard assessment and estimate probable consequences of building damage, human casualties and economic losses.
After completion of the course, the students should be able to

- Understand concept of seismic hazard and calculate probable hazard in an area
- Comprehend vulnerability function of building structures
- Integrate hazard and vulnerability in order to estimate probable damage and loss
- use risk assessment tools

1. Seismicity and earthquakes (4 hours)
- 1.1. Seismic sources
- 1.2. Distribution of earthquake
- 1.3. Earthquake magnitude/intensity

2. Earthquake Ground motion (6 hours)
- 2.1. Characteristics of earthquake motion
- 2.2. Attenuation laws
- 2.3. Uncertainties in ground motion

3. Seismic Hazard Analysis (10 hours)
- 3.1. Deterministic approach
- 3.2. Probabilistic approach
- 3.3. Logic trees
- 3.4. Seismic hazard maps for different return periods

4. Effects of local site condition (4 hours)

5. Exposure information and Vulnerability Analysis (6 hours)
- 5.1. Structural Vulnerability
- 5.2. Vulnerability functions
- 5.3. Concept of fragility analysis
- 5.4. Fragility curves
- 5.5. Estimation of damage

6. Determination of Seismic risk and loss (8 hours)
Integration of hazard information and vulnerability to obtain the seismic risk

7. **Introduction to risk assessment tools (7 hours)**

Tutorial
1. Probability hazard assessment
2. Local site effects

Project:
1. Probability Seismic Hazard Assessment
2. Development of Vulnerability Functions
3. Application of risk assessment tools like RADIUS, HAZUS and CAPRA (A selected area can be choosen

References

1. Robin K. McGuire. Seismic Hazard and Risk Analysis. EERI, 2004
2. Steven L. Kramer. Geotechnical Earthquake Engineering. Prentice Hall, 1995

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	4	6
2	6	8
3	10	20
4	4	12
5	6	12
6	8	12
7	7	10
Total	45	80

* There may be minor deviation in marks distribution.

GEOTECHNICAL EARTHQUAKE ENGINEERING
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
The knowledge of geotechnical aspect of earthquake engineering is very essential of civil engineering structures. Seismic considerations are a significant factor in the design of much of the infrastructure in seismically active countries like Nepal. This course combines the fundamental ideas learned in the previous introductory engineering geology with seismology and design aspect of earthquakes, and applies these ideas in analyzing and understanding the seismic effects on soil structures. Various concepts, theories and practices of modern geotechnical earthquake engineering will be introduced. In this course, the student will get an overall view of the nature of seismic hazards, the methods used to assess their impacts on society and the techniques available to mitigate their damaging effects.

1. Introduction (5 hours)
- 1.1. Mechanics and classification of earthquakes
- 1.2. Seismic hazard
- 1.3. Seismic waves – types, measures and conversion
- 1.4. Causes of earthquakes, Plate tectonics, faults
- 1.5. Measure of earthquakes- magnitude, intensity, seismograph
- 1.6. Review of historical earthquakes

2. Strong motion seismology (6 hours)
- 2.1. Mechanics and classification of earthquakes
- 2.2. Estimation of ground motion parameters
- 2.3. Attenuation relation- model parameters, theoretical models
- 2.4. Classifications of attenuations relations, applicability for Himalayan region
- 2.5. Simulation of strong motions
  - 2.5.1. Earthquake source model
  - 2.5.2. Time and frequency domain characteristics
  - 2.5.3. Rupture directivity
- 2.6. Local site effects on strong ground motions

3. Dynamics of single degree of freedom systems (8 hours)
- 3.1. Free vibration of damped and undamped systems
- 3.2. Forced vibration of damped and undamped systems
- 3.3. Response spectrum concept

4. Seismic hazard assessment (8 hours)
- 4.1. Introduction
- 4.2. Earthquake recurrence relationship
- 4.3. Probabilistic hazard assessment methodology
  - 4.3.1. Source modeling
  - 4.3.2. Size of earthquakes
  - 4.3.3. Distance and attenuation laws
- 4.4. Probabilistic spectra

5. Site Amplification and Ground Response Analysis (8 hours)
- 5.1. Simplified site amplification procedures
- 5.2. Dynamic soil properties
- 5.3. One dimensional equivalent linear site response analysis
- 5.4. Soil structure interaction

6. Liquefaction (6 hours)
- 6.1. Definition of soil liquefaction
- 6.2. Features of liquefaction induced damages
- 6.3. Factor governing liquefaction
- 6.4. Assessment of liquefaction potential
- 6.5. Permanent displacement due to liquefaction
- 6.6. Factor of safety against liquefaction

7. Seismic slope stability (4 hours)
- 7.1. Pseudostatic approach
- 7.2. Newmark's sliding block method

Tutorials:

1. Introduction (1 hour)
Theory, definition and concept type questions
Review of impact of historical earthquakes in human environment

2. Strong motion seismology (2 hours)
Theory, definition and concept type questions
Practical examples, and numerical examples types questions

3. Dynamics of single degree of freedom systems (3 hours)
Theory, definition and concept type questions

Examples of free and forced SDOF method

4. **Seismic hazard assessment** **(3 hours)**

5. **Theory, definition and concept type questions** **(3 hours)**
   Examples of recurrences relationship and hazard assessment

6. **Site amplification and ground response analysis** **(2 hours)**
   Theory, definition and concept type questions
   Practical examples of site response analysis

7. **Liquefaction** **(2 hours)**
   Theory, definition and concept type questions
   Practical examples of liquefaction problems

8. **Seismic slope stability** **(2 hours)**
   Theory, definition and concept type questions
   Practical examples of earth pressure problems

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Mark distribution*
1	5	8
2	6	10
3	8	15
4	8	15
5	8	15
6	6	10
7	4	7
Total	45	80

* There may be minor deviation in marks distribution.

Projects

- Seismology and earthquakes, single degree of freedom systems
- Strong ground motion parameters and response analysis
- Site amplification and dynamic soil properties
- 1-D equivalent linear site response with computer program
- Analysis of seismic hazards (Liquefaction and seismic slope stability)

References:

1. Iku Towhata, Geotechnical Earthquake Engineering, Springer, 2007
2. Stephen L. Kramer, Geotechnical Earthquake Engineering, Prentice Hall, 1996
3. W. F. Chen and C. Scawthorn, Earthquake Engineering Handbook, CRC press LLC, 2003

STRUCTURAL RELIABILITY
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
The knowledge of probabilistic design of civil engineering structures. This course includes the fundamentals of statistics and its applications in civil engineering.

1. Basic Statistics (8 hours)
- 1.1. Introduction
- 1.2. Probability theory
  - 1.2.1. Introduction
  - 1.2.2. Random events
  - 1.2.3. Random variables
  - 1.2.4. Functions of random variables
  - 1.2.5. Moments and expectation
  - 1.2.6. Common probability distributions

2. Resistance distributions and parameters (10 hours)
- 2.1. Introduction
- 2.2. Statistics of properties of concrete, steel and other building materials
- 2.3. Statistics of dimensional variations
- 2.4. Characterization of variables, allowable stresses based on specified reliability
- 2.5. Probabilistic analysis of loads: gravity loads, wind loads

3. Basic Structural reliability (12 hours)
- 3.1. Introduction
- 3.2. Computation of structural reliability
- 3.3. Level 2 Reliability methods
  - 3.3.1. Introduction
  - 3.3.2. Basic variables and failure surface
  - 3.3.3. First order second moment methods (FOSM)
- 3.4. Reliability based design
  - 3.4.1. Determination of partial safety factors
  - 3.4.2. Development of reliability based design criteria
  - 3.4.3. Optimal safety factors

4. Monte Carlo Method (15 hours)
- 4.1. Monte Carlo study of structural safety
- 4.2. General, Monte Carlo method, applications.
- 4.3. Reliability of Structural system
  - 4.3.1. System reliability
  - 4.3.2. Modeling of structural systems
  - 4.3.3. Bounds of system reliability, reliability analysis of frames.

Tutorials:
1. Basic Statistics (2 hours)
   Theory, definition and concept type questions
2. Resistance distributions and parameters (3 hours)
   Theory, definition and concept type questions
   Practical examples, and numerical examples types questions
3. Basic Structural reliability (4 hours)
   Theory, definition and concept type questions
   Practical examples of FOSM method
4. Monte Carlo Method (6 hours)
   Theory, definition and concept type questions
   Practical examples of beams and frames

Practical:
There shall related practical assignment

References:

1. R. Ranganathan., Reliability Analysis and Design of Structures, Tata McGraw Hill, 1990.
2. Ang, A. H. S & Tang, W. H., Probability Concepts in Engineering Planning and Design, Vol. I Basic Principles, John Wiley & Sons, 1975.
3. Ang, A. H. S & Tang, W. H., Probability Concepts in Engineering Planning and Design, Vol. II Decision, Risks and Reliability, John Wiley & Sons, 1984.
4. Benjamin, J.R & Cornell, C.A., Probability, Statistics and Decision for Engineers, McGraw-Hill, 1982.
5. H. O. Madsen, S. Krenk & N. C. Lind, Methods of Structural Safety, Prentice-Hall, 1986.
6. R. E. Melchers. Structural Reliability - Analysis and prediction, Ellis Horwood Ltd, 1987.

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Mark Distribution*
1	8	10
2	10	15
3	12	25
4	15	30
Total	45	80

* There may be minor deviation in marks distribution.

ROCK SLOPE ENGINEERING
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
The objective of the course is to contribute to the safe and economic designs of excavation and embankments in hilly areas. Other objectives are: to determine the slope sensitivity to different triggering mechanism and to test and compare different support and stabilization options.

1. Principles for Rock Slope Stability Analysis (2 hours)
- 1.1. Introduction
- 1.2. Definitions and Aims of Slope Stability Analysis
- 1.3. Factors affecting the Slope Stability

2. Methods for Rock Slope Stability Analysis (5 hours)
- 2.1. Empirical Methods
- 2.2. Deterministic Method
- 2.3. Probabilistic Method
- 2.4. Numerical Modeling

3. Quantification of Groundwater Pressure (2 hours)
- 3.1. Occurrence and Characteristics of Groundwater
- 3.2. Groundwater Effects on Slope Stability
- 3.3. Groundwater Pressure Models

4. Quantification of Shear Strength Parameters of Discontinuities (6 hours)
- 4.1. Shear Strength of Planar Surface
- 4.2. Shear Strength of Rough Surface
- 4.3. Determination of Shear Strength on Rock Mass
- 4.4. Influence of Water on Shear Strength

5. Quantification of Seismic Force (2 hours)
- 5.1. Basic Aspects of Earthquake
- 5.2. Determination of Earthquake Magnitude

6. Graphical Presentation of Geological Data (6 hours)
- 6.1. Definition of Geological Terms
- 6.2. Graphical Techniques for Data Problems
- 6.3. Evaluation of Potential Slope Problems

7. Geological Data Collection (6 hours)
- 7.1. Geological Investigate
- 7.2. Mapping of Exposed Structures
- 7.3. Measurement of Surface Roughness
- 7.4. Drill Coring for Structural Purpose

8. Analysis (12 hours)
- 8.1. Plane Failure
- 8.2. Wedge Failure
- 8.3. Circular Failure
- 8.4. Toppling

9. Support and Lining (4 hours)
- 9.1. Basic Methods for Improving the Stability of Slopes
- 9.2. Support Methods and Principles
- 9.3. Control of Rock Falls

Tutorial:
1. Graphical presentation of geological data
2. Design of rock slopes
3. Estimation of preventive measures for unstable slopes

Practical: 2 days
- Field visit to potential unstable slopes
- Field report and group presentation is necessary

Reference:

1. Hoek, E. and Bray, J. W. 1981. Rock Slope Engineering. Institute of Mining and Metallurgy, London, 358p.
2. Hoek, E. 1998. Slope stability problem in Hong Kong (Chapter 7). Course notes, Internet edition, http://wwwrockeng.utronto.ca/hoekcorner.htm, pp. 92 - 104.
3. Hoek, E. 1998. Development of Rock Engineering (Chapter 1). Course notes, Internet edition http://wwwrockeng.utronto.ca/hoekcorner.htm, pp. 1 - 17.
4. Hoek, E. 1998. Factor of safety and probability of failure (Chapter 8). Course notes, Internet edition, http://wwwrockeng.utronto.ca/hoekcorner.htm, pp. 105 - 114.

5. Hoek, E. 2000. Shear strength of discontinuities (Chapter 4). Course notes, Internet edition. http://wwwrockeng.utronto.ca/hoekcorner.htm, pp.60-72.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	2	4
2	5	8
3	2	4
4	6	10
5	2	4
6	6	10
7	6	10
8	12	22
9	4	8
Total	45	80

* There may be minor deviation in marks distribution.

HILL IRRIGATION ENGINEERING
CE ….

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
This course is aimed at training the students specific engineering design considerations for canal irrigation, their operation, maintenance and management with environmental balance and farmer's participation in the hills of Nepal. The course is emphasized with the design of non-conventional micro irrigation technology such as sprinkler and drip in the remote hills of Nepal. After the completion of this elective course the students will confidently design the canal and micro irrigation projects in the remote hilly areas of Nepal.

1. Introduction (4 hours)
- 1.1. Physiographic Regions and Farming Systems of Nepal
- 1.2. Characteristics of Hill Irrigation Systems (HIS)
- 1.3. Need, Potentiality and Types of Irrigation Development in the Hills of Nepal

2. Environmental Aspects of Hill Irrigation (6 hours)
- 2.1. Problems of Floods, Soil Erosion and Land Slides
- 2.2. Mountain Zone Classification
- 2.3. Engineering and Vegetative Measures for Canal Design in Different Mountain Zones
- 2.4. Guidelines for Hill Irrigation Design [Scheme Objectives; Agricultural Considerations;
- 2.5. Managerial, Social and Institutional Arrangements; Financial Provisions and Engineering solutions]

3. Planning and implementation of hill irrigation (3 hours)
- 3.1. Long Term Planning with Farmer's Participation
- 3.2. Request Proposal for Project Assistance and Screening
- 3.3. Stages of Project Study and Data Collection
- 3.4. Detail Design and Implementation of Project

4. water availability and irrigation requirements (8 hours)
- 4.1. Flow Assessment Techniques Based on Data Availability (MIP, WECS & HSC)
- 4.2. Extractable Flow for Irrigation
- 4.3. Consumptive Use of Selected Cropping Pattern
- 4.4. Operational Water Requirements
- 4.5. Effective Rainfall Contribution with 80% reliability
- 4.6. Percolation Losses and Irrigation Efficiencies
- 4.7. Computation of Irrigation Requirements

5. Canal Irrigation in hills (12 hours)

5.1. Canal Intakes for Hill Irrigation
- 5.1.1. Design issues and construction materials for diversions; Suitable intakes and their locations;
- 5.1.2. Design factors of bank intakes; Design of single orifice and bottom rack intakes

5.2. Sediment Control for Hill Canals
- 5.2.1. Natural and artificial methods; Sediment control structures for hill canals;
- 5.2.2. Design of gravel trap and settling basin; Estimation of sediment load in the absence of data

5.3. Canals and Distribution Systems for Hill Irrigation
- 5.3.1. Nomenclature, layout and alignment of hill canals; Design of hill canals; Seepage and lining of hill canals;
- 5.3.2. Characteristics of distribution systems and Layout pattern appropriate to hill irrigation; Structural components of the distribution system; Flow division structures and Operation of Saacho

5.4. Escapes and Drop structures for Hill Canals
- 5.4.1. Need of escapes in hills; Suitable escapes for hills; Location of escapes in hills; Suitable drops in hills;
- 5.4.2. Design of cascade and chute drops; Use of small drops to control water level and erosion

5.5. Cross Drainage Structures for Hill Canals
- 5.5.1. Selection of suitable C/D structures in hills; Aqueducts, their advantages and disadvantages;
- 5.5.2. Problems of aqueducts and prevention; Super passages, their advantages and disadvantages;
- 5.5.3. Problems of super passages and prevention; Siphons and their disadvantages; Problems of siphons
- 5.5.4. and prevention; Level crossings, their advantages and disadvantages; Inlets and Outlets

6. Sprinkler irrigation (5 hours)
- 6.1. Advantages and Suitability of Sprinkler for Hill Irrigation
- 6.2. Limitations and Disadvantages of Sprinkler Irrigation
- 6.3. Types and Components of Sprinkler System

6.4. Design Approach and Selection of Sprinklers
6.5. Design of a Portable Sprinkler System
6.6. Operation and Maintenance of Sprinkler System

7. Drip or Trickle irrigation (5 hours)
7.1. Advantages and Suitability of Drip for Hill Irrigation
7.2. Limitations and Disadvantages of Drip Irrigation
7.3. Types and Components of Drip System
7.4. Design Approach and Selection of Drips
7.5. Design of a Portable Drip System
7.6. Operation and Maintenance of Drip system

8. Gabion structures for remote hill areas (2 hours)
8.1. Advantages of Gabion Construction
8.2. Design Considerations for Gabion Structures
8.3. Characteristics of Fill Material

Tutorials:

1. Estimation of mean monthly and 80% reliable flows by MIP Method (1hour)
2. Estimation of mean monthly, low and 80% reliable flows by WECS/DHM Method (1 hour)
3. Estimation of mean monthly and 80% reliable flows by HSC method (1 hour)
4. Estimation of 80% reliable, effective monthly rainfall & half monthly values (2 hours)
5. Computation of Irrigation Requirements using Crpwat8 windows software (1 hour)
6. Design of single orifice & bottom rack intake (2 hours)
7. Design of gravel trap and settling basin (2 hours)
8. Estimation of sediment load in the absence of data (1 hour)
9. Design of cascade & chute drops (2 hours)
10. Design of a Portable Sprinkler System (1 hour)
11. Design of a Portable Drip System (1 hour)

Assignments:
Individual assignment on design of Sprinkler and Drip irrigation systems

References:

1. Hill Irrigation Engineering, Institute of Engineering, Pulchowk Campus, TU, Basil S. Jacob, The Ford Foundation, New Delhi, January 1995.
2. Design Manuals for Irrigation Projects in Nepal, M.1 to M.13, Sir M MacDonald & Partners Ltd,
PDSP, UNDP, World Bank, DOI, February 1990.

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distributions*
1	4	10
2	6	10
3	3	5
4	8	10
5	12	20
6	5	10
7	5	10
8	2	5
Total	45	80

* There may be minor deviation in marks distribution.

GROUNDWATER ENGINEERING
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
Groundwater Engineering is the first course in the physics of saturated flow in porous media with engineering applications. The course includes topics such as ground-water occurrence and Darcian flow, well hydraulics, pumping tests for finding aquifer parameters, overview of methods for groundwater explorations, tubewell construction methods and design, pump selection for lifting groundwater and economics of groundwater utilization. Moreover, the course gives an overview of groundwater resources of Nepal.

1. **Occurrence of groundwater and its importance (5 hours)**
   Hydrological cycle and groundwater, Origin and age of groundwater, Groundwater basins, springs, and their types , Characteristics of groundwater its comparison and relation with surface water, Basic definitions of terms in groundwater hydrology with illustrations: Aquifer, Aquiclude, Aquifuge, Aquitard,Types of aquifer with illustrations- confined, unconfined, leaky, perched, Properties of soil/rock affecting groundwater flow: porosity, storage coefficient, specific yield

2. **Fundamentals of Groundwater motion (8 hours)**
   Review of continuum approach and REV with specific reference to groundwater flow, Darcy's experiment and empirical expression of Darcy's law and its extension with 3-d generalization, Range of validity of Darcy's law and examples of non-Darcian flow in sub-surface, Definition of hydraulic conductivity, permeability (with their typical values), aquifer transmissivity, aquifer heterogeneity and anisotropy

3. **Potential groundwater flow theory and Flow Net analysis (8 hours)**
   Plotting stream lines, equipotential lines, and flow net in groundwater, direction of groundwater flow from piezometric head observations, analysis of water table maps , Derivation of Laplace equation and its use in steady groundwater flow in isotropic and anisotropic media. Application of potential flow theory in steady one-dimensional flow in homogenous unconfined aquifer, horizontal galleries extending up to impervious rock and aquifer with recharge; steady flow in a confine aquifer of constant and variable thickness.

4. **Well hydraulics (4 hours)**
   Steady and unsteady radial flow in fully and partially penetrating non-leaky wells,
   Introduction of Multiple well systems and Interference of wells

5. **Pumping test and estimation of aquifer properties (5 hours)**
   Use of Pumping tests in Groundwater hydrology, overview of types of pumping tests, Theis method for unsteady flow in unconfined, and confined non-leaky aquifers, Thiem's equilibrium formula for steady flow in unconfined aquifer, Jacob's time-drawdown and distance-drawdown methods for unsteady flow in non-leaky confined aquifer

6. **Overview of Groundwater exploration (2 hours)**
   Objectives of groundwater exploration, Overview of methods of groundwater exploration, Water Winching, Geological, geophysical, electrical resistivity, seismic refraction methods

7. **Water Well design (6 hours)**
   Classification of wells and tubewells, Design considerations in wells in confined and unconfined aquifer: well diameter, well depth, well screens(slot size, screen diameter, types and selection of screen), gravel pack design, Overview of design principle of collector wells and infiltration galleries

8. **Pumps for groundwater lifting (4 hours)**
   a. Types of pumps, Overview of working principle and suitability of plunger, jet, deep-well vertical turbine, submersible, air-lift and centrifugal pumps,Factors to be considered in the selection of pump sets

9. **Groundwater Resources of Nepal (3 hours)**
   Kathmandu Valley and Terai aquifers: Schematic zones showing water availability and development possibility

Tutorials:
1. Fundamentals of Groundwater motion [4 hours]
2. Potential groundwater flow theory and Flow Net analysis [4 hours]
3. Well hydraulics [2 hours]
4. Pumping test and estimation of aquifer properties [2 hours]
5. Water Well design [3hours]

Field visit and project works:
Field visit to any drilling site or groundwater development project in Kathmandu or other areas. Students are also encouraged to visit drilling companies on their own to gain practical knowledge on hydrogeology. Also, assignment with project works related with ground water modeling is encouraged in the course.

References:

1. Groundwater. H. M. Raghunath, New Age International Publishers, 2nd Edition (1987)
2. Groundwater Hydrology, David Keith Todd, 2nd edition.
3. Hydraulics of Groundwater, Jacob Bear, McGraw-Hill, Inc.1979.
4. Handbook of Groundwater Develoment, John Wiley & Sons. U.S. Department of Interior, Bureau of Reclamation. 1995
5. Study of Groundwater Development: Strategies for Irrigation in the Terai, Volume 3. Groundwater, Groundwater Dvelopment Consultants (International) Limited, Cambridge, United Kingdom, 1987.
6. Groundwater Management Project in the Kathmandu Valley. Final report, Main report. Japan International Cooperation Agency. 1990.

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	5	4
2	8	16
3	8	16
4	4	8
5	5	8
6	2	4
7	6	10
8	4	8
9	3	6
Total	45	80

* There may be minor deviation in marks distribution.

Elective III

GIS AND REMOTE SENSING

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives

This course introduces principles, concepts and applications of Geographic Information Systems (GIS): a decision support tool for planners and managers of spatial information. Database development, manipulation and spatial analysis techniques for information generation will be taught. Students will have the scope of using GIS for applications in their related fields such as natural resource management, environment, civil engineering, agriculture, information system, etc will be discussed through miniproject and laboratory exercises.

1. **Introduction and Overview of GIS and Software:** **[3 hours]**
   Definition of a GIS features and functions; why GIS is important; how GIS is applied; GIS as an Information System; GIS and cartography; contributing and allied disciplines; GIS data feeds; historical development of GIS.

2. **GIS and Maps:** **[3 hours]**
   Map Projections and Coordinate Systems; Maps and their characteristics (selection, abstraction, scale, etc.); automated cartography versus GIS; map projections; coordinate systems; precision and error.

3. **Spatial Data Models:** **[3 hours]**
   Concept of data model; raster data model; compression; indexing and hierarchical data structures; vector data model; topology; TIN data model.

4. **Data Sources:** **[3 hours]**
   Data Input and Data Quality; Major data feeds to GIS and their characteristics; maps, GPS, images, databases; commercial data; locating and evaluating data; data formats; data quality; metadata.

5. **Database Concepts:** **[3 hours]**
   Database concepts and components; flat files; relational database systems; data modeling; views of the database; normalization; databases and GIS.

6. **Vector Analysis:** **[6 hours]**
   Data management functions; Data Analysis functions.

7. **Spatial Analysis:** **[6 hours]**
   Spatial interpolation methods; raster analysis including topological overlay; Map calculations; statistics; integrated spatial analysis.

8. **Surface Model:** **[3 hours]**
   DEM; slope; aspect; other raster functions.

9. **River network Generation:** **[4 hours]**
   Flow direction; flow accumulation; river network; and watershed boundary delineation.

10. **GPS:** **[4 hours]**
    Basic concept of GPS; How GPS works; DGPS; Errors in GPS; application.

11. **Introduction to Remote Sensing:** **[4 hours]**
    Concept of Remote Sensing; Electro Magnetic Spectrum and windows; Spectral signature of different landuse; Introduction to different satellites; Resolutions in RS; Application of Remote Sensing.

12. **Making Maps:** **[3 hours]**
    map functions in GIS; map design; map elements; choosing a map type; Exporting map in different format printing a map.

Tutorials & Practical:

1. Spatial database development [3 hours]
2. Linking non-spatial and spatial database [3 hours]
3. Projection [3 hours]
4. Database editing and updating [6 hours]
5. GPS data integration in GIS, [2 hours]
6. Geo processing [3 hours]
7. Spatial analysis [4 hours]
8. River Analysis [2 hours]
9. Map Layout [2 hours]
10. Mini-project for GIS application. [8 hours]

References:

1. *Raghunath Jha (2000):* Course Manual for GIS, IOE, Water Resources Engineering.
2. *P.A. Burrough and R. A. McDonnell (1998):* Principles of Geographical Information Systems, Oxford University Press.
3. *J. Star and J. Estes (1990):* Geographic Information Systems: An Introduction: Prentice Hall, Englewood Cliffs, N.J.

4. *J. Lee, D.W.S. Wong (2002):* Statistical Analysis with Arc View GIS: John Wiley and Sons, Inc., New York.
5. *Raghunath Jha (2000):* Course Manual for GIS, IOE, Water Resources Engineering.
6. *P.A. Burrough and R. A. McDonnell (1998):* Principles of Geographical Information Systems, Oxford University Press.
7. *J. Star and J. Estes (1990):* Geographic Information Systems: An Introduction: Prentice Hall, Englewood Cliffs, N.J.
8. *J. Lee, D.W.S. Wong (2002):* Statistical Analysis with Arc View GIS: John Wiley and Sons, Inc., New York.
9. Davide J Maguire, Michael Goodchild and David W RHIND, 1999, *Geographical Information Systems Vol 1: Principles*, Longman Scientific Technical.
10. Laura Lang, 2000, *Managing Natural Resources with GIS*, ESRI, Redlands, CA.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	3	6
2	3	6
3	3	6
4	3	6
5	3	6
6	6	10
7	6	10
8	3	6
9	4	6
10	4	6
11	4	6
12	3	6
Total	45	80

* There may be minor deviation in marks distribution.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
The objective of the course is to teach the students of civil engineering the functions of the various components of natural and manmade environment and their interaction with development activities. The course is aimed at imparting the knowledge of Environmental Impact Assessment (EIA) as relevant to various types of development projects. Students will be aware of prevailing practice of carrying out IEE/EIA studies for different governmental and non-governmental organizations, international donor agencies.
By the end of this course, students should be able to:

i. Fully understand the IEE and EIA Regulatory Framework as specified in EPA and EPR, and the steps and process involved in IEE and EIA.
ii. Conduct IEE/EIA in a team and be familiar with the principles and procedures of EIA, tools and techniques used in identification and analysis of impacts, suggest appropriate mitigation measures and prepare environmental management plans.

1. Introduction to Environmental Impact Assessment (EIA) [5 hours]
- 1.1. Emergence of EIA
- 1.2. History of EIA in Nepal
- 1.3. Definition and Types of EIA
- 1.4. Project Types, impacts and their types
- 1.5. The EIA Process and Project cycle

2. Screening and Initial Environmental Examination (IEE) [5 hours]
- 2.1. Objectives of Screening
- 2.2. Screening procedure
- 2.3. Initial Environmental Examination
- 2.4. Methods for IEE

3. Scoping and Preparation of Terms of Reference (ToR) [5 hours]
- 3.1. Objectives of Scoping
- 3.2. Scoping Process
- 3.3. Terms of Reference and its main components

4. Establishing the Environmental baseline [5 hours]
- 4.1. The Environmental setting
- 4.2. Purpose of baseline data
- 4.3. Methods of data collection
- 4.4. Importance of baseline data

5. Impact Identification, Prediction and Evaluation Techniques [10 hours]
- 5.1. Methods of impact identification
- 5.2. Methods of impact prediction
- 5.3. Impact evaluation techniques
- 5.4. Numerical on impact prediction and evaluation

6. Environmental Protection Measures (EPMs) [6 hours]
- 6.1. Introduction
- 6.2. Types of mitigation measures
- 6.3. Implementation of EPMs

7. Management of EIA process [9 hours]
- 7.1. Environmental Management Plan
- 7.2. Environmental Monitoring
- 7.3. Environmental Auditing
- 7.4. EIA Report Review and Decision Making
- 7.5. Stakeholder Consultation and Public Participation

Tutorials:

1. Introduction to EIA
Definitions, History of EIA, Types of EIA, EIA process & Project cycle
2. Screening & IEE (1 hour)
Definitions, Objectives & Need of screening, Screening criteria & procedures, Methods for IEE
3. Scoping & Preparation of ToR (1 hour)
Definitions, Objectives of scoping, scoping procedure, ToR & its main components
4. Establishing the environmental baseline (1 hour)
Definition, Purpose of baseline information, data collection methods, importance of baseline data
5. Impact identification, prediction & evaluation techniques (6 hours)
Importance of impact identification and prediction, Evaluation techniques, Numerical on impact prediction
6. Environmental Protection Measures (1 hour)
Definitions, Types of mitigation measures, Implementation of EPMs,
7. Management of EIA Process (3 hours)

Practical / Project Work.

Environmental management plan, Environmental monitoring plan, Environmental auditing plan, Review of EIA Report, Process of stakeholder consultation & public participation

Reference:

1. Canter, Larry W., Environmental Impact Assessment, McGraw Hill, 1996
2. Upreti, B. K.: Environmental Impact Assessment: process and practice. Published by Uttara Uprety, Koteshwor, Kathmandu, 2003
3. IUCN/Nepal: EIA Training Manual for Professionals and Managers. Published by IUCN/Nepal, 2003

Examination Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	5	10
2	5	8
3	5	8
4	5	8
5	10	21
6	6	9
7	9	16
Total	45	80

* There may be minor deviation in marks distribution.

CONSTRUCTION SAFETY MANAGEMENT
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
To provide basic knowledge on accidents and their impacts on construction; safety legislations and rules to be followed in construction; site safety practices to be followed during construction practices; human factors; ergonomics and cost of accidents and make aware on role of various parties for site safety management.

1. Introduction **[3 hours]**
- 1.1. Accidents
- 1.2. Nature and Causes of Accidents
- 1.3. Impact of Accidents
- 1.4. Evolution of Safety Concepts

2. An Overview of Construction Safety **[4 hours]**
- 2.1. Construction Safety
- 2.2. Current Situation
- 2.3. Organizational Aspect
- 2.4. Behavioral Aspect

3. Important Safety Rules **[4 hours]**
- 3.1. Accident Reporting
- 3.2. Storage of Materials
- 3.3. Atmosphere in Confined Place
- 3.4. Prevention from Drowning
- 3.5. Fire Prevention and Protection
- 3.6. First Aid and Medical Care
- 3.7. Personal Protective Equipments

4. Site Safety Management **[4 hours]**
- 4.1. Workplace and Equipment
- 4.2. Structures and Equipments
- 4.3. Working Platforms
- 4.4. Safety Organizations

5. Safety in Construction Operations **[6 hours]**
- 5.1. Planning For Safety
- 5.2. Excavation
- 5.3. Blasting
- 5.4. Tunneling
- 5.5. Building Works
- 5.6. Scaffolding
- 5.7. Lifting
- 5.8. Use of Electricity

6. Safety in the Use of Construction Equipment **[4 hours]**
- 6.1. Psychology of Construction Workers
- 6.2. Rights and Obligation of Parties
- 6.3. Health of Equipment Operators
- 6.4. Vehicles
- 6.5. Cranes
- 6.6. Lifting Gears
- 6.7. Temporary Power Supply

7. Safety and Economy **[3 hours]**
- 7.1. Direct Costs of Accidents
- 7.2. Indirect Cost of Accidents
- 7.3. Cost of Safety Programs
- 7.4. Safety Cost Optimization.

8. Psychological Aspect and Ergonomics **[3 hour]**
- 8.1. Carelessness
- 8.2. Related Physical Factor
- 8.3. Other Factors
- 8.4. The Shop Environment and Safe Behavior
- 8.5. Job Stress and Its Effect
- 8.6. Human Factors, Biomechanics and Ergonomics

9. Human Factors in Construction Safety **[2 hours]**
- 9.1. Employee Selection
- 9.2. Placement
- 9.3. Motivation: Awareness and Training

10. Personal Protection **[4 hours]**
- 10.1. Eye Protection
- 10.2. Finger, Arm and Hand Protection
- 10.3. Foot and Leg Protection
- 10.4. Noise Safeguard

10.5. Head Protection
10.6. Safety Belt

11. Safety Legislation in Construction Industry [4 hours]
11.1. Safety Codes Applicable to Construction Industry
11.2. ILO Standards
11.3. OSHA regulations
11.4. Health and Safety Provision in Nepal
11.5. Contract Conditions on Safety in Civil Works Projects

12. Safety Management: Role of Various Parties [4 hours]
12.1. Employers
12.2. Designers
12.3. Supervisors
12.4. Manufacturers/Dealers
12.5. Workers/employees
12.6. Motivating management
12.7. Contractual provisions

Tutorials:
1. Safety rules implementation
2. Accident Analysis
3. Safety cost Analysis and Optimization

Field Visit:
Minimum of one day Field Visit of Construction Projects to observe site safety practices is required

References:

1. Grimaldi John. V. and Simonds R.H., "Safety Management" 1991, All India Traveller Book Seller, Fifth Edition.
2. Vaid, K.N. "Construction Safety Management", NICMAR Publication,1988.

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks distribution*
1	3	6
2	4	6
3	4	8
4	4	8
5	6	10
6	4	8
7	3	5
8	3	5
9	2	3
10	4	5
11	4	8
12	4	8
Total	45	80

* There may be minor deviation in marks distribution.

DISASTER RISK MANAGEMENT
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
The course provides practical information on Disaster Risk Management. This course deals with Disaster risk reduction and disaster risk management and students will learn all three cycle of disaster management and its activities. Student will be able to deal with pre and post disaster cycle and planning on disaster risk reduction. The students will also learn DRR terminology and will learn the tools and techniques of assessment and planning for both pre and post disaster.

1. **Introduction Disaster Risk Management** **[4 hours]**

2. **Terminology on DRR** **[2 hours]**

3. **Hazard, Risk and Vulnerabilities** **[6 hours]**
   - 3.1. Physical dimensions
   - 3.2. Social dimensions
   - 3.3. Economic dimensions
   - 3.4. Disaster and emergencies – its types and level of impact

4. **Disaster Management Cycle** **[12 hours]**
   - 4.1. Pre Disaster Management
     - 4.1.1. Preparedness
     - 4.1.2. Prevention
     - 4.1.3. Mitigation
   - 4.2. Post Disaster Management
     - 4.2.1. Emergency Response
     - 4.2.2. Recovery
     - 4.2.3. Reconstruction/Rehabilitation

5. **Cluster Approach** **[6 hours]**

6. **Assessment tools** **[6 hours]**

7. **Risk Reduction approach, strategies and polices** **[4 hours]**

8. **Risk analysis technique** **[5 hours]**

Tutorials & Practicals
1. Case study of recent disaster and its management
2. Project work - Hazard on districts
3. Project work - post disaster management for given scenario

References

1. At Risk: Natural Hazards, people's Vulnerability and Disasters, Wisner et all, 2004, Routledge
2. Manual on International Law and Standards Applicable in Natural Disaster Situations, International Development Law Organisation, 2008 http://www.idlo.int
3. Human Rights and Natural Disasters, Operational Guidelines and Field Manual on Human Rights Protection in Situations of Natural Disaster, Brookings-Bern Project on Internal Displacement. http://www.brookings.edu/projects/idp/2006_naturaldisasters aspx
4. Guidelines for assessment in emergencies March 2008, ICRC, IFRC
5. *Sphere Humanitarian Charter: Common Standard 2*
6. *http://www.logcluster.org/tools/lca*

Evaluation scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution *
1	4	4
2	2	4
3	6	10
4	12	30
5	6	10
6	6	10
7	4	4
8	5	8
Total	**45**	**80**

* There may be minor deviation in marks distribution.

PROCUREMENT MANAGEMENT
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:

- To introduce the concept of Procurement, Procurement Planning, Methods and Types of Procurement
- To make aware on the present procurement rules followed in Nepal
- To provide knowledge on dispute resolution that arises during contract
- To introduce on procurement guidelines followed by different Agencies working in Nepal
- To make aware on Technical Audit Process that is followed in Nepal.

1. Concept of Procurement [4 hours]
- 1.1. Definition
- 1.2. Difference between Public and Private Procurement
- 1.3. Procurement of Works, Goods and Services, and Consulting Services
- 1.4. Procurement Cycle

2. Procurement Planning [4 hours]
- 2.1. Plan and Planning
- 2.2. Need and Importance of Procurement Planning\
- 2.3. Master Procurement Plan
- 2.4. Planning and Initiation of Individual Requirements
- 2.5. Implementation Arrangements

3. Methods of Procurement [6 hours]
- 3.1. Open Competitive Bidding
- 3.2. Limited Bidding
- 3.3. Sealed Quotations
- 3.4. Direct Procurement
- 3.5. Community Participation
- 3.6. Force Account

4. Types of Procurement [6 hours]
- 4.1. Unit Price Works (BOQ) contract
- 4.2. Lump Sum Contract
- 4.3. Cost Reimbursable Contract
- 4.4. Time and Material Contract
- 4.5. Design and Build Contract
- 4.6. BOOT, BOT Contract

5. Present Procurement Rules and Regulations (Procurement of Consulting Services) [4 hours]
- 5.1. Advertising, EoI, ToR, and RFP Preparation
- 5.2. Technical and Financial Evaluation
- 5.3. Negotiation and Award of Contract

6. Present Procurement Rules and Regulations (Procurement of Works and Goods) [6 hours]
- 6.1. Bid Document Preparation including technical specification, Evaluation Criteria,
- 6.2. Sale/Issue of Bid Documents, Pre-bid Conference, Bid Opening, Bid Examination, Bid Evaluation and Award of Contract
- 6.3. Nepal Specific Contract Management

7. Contract Management [6 hours]
- 7.1. Dispute: Causes and Resolutions
- 7.2. Extension of Contract
- 7.3. Termination of Contract
- 7.4. Closing of Contract

8. Introduction to Guidelines [4 hours]
- 8.1. FIDIC Documents
- 8.2. ADB Guidelines
- 8.3. WB Guidelines
- 8.4. Other Donor Guidelines

9. Technical Audit [5 hours]
- 9.1. Concept of Technical Audit
- 9.2. Status of Technical Audit in Nepal
- 9.3. Technical Audit Process
- 9.4. Performance Evaluation

Tutorials

1. Prepare procurement Master Plan
2. Prepare typical tender notice
3. Bid-evaluation

Practical

1. Prepare contract document
2. Field visit for technical audit

Project work

At least five case studies on Procurement will be discussed in classes.

Evaluation Scheme:

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Marks Distribution*
1	4	8
2	4	8
3	6	10
4	6	10
5	4	8
6	6	10
7	6	10
8	4	8
9	5	8
Total	45	80

* There may be minor deviation in marks distribution.

TIME SERIES ANALYSIS
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objectives:
To enhance the students understanding and the possibilities and limitation of different types of time series models through lectures and practical model application..

1. **Introduction** **(2 hours)**
   Stochastic processes and time series, Time series modeling, Physical basis of time series modeling in hydrology, Applicability.

2. **Characteristics of hydrologic series** **(2 hours)**
   Type of hydrologic series, General properties of hydrologic time series.

3. **Statistical principles and techniques for time series modeling** **(8 hours)**
   Probability function and distribution function, Derived distributions, Chebyshev's Inequality, moment generating function, normal distribution, Central limit theorem, Estimation of the parameters of the distribution; Methods of moments, Method of maximum likelihood, selection of distribution.

4. **Autocorrelation Analysis** **(8 hours)**
   Classification of time series, Components of time series, Method of investigation, estimation of the auto-correlation coefficient, Correlogram of an independent process

5. **Time Series Models** **(12 hours)**
   Moving average process, Auto regressive process, Goodness of fit for annual AR models; Test on the assumptions of the model, Comparison of the historical and model correlograms, Test of Parsimony of parameters, Generation and forecasting using annual AR models; Thomas-fiering model; Auto regressive moving average process, application in flood forecasting system, Autoregressive integrated moving average process,

6. **Seasonal models** **(8 hours)**
   Univariate seasonal models, Daily flow model, spectral analysis; introduction, Line spectrum.

7. **Generation of random variates** **(5 hours)**
   Uniformly distributed random numbers; Mid square technique, Mid-product technique, Mixed congruential method, testing the random numbers sequence, generation of normal random numbers; The inverse transformation method, the central limit theorem method, Box-muller method.

Tutorials:
1. Statistical principles and Techniques [2 hours]
2. Auto Correlation Analysis [4 hours]
3. AR models, Thomas Fiering models [5 hours]
4. ARMA , ARIMA [2 hours]
5. Generation of Random variates [2 hours]

Practical:
1. Non seasonal modeling of River system of Nepal
2. Daily flow modeling of River System of Nepal

References:

1. **Stochastic Hydrology**, P.Jayarami Reddy, Laxmi Publications, New Delhi
2. **Applied Modelling of Hydrologic Time Series**, Salas, Delleur, Yevjevich and Lane, Water Resources Publications, Colorado, USA

Evaluation Scheme:
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	2	8
2	2	8
3	8	12
4	8	12
5	12	20
6	8	12
7	5	8
Total		

* **There may be minor deviation in marks distribution.**