ADVANCED GEOTECHNICAL ENGINEERING (ELECTIVE I)
BCI7800

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objective:

The main objective of the course is to provide the concept and the tools that can be used to incorporate in the field of geotechnical engineering. The course includes the advanced techniques above than of soil mechanics and foundation engineering.

Course Content:

1. Dynamically Loaded Foundations (5 hrs)

1.1 Selection of design criteria
1.2 Identification of dynamic Loads
1.3 Design of foundations subjected to dynamic loaded (machine foundations, etc.) : spring-supported model, analysis of foundation vibration on elastic layers, effect of foundation shape and embedment
1.4 Vibration transmission, isolation and monitoring

2 Foundations in Earthquake Regions 5hrs

2.1 Selections of design earthquake
2.2 Site response to earthquake: site specific conditions soil structure interaction and their influence on ground motions, response spectra
2.3 Seismic analysis: selection of response spectrum corresponding to the design earthquake, determination of seismic loads
2.4 Design of foundations for earthquake conditions: earth retaining structures, footing foundations, mat foundations, etc.

3 Field Instrumentation and Monitoring 11 hrs.

3.1 Types of field measurement and their uses
3.2 Monitoring displacements of foundations and structures: vertical displacements and horizontal displacements
3.3 Monitoring slope/rock mass movement: slope movement using borehole extensometers,

Inclinometers and Tilt meters; rock mass displacement in underground excavations etc. Using optical electro-optical methods of borehole extensometers

3.4 Monitoring pressures/loads in earth walls and structures; monitoring pressures in the body of earth structures; monitoring loads on temporary supports

3.5 Monitoring In-situ stresses in rock: hydraulic fracture techniques, direct stress measurement techniques, and borehole methods

3.6 Monitoring pore pressure: methods based on various types of piezometers, selection of piezometers to suit the ground conditions

3.7 Recording and data handling

4. Geosynthetics **9hrs**

4.1 Types of geosynthetics

4.2 Application of geosynthetics drainage, filtration reinforcement and separation

4.3 Design considerations: physical properties, mechanical/hydraulic/durability requirements

4.4 Construction requirements: site preparation, selection of equipment, placement and compaction requirements

5. Anchors, Rock Bolts and Shotcrete **9 hrs.**

5.1 Application and types of anchors and rock bolts

5.2 Design criteria: safety against uplift, overturning, tangential displacement, shear failure and caving in

5.3 Installation: drilling, insertion, grouting (anchoring) stressing and final grouting

5.4 Mechanism of load transfer in anchors

5.5 Testing of anchors

5.6 Protection from corrosion

5.7 Selection of materials and mix design of Shotcrete

5.8 Engineering properties of Shotcrete

6. Grouting **6 hrs.**

6.1 Purpose of grouting

6.3 Characteristics of good routing materials: viscosity, setting time, permeability of grouting works

6.4 Planning of grouting works

6.5 Selection of grouting materials

6.6 Grouting methods

6.7 Control of grouting works

Two days field visit to learn the following works related to geotechnical engineering:

1. Monitoring displacements of foundations and structures
2. Monitoring slope/rock mass movement
3. Monitoring In-situ stresses in rock
4. Monitoring In-situ stresses in rock
5. Monitoring pressures/loads in earth walls and structures
6. Installation of rock bolts and anchors

7. Grouting works
8. Application of geosynthetics

Reference Books:

1 "Engineering Principles of Ground Modifications", M.R. Housmann, McGraw-Hill Co., New York.
2 "Grouting in Engineering Practice", R. Bowen, Allied Science Pub., London
3 "Underground Excavation", E. Hoek & E. Brown, Institution of Mining & Metallurgy, London
4 "Foundation Instrumentation", T.H. Hanna, Trans. Tech. & McGraw Hill Book Co.
5 "Principles of Geotechnical Engineering", B.M. Das, Boston PWS Engineering

Marks Distribution

Chapter	Time allocated in hour	Marks Distribution Final (60)
1	5	6
2	5	6
3	11	14
4	9	14
5	9	14
6	6	6
Total	**45 hr**	**60**

Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

AIRPORT PLANNING AND ENGINEERING (ELECTIVE I)
BCI7801

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objective:

The main objective of this course is to give the knowledge to the students on airport development, planning, design, operation etc. This course provides an overview of the design and operation of modern airport transportation system, including airside, terminal and groundside elements. Aviation demand management and forecasting will also be studied and brief consideration will be given to critical environmental issues facing airports.

Course Content:

1.0 Introduction to Air Transport (3 hrs)

1.1. History of Air Transport Development in World
1.2. History of Air Transport Development in Nepal
1.3. Advantages and Disadvantages of Air Transport in the context of Nepal
1.4. Air Transport Organizations (ICAO & CAAN), their Responsibilities and Functions
1.5. Airlines in Nepal

2.0 Classification of Airports (3 hrs)

2.1. ICAO Classification
2.2. FAA Classification
2.3. Based on Function, takeoff and landing etc.
2.4. Airports in Nepal

3.0 Air Transport Demand Analysis (6 hrs)

3.1. Objectives
3.2. Conventional Method of Demand Analysis
3.3. Analytical Method (4-step model)
3.4. Airport Choice Models
3.5. Air Passenger Demand Analysis

3.6. Air Carrier Choice Models

4.0 Airport Site Selection and Characteristics of Aircraft (4 hrs)

4.1. Factors affecting Airport site selection
4.2. Factors affecting Airport size
4.3. Airport obstructions
4.4. Characteristics of Aircraft that affect design (Engine type & Propulsion, Size, weight, and wheel configuration of aircraft, Turning and circulating Radius, Speed, Noise, Vortices at tail ends, Jet blasts etc)
4.5. Layout of Airport Area

5.0 Runways (6 hrs)

5.1. Runway orientation
5.2. Wind Rose Diagram
5.3. Runway Configuration
5.4. Runway length
5.5. Runway pavements

6.0 Taxiway and exit Taxiway (6 hrs)

6.1. Factors Affecting Taxiway
6.2. Taxiway Geometry (Length, Width, Grade etc.)
6.3. Sight Distances
6.4. Design of Turning Radius
6.5. Exist Taxiway and its location
6.6. Optimum location of Exit Taxiway

7.0 Airport Terminal - Apron and Airport parking (4 hrs)

7.1. Concept of Airport Terminals
7.2. Holding Apron (Size, Shape, operation and design)
7.3. Loading Apron (Size, operation and design)
7.4. Types of Aircraft Parking

8.0 Visual Aid Markings, Sign and Signage (3 hrs)

8.1. Purpose and functions
8.2. Airport Markings
8.3. Airport Lightings
8.4. Signs

9.0 The basics of air traffic control **(3 hrs)**

9.1. Visual Flight Rules (VFR) versus Instrument Flight Rules (IFR)

9.2. Air traffic control towers

9.3. Air space and Special Use Air space

10.0 Passenger Terminal Areas and Ground Access **(4 hrs)**

10.1. Functions

10.2. Physical Facilities

10.3. Passenger Handling System

10.4. Baggage Handling System

10.5. Ticketing

10.6. Security Checks

11.0 Ground Access **(3 hrs)**

11.1. Definition and its user

11.2. Factors Affecting Ground Access

11.3. Access Mode

References:

- Airport Planning and Management, Alexander T. Wells, Seth B. Young, The McGraw-Hill Companies
- Airport Engineering, Norman Ashford and Paul H. Wright, John Wiley & Sons, Inc.Publications from ICAO (www.icao.int) and CAAN (http://www.caanepal.org.np/)

Marks Distribution

Chapter	Time allocated in hour	Marks Distribution Final (60)
1	3	8
2	3	
3	6	14
4	4	
5	6	16
6	6	
7	4	14
8	3	
9	3	
10	4	8
11	3	
Total	45	60

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks/Question	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

CLIMATE CHANGE
BCI7802

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objectives:

The objective of the course is to gain the knowledge of climate change, its causes and effect, its knowledge on technology, technological option for mitigation of climate change and their impact on outcomes.

Course content :

1. Introduction to Climate Change Science (10 hrs)

1.1 Radiation balance, atmospheric and ocean circulations, Historic climate change

1.2 Feedback effects, impacts of land use, albedo, clouds, ocean, storage of CO_2

1.3 GHGs and energy use, inventory of GHGs, the carbon cycle

1.4 Natural and anthropogenic actors

1.5 Key indicators of global climate change and evidence like carbon-dioxide concentration, Global surface temperature, Arctic sea ice, Land use, Sea level

1.6 Effect of greenhouse gases

1.7 The role of human activities, industrialization, combustion of fossil fuels, deforestation, forest fires, agriculture farming

1.8 Impact on wildfires, Air pollution, Extreme weather, Deforestation, Agriculture change, Ecosystem and biodiversity, Economic effect, Disease and Water scarcity

2. Technology (15 hrs)

2.1 Role of human activities on Combustion of fossils fuels in industry, transport, electricity generation, households, Deforestation and agricultural farming

2.2 Climate change in infrastructure like building, transportation and energy

2.3 Technology options for mitigating climate change like energy supply, transport, building, industry, agriculture, forest waste

2.4 Adaption measure on water, agriculture, human health, tourism, transport, energy, biodiversity and ecosystem

2.5 Risk analysis and climate change

3. Economics **(8 hrs)**

3.1 Population growth and economic growth as climate change drivers

3.2 Costs of adaptation and impacts

3.3 Consequences of alternative regimes of action and 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 hrs)**

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 Policies 2006

4.6 Climate Change Policies 2011 and 2019

5. Legal Aspects **(4 hrs)**

5.1 Water Resource Act 1992

5.2 Environment Protection Act 2076 & Environment Protection Rule 2077

5.3 Forest act 2076 & Forest rule 2079

References

- Climate Change: Causes, Effects, and Solutions by Jameel R. Kaddo
- Global Warming The Complete Briefing , Fourth Edition by Sir John Houghton
- John P. Holdren, 2007
- www.aaas.org

Chapter wise marks division in final examination:

Final Examination Scheme:		
Chapters	Marks	Remarks
1	14	Th
2	20	Th
3	10	Th
4	10	Th
5	6	Th
Total	60	Th: Theory
Note: There might be minor deviation in mark distribution. *Mandatory: Evaluation should be based on solving approach and steps.*		

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks	Total Marks

Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

CONFLICT MANAGEMENT(ELECTIVE I)
BCI7803

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objectives:

The main objective of this course is to provide sufficient knowledge to the students about Conflict Management and conflict resolution techniques with current practices.

Course Contents:

1. Introduction to Conflict Management **(7 hrs)**

1.1 Concept of conflict management
1.2 Development conflict management as a discipline
1.3 Basic Terminologies used in conflict management.
1.4 Global conflict trends and analysis

2. Organizational and Interpersonal Conflict **(6 hrs)**

2.1 The nature of conflict
2.2 Causes of conflict
2.3Stimulating conflict
2.4 Controlling conflict
2.5 Managing Conflict in Organization.

3. Conflict Prevention **(6 hrs)**

3.1 Concept of Early warning in relation to Conflict Prevention
3.2 Conflict Prevention and Early Warning in Practice
3.3 UN Efforts to Prevent Conflicts

4. Approaches to Conflict Analysis **(8 hrs)**

4.1 Conflict dynamic approach.
4.2 Basic need approach
4.3 Rational Calculation Approach
4.4 Triple R and Triple M approach
4.5 Conflict Mapping Techniques.

5. Theoretical concept on Resolving Conflict (8 hrs)

5.1 The Conflict Management School
5.2 The Conflict Resolution School
5.3 The complementary school
5.4 The conflict transformation school

6. Diplomacy (4 hrs)

6.1 Introduction and Basic Concept of Diplomacy
6.2 Track I, Track II and Track III Diplomacy
6.3 The role of Diplomacy to Peace making

7. Arbitration, Adjudication and Humanitarian Intervention (3 hrs)

7.1 Arbitration
7.2 Adjudication

8. Indigenous and Traditional Mechanism of Conflict Resolution in Nepal (3 hrs)

8.1 Overview of Indigenous and Traditional Mechanism of Conflict Resolution in Nepal

8.2 Community Mediation in Nepal

References:

- Ackermann. A. (2003). The Idea and Practice of Conflict Prevention. Journal of Peace Research, 40 (3), 339-347.
- Goodhand. J. (2001). Conflict Assessment, A synthesis Report: Kyrgyzstan, Moldavia, Nepal and Srilanka. Kings College London: The Conflict, Security and Development Group.
- Thapa. M. (2005). Back to Negotiation: Diagnosis and Prognosis for future Negotiation in Nepal. European Peace University- Research Paper Series, 02(2006).

Marks Distribution

Chapter	Time allocated in hour	Marks Distribution Final (60)
1	7	6
2	6	6
3	6	9
4	8	9
5	8	9
6	4	9
7	3	6
8	3	6
Total	**45 hr**	**60**

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks/Question	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

DESIGN OF RCC BRIDGE (ELECTIVE I)
BCI7804

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objectives:

The main objective of this course is introduce bridge structures & their types and make capable to select appropriate bridge type, and make capable to analyze and design simple reinforced concrete and steel bridge deck, bridge bearing and substructure of bridge. In addition, it introduce with the construction and maintenance techniques of bridges.

Course Content:

1. Introduction to Bridge Structures and Fundamentals of Bridge Design. (4 hrs)

1.1. Bridge and its components
1.2. Types of bridges and their characteristics
1.3. Selection of bridge type
1.4. General design requirements

2. Bridge Loading and Responses (4 hrs)

2.1. Bridge Loads
2.2. Bridge responses

3. Bridge Deck Analysis and Method of Lateral Load Distribution (6 hrs)

3.1. General principle and methods of bridge deck analysis
3.2. Effective Width Method
3.3. Courbon's Method
3.4. Distribution Coefficient / Hendry Jaegar Method
3.5. Longitudinal and lateral positioning of moving loads and response

4. Design of Bridge Deck (14 hrs)

4.1. Design of RC Culvert / Slab Bridge
4.2. Design of RC T-Beam Bridge
4.3. Introduction to design of plate girder /composite /steel truss bridge

5. Design of Bridge Substructure (**8 hrs)**

5.1. Design of Pier
5.2. Design of Abutment
5.3. Introduction to Bridge Foundation

6. Bridge Bearing and Expansion Joint **(5 hrs)**

6.1. Bridge Bearing
6.1.1. Types of bearing
6.1.2. Design of metallic bearing
6.1.3. Design of elastomeric bearing
6.1.4. Expansion Joint
6.1.4.1. Requirement to expansion joint
6.1.4.2. Types of expansion joint and their design

7. Construction and Maintenance of Bridge **(4 hrs)**

7.1. Introduction to construction of bridges
7.2. Introduction to maintenance of bridges

References

- Essential of Bridge Engineering; Victor, D.J.
- Analysis & Design of Substructure; Swami Saran
- Standard Specification & Code of Practice for Road Bridge

Marks Distribution

Chapter	Time allocated in hour	Marks Distribution Final (60)
1	4	6
2	4	6
3	6	6
4	14	20
5	8	10
6	5	6
7	4	6
Total	**45 hr**	**60**

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks/Question	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

EARTHQUAKE RESISTANT DESIGN (ELECTIVE I)
BCI7805

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objective:

- Understand the fundamentals of seismology and earthquake ground motions.
- Analyze structural response to earthquakes.
- Apply seismic design principles in structural systems.
- Design earthquake-resistant elements of buildings and infrastructure according to relevant codes.

Course Content:

1.0 Introduction to Earthquakes and Seismology (4 hrs)

1.1 History of earthquakes
1.2 Seismic hazard
1.3 Elastic Rebound theory & Plate tectonic
1.4 Fault and its mechanism
1.5 Earthquake Measurement
1.6 Seismic waves

2.0 Earthquake Ground Motion (4hrs)

1.7 Ground motion parameters
1.8 Local site effect
1.9 Response of Structure
1.10 Seismic Zoning

3.0 Introduction to Structural Dynamics (10 hrs)

3.1 Dynamic Loading
3.2 Natural frequency, Damping, Vibration and resonance
3.3 Single Degree of Freedom (SDOF)

3.3.1 Free Undamped and damped free vibration response
3.4 Multi degree of Freedom MDOF
3.4.1 Formulation of Equation of motion
3.4.2 Undamped free vibration
3.4.3 Orthogonal Properties
3.4.4 Mode Superposition method
3.4.5 Response Spectra analysis of MDOF

3.0 Lateral Load Resisting Systems for Buildings (8 hrs)

4.1 Building configuration
4.2 Different structural systems for lateral loads
4.3 Floor diaphragms (Eccentricity / Torsional calculation)
4.4 Moment resisting frames
4.5 Shear walls
4.6 Bracing System

5. Analysis Method for Earthquake-Resistant Structures (15hrs)

5.1 Principle of earthquake resistant design (NBC: 105:2020)
5.2 Linear method
5.2.1 Equivalent Static Method
5.2.2 Linear Dynamic analysis Methods
5.2.3 Model Response Spectrum Method
5.2.4 Elastic Time History Analysis
5.3 Introduction to Non-Linear Method
5.4 Building Analysis Check List
5.5 Introduction to Ductile Detailing (Element and connection detail)

6. Seismic Vulnerability Assessment and Retrofit (4 hrs)

6.1 Seismic evaluation method
6.2 Retrofitting technique

Course Project:

Seismic analysis and design of a residential building

पूर्वाञ्चल विश्वविद्यालय धनगढ, मोरङ, नेपाल
PURBANCHAL UNIVERSITY
GOTHGAUN, MORANG, NEPAL
1995
२०५२
Faculty of Engineering

References*:

1. "Dynamics of Structures" by Anil K. Chopra
2. Clough R. W., Penzien J, "Dynamics of Structures", McGraw Hill.
3. "Earthquake Resistant Design of Structures" by Pankaj Agarwal & Manish Shrikhande
4. NBC 105:2020 (Seismic Design of Building in Nepal)
5. IS 1893, IS 13920 or national equivalent codes
6. IS 15988:2013 (Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings -Guidelines)
7. IS 13935:2009 (Seismic Evaluation, Repair and Strengthening of Masonry Buildings – Guidelines)
8. Relevant journal articles and research papers

**Latest edition will be preferable.*

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks/Question	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

ENVIRONMENTAL MANAGEMENT SYSTEM (ELECTIVE I)
BCI7806

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objectives:

The objective of the course is aimed at teaching the students the knowledge of environmental pollution, its impact on society, and management strategies. It would be helpful to the students to understand the global, national and local environmental issues and challenges of the information society.

Course Content:

1. Environment and Technology **(5 hrs)**

1.1 Definition
1.2 Conservation of environment
1.3 Global environmental issues
1.4 The impact of human on environment
1.5 The impact of environment on human
1.6 The role of environmental and civil engineers
1.7 Adverse effects of environmental pollution
1.8 Environmental issues of Nepal
1.9 Environment and human health
1.10 Impact of technology on environment and society
1.11 Benefits of technology due to new inventions
1.12 Appropriate technology

2. Water Pollution **(5 hrs)**

2.1 Water quality standards
2.2 Contaminants in ground water
2.3 Origin and sources of water pollution
2.4 Effect of water pollution on aquatic systems
2.5 Organic pollution
2.6 Inorganic pollution (pesticide, heavy metals)
2.7 Water-borne pathogens and other nuisance aquatic organisms

2.8 Importance of health education

2.9 Water pollution control laws and regulations in Nepal

3. Air Pollution **(5 hrs)**

3.1 Sources and causes of air pollution

3.2 Classification of pollutants

3.3 Air pollutants and global climate: Global warming, stratospheric ozone depletion, acid rain

3.4 Effects of air pollution on human health, property and visibility

3.5 Indoor air pollution

3.6 Air pollution control laws and regulations in Nepal

4. Noise Pollution **(5 hrs)**

4.1 Introduction

4.2 Level of noise and its measurement

4.3 Sensitivity of sound

4.4 Adverse Effects of noise

4.5 Community noise in Nepal

5. Solid Waste **(5 hrs)**

5.1 Development and issues of solid waste management

5.2 Types of solid waste

5.3 Sources of solid waste

5.4 Environmental concerns with wastes (Growing quantities, improper handling and disposal, toxic chemicals, health effects and effects on ecosystems)

5.5 Solid waste management in Nepal

6. Environmental Management **(10 hrs)**

6.1 Environmental management tools and techniques

6.2 Benefits of environmental management

6.3 Centralized and decentralized wastewater management system

6.3.1 Types of centralized and decentralized wastewater management techniques

6.3.2 Constructed wetland (Reed bed treatment: Design, principle and importance)

6.4 Water management

6.4.1 Water conservation

6.4.2 Reducing demand of water, evaporation control, conservation of soil moisture

6.4.3 Rainwater harvesting

6.4.4 Artificial recharge methods

6.4.5 Reuse of water

6.5 Solid waste management

6.5.1 Engineered waste disposal facilities

6.5.2 Principles of 3R

6.5.3Waste management strategies: Pollution preventions, waste minimizations, recycling,

incinerations

6.5.4. Engineered system for resource and energy recovery

6.6 Engineered systems for air pollution control

6.6.1 Control devices for particulate contaminants (Gravitational settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitators)

6.6.2 Control devices for gaseous contaminants (adsorption, absorption, condensation, combustion, automotive emission control)

6.7 Control of noise pollution at source

7. Environmental Management System (EMS) (10 hrs)

7.1 Cleaner Production

7.2 Energy Efficiency

7.3 Clean Development Mechanism (CDM)

7.4 Definition of EMS

7.5 Basic concept of EMS

7.6 Components of EMS

7.7 Types and Benefits of EMS (ISO 14001)

Reference books:

- G. M. Masters, "Introduction to Environmental Engineering and Sciences", Pearson Education (Singapore) Pvt. Ltd., India
- H. S. Peavy, D. R. Rowe, and G. Tchobanoglous, "Environmental Engineering", McGraw- Hill Inc Editions, New York.
- N. D. Nevers, Air Pollution Control Engineering", McGraw-Hill Inc., New York.
- P.K. Goel, "Water Pollution", New Age International Publishers, New Delhi.
- R.C. Gaur, "Basic Environmental Engineering", New Age International Publishers, New Delhi.
- S. Cairncross, and R. Feachem, "Environmental Health Engineering in the tropics", John Wiley & Sons, New York.
- D.P. Bhatt, and L.P. Bhatt, "Environmental Engineering- I, Water Supply Engineering", Laxmi Pustak Bhandar, Maitighar, Kathmandu.
- S. Somvanshi, and R. Dhupper, "Fundamental of Environmental Studies:, S.K. Kataria & Sons, New Delhi.
- A.S. Patel, and D.L. Shah, "Water Management", New Age International Publishers, New Delhi.
- S.K. Soni, "Environmental Engineering- I", S.K. Kataria & Sons, New Delhi.
- S.K. Soni, "Environmental Engineering- II", S.K. Kataria & Sons, New Delhi.

Chapter wise marks division in final examination:

Final Examination Scheme:		
Chapters	**Marks**	**Remarks**
1	8	Th
2	6	Th
3	6	Th
4	6	Th
5	6	Th
6	16	Th
7	12	Th
Total	**60**	Th: Theory
Note: There might be minor deviation in mark distribution. *Mandatory: Evaluation should be based on solving approach and steps.*		

Evaluation Scheme: Marks Division

Question Type	**No. of Questions**	**Marks**	**Total Marks**
Short	4	2	8
Medium	7	4	28
Long	3	8	24
Total			**60**

ENVIRONMENTAL SOIL SCIENCE
BCI7807

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objectives:

- After successful completion of this course student will be able to describe physical and chemical process affecting contaminant fate and transport in soil and ground water
- Explain pollutants in soil and remediation technologies.

Course Content:

1. Soil Solid Phase **(5 hrs)**

1.1 Function of soils in our ecosystem
1.2 Soil as a three phase system
1.3 Soil formation
1.4 Soil profiles
1.5 Primary particles and soil texture
1.6 Soil structure
1.7 Cation exchange capacity
1.8 Soil pH
1.9 Organic matter

2. Gaseous Phase and Liquid Phase **(5 hrs)**

2.1 Constituents of soil atmosphere
2.3 Availability of oxygen and soil respiration

2.3 Properties of water
2.4 Soil water potential

3. Biotic Activities in Soil and Water **(5 hrs)**

3.1 Major Groups of organism (Bacteria, Mode of nutrition, Type of electron acceptor, Fungi)
3.2 Soil Factors affecting the growth and activity of soil microbes

4. Soil-Water Retention and Water Movement in Soil **(7 hrs)**

4.1 Water in soil and ground water
4.2 Movement of water in soil and ground water

5. Physical Process Affecting Contaminant Fate and Transport in Soil and Ground Water (8 hrs)

5.1 Mechanism of chemical transport
5.2 Movement through one-dimensional columns

6. Chemical Process Affecting Contaminant Fate and Transport in Soil and Ground Water (8 hrs)

6.1 Soil Phases

6.2 Solubility and Volatility

6.3 Sorption of Pollutants

6.4 Transport of Sorbing Pollutants

7. Polluted Soil Remediation **(7 hrs)**

7.1 Pollutants in Soil

7.2 Remediation Technologies

References books/ Journal papers:

- Jury, W. A., and Robert, H., "Soil Physics", John Wiley & Sons, USA
- Ghildyal, B.P., and Tripathi, R.P." Soil Physics", New Age International Publishers, New Delhi.
- Komatsu, T., "Environmental Soil Science", International Program on Civil and Environmental Engineering, Saitama University, Japan.
- Subedi, S., Kawamoto, K., Moldrup, P., de Jonge, L.W., Müller, K., Clothier, B.E., and Komatsu, T. (2013). Contact angles of water-repellent porous media inferred by Tensiometer- TDR probe measurement under controlled wetting and drying cycles. Soil Sci. Soc. Am. J. doi:10/2136/sssaj2013.05.0202
- Subedi,S., Kawamoto,K., Karunarathna, A.K.,Moldrup, P., de Jonge, L.W., and Komatsu, T.(2013). Mini tensiometer-TDR coil probe for measuring soil water retention properties. Soil Sci. Soc. Am. J. doi: 10.2136/sssaj2012.0106
- Subedi,S., Kawamoto,K., Jayarathna, L., Vithanage, M., Moldrup, P., de Jonge, L.W., and Komatsu, T. (2012).Characterizing time-dependent contact angles for sands hydrophobized with oleic and stearic acids. Vadose Zone J. doi:10.2136/vzj2011.0055.

Chapter wise marks division in final examination:

Final Examination Scheme:		
Chapters	Marks	Remarks
1	6	Th
2	6	Th
3	6	Th
4	10	Th
5	12	Th
6	12	Th
7	8	Th
Total	**60**	Th: Theory
Note: There might be minor deviation in mark distribution. *Mandatory: Evaluation should be based on solving approach and steps.*		

Evaluation Scheme: Marks Division for Final Examination

Question Type	**No. of Questions**	**Marks**	**Total Marks**
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

GROUND WATER ENGINEERING (ELECTIVE I)
BCI7808

Year: IV Semester: VII

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3	60	-	-	100

Course Objectives:

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

Course Content:

1. Introduction to Groundwater and its occurrence (4 hrs)

1.1. Hydrological cycle and Groundwater
1.2. Origin and age of groundwater
1.3. Vertical distribution of Groundwater
1.4. Groundwater basins, springs, and their types, Characteristics of groundwater its comparison and relation with surface water
1.5. Basic definition and terms in groundwater hydrology with illustrations: Aquifer, Aquiclude, Aquifuge, Aquitard
1.6. Types of aquifer - confined, unconfined, leaky, perched, aquifer

2. Fundamentals of Groundwater Flow (8 hrs)

2.1 Aquifer properties and groundwater flow: effective porosity, storage coefficient, specific yield, permeability
2.2 Definition of Hydraulic conductivity (with their typical values), aquifer transmissivity, aquifer homogeneity, heterogeneity, isotropic and anisotropy.
2.3 Darcy's experiment and empirical expression of Darcy's law and its extension with 3-d generalization, validity of Darcy's law
2.4 Determination of Hydraulic conductivity

3. Potential Groundwater Flow Theory and Flow Net Analysis (6 hrs)

3.1. Plotting stream lines, equipotential lines, and flow net in groundwater, direction of groundwater flow from piezometric head observations, flow boundary and analysis of water table maps

3.2. 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 hrs)

4.1. Steady and unsteady radial flow in fully and partially penetrating non-leak wells,

4.2. Introduction of multiple well systems and interference of wells

5. Pumping Test and Estimation of Aquifer Properties (6 hrs)

5.1. Use of pumping tests in Groundwater hydrology, overview of types of pumping tests

5.2. Theis method for unsteady flow in unconfined and in confined non-leaky aquifers

5.3. Thims'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 (4hrs)

6.1. Objectives of groundwater exploration

6.2. Overview of different methods of groundwater exploration: Surface exploration:- geological, geophysical, electrical resistivity, seismic refraction methods, Sub-surface exploration:- drilling methods and borehole logging

7. Water Well Design (5 hrs)

7.1. Classification of wells

7.2. Design considerations in wells 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 Ground Water Lifting (4hrs)

8.1. Type of pumps

8.2. 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 Pumpsets

9. Groundwater Resources of Nepal (4 hrs)

9.1. Kathmandu valley and Terai regions aquifer: Schematic zones showing water availability and development possibility

9.2. Artificial recharge of groundwater

References:

- Groundwater, H.M.Raghunath, New Age International Publisher, 2nd Edition 1987
- Hydraulics of Groundwater, Jacob Bear, MCGraw –Hill INC 1979
- Ground Water Hydrology, David Keith Todd 2nd edition
- Handbook of Ground water development, John Wiley and sons US Department of interior, Breau of Reclamation 1995
- Groundwater and wells, Driscoll F.G. 3rd Edition 2007

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks/Question	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

HILL IRRIGATION ENGINEERING
BCI7809

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objectives:

This course is aimed at training the students about 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 be able to design the canal and micro irrigation projects in the hilly areas of Nepal.

Course Content

1. Introduction (4 hrs)
   - 1.1. Physiographic Regions and farming systems of Nepal
   - 1.2. Characteristics of Hill Irrigation systems (HIS)
   - 1.3. Needs, potentiality and types of Irrigation Development in the hills of Nepal.

2. Environmental Aspects of Hill Irrigation (6 hrs)
   - 2.1. Problems of floods, Soil erosion and Landslides
   - 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 consideration)
   - 2.5. Managerial, Social and institutional arrangement: Financial provisions and Engineering Solutions

3. Planning and Implementation of Hill Irrigation (3 hrs)
   - 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 Requirement (8 hrs)
   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 requirement
   4.5. Effective rainfall contribution with 80% reliability
   4.6. Percolation losses and irrigation efficiencies
   4.7. Computation of irrigation water requirement

5. Canal Irrigation in Hills (12 hrs)
   5.1. Canal Intakes for hill irrigation
      5.1.1. Design issues and construction materials for diversion: suitable intakes and their location;
      5.1.2. Design factors of intake; 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 for gravel trap and setting basin; Estimation of sediment load in the absence of data
   5.3. Canals and distribution system for hill irrigation
      5.3.1. Nomenclature, layout and alignment of hill canal; 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. Escape and drop structure 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 structure for hill canals
      5.5.1. Selection of suitable C/D structure in hill; Aqueducts their advantages and disadvantages;
      5.5.2. Problems of aqueducts and prevention; Superpassages, their advantages and disadvantages;
      5.5.3. Problems of super passages and prevention ; siphons and their advantages and disadvantages Problems of siphons and prevention
      5.5.4. Level crossing ,their advantages and disadvantages; inlets and Outlets

6. Sprinkler Irrigation (5 hrs)
   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 Irrigation System
   6.4. Design of a Portable Sprinkler System

6.5. Operation and Maintenance of Sprinkler System

7. Drip or Trickle Irrigation (5 hrs)
   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 hrs)
   8.1. Advantages of Gabion Construction

   8.2. Design Considerations for Gabion Structures
   8.3. Characteristics of Fill Material

Assignments:
Individual assignment on design of Sprinkler and Drip Irrigation Systems

References:

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

Final Examination Scheme:		
Chapters	**Marks**	**Remarks**
1	5	Th
2	6	Th
3	5	Th
4	10	Th+N
5	14	Th+N
6	8	Th or N
7	8	Th or N
8	4	Th
Total	**60**	Th: Theory
Note: There might be minor deviation in mark distribution. *Mandatory: Evaluation should be based on solving approach and steps.*		

Evaluation Scheme: Marks Division for Final Examination

Question Type	**No. of Questions**	**Marks**	**Total Marks**
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

PUBLIC HEALTH ENGINEERING

BCI7810

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objectives:

The objective of the course is aimed at teaching the students the knowledge of environmental health engineering and its impact on public.

Course Contents:

1. Infectious Disease (5 hrs)

1.1. Water related infections
1.2. Excreta-related infections
1.3. Refuse related infections
1.4. Housing related infections

2. Water Chemistry and Water Quality (10 hrs)

2.1. Harmful organic and inorganic
2.2. Drinking water quality
2.3. Wastewater quality
2.4. Waste and its types (Municipal, Industrial, Hazardous, Radioactive wastes)
2.5. Bathing water quality
2.6. Irrigation water quality
2.7. Water quality and fish

3. Water Supply (10 hrs)

3.1. Water supply in developing countries
3.2. Operation and maintenance
3.3. Appropriate Technology
3.4. Hygiene Education

3.5. Rural water supply (Breakdown and technology, Sources of water, Raising water, Storage, Treatment, Water distribution)
3.6. Urban water supply and water treatment (Coagulation and sedimentation, Filtration, Disinfection, Distribution, Water demand management)

4. Excreta and Refuse: Treatment, Disposal and Re-use (10 hrs)

4.1. Excreta disposal in developing countries
4.2. Types of excreta disposal system (Latrines and its types)
4.3. Planning a sanitation programme
4.4. Wastewater treatment (Conventional and non conventional system)
4.5. Sewage workers health
4.6. Surface water drainage
4.7. Refuse collection and disposal
4.8. Composting
4.9. Health aspects of waste re-use

5. Environmental Modifications and Vector-borne Diseases (5 hrs)

5.1. Engineering control of arthropod vectors
5.2. Dams, irrigation and health
5.3. Schistosomiasis

6. Risk Assessment (5 hrs)

6.1. Perspectives on risks
6.2. Perception of risk
6.3. Risk assessment
6.4. Hazard identification
6.5. Dose-response assessment
6.6. Human exposure assessment
6.7. Risk characterization
6.8. Comparative risk analysis

References:

- G. M. Masters, "Introduction to Environmental Engineering and Sciences", Pearson Education (Singapore) Pte. Ltd., India
- H. S. Peavy, D. R. Rowe, and G. Tchobanoglous, "Environmental Engineering", McGraw-Hill Inc Editions, New York.
- N. D. Nevers, Air Pollution Control Engineering", McGraw-Hill Inc., New York.
- R.C. Gaur, "Basic Environmental Engineering", New Age International Publishers, New Delhi.

- S. Cairncross, and R. Feachem, "Environmental Health Engineering in the tropics", John Wiley & Sons, New York.
- S. Somvanshi, and R. Dhupper, "Fundamental of Environmental Studies:, S.K. Kataria & Sons, New Delhi.

Chapter wise marks division in final examination:

Final Examination Scheme:

Chapters	Marks	Remarks
1	8	Th
2	12	Th
3	14	Th
4	14	Th
5	6	Th
6	6	Th
Total	**60**	Th: Theory

Note: There might be minor deviation in mark distribution.

Mandatory: Evaluation should be based on solving approach and steps.

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

QUALITY MANAGEMENT (ELECTIVE I)
BCI7811

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objective:

This main objective of this course is to train the students in the area of Quality Management (QM) that includes quality evolution, concept of QM, QM tools and techniques including statistical process control, TQM implementation and continuous improvement in products or services of any organization.

Course Contents:

1. **Introduction to Quality and Quality Management** **(6 hrs)**
   - 1.1 Concept of quality
   - 1.2 Dimensions of quality
   - 1.3 Importance of quality
   - 1.4 Concept and Principles of Quality Management
   - 1.5 Strategic Quality Management
   - 1.6 Bench Marking
   - 1.7 Cost of Quality
2. **Total Quality Management** **(8 hrs)**
   - 2.1 History of quality
   - 2.2 TQM definition
   - 2.3 Main elements of TQM
   - 2.4 Pioneers of TQM
   - 2.5 Total Productive Maintenance (TPM)
3. **Quality Standards** **(9 hrs)**
   - 3.1Quality System Standards
   - 3.2 International Organization for Standardization
   - 3.3 Conformance to Specification
   - 3.4 Types of Quality Audits
   - 3.3 Quality assurance
   - 3.4 ISO standards (ISO 9000, 14000 …)
   - 3.5 Nepal Standard (NS)

4. **TQM Tools and Techniques** **(6 hrs)**
   4.1 Process variation
   4.2 Statistical tools
   3 .3 Management tools

5. **Six Sigma** **(5 hrs)**
   5.1 Meaning of six sigma
   5.2 The seven Magnificent Quality Tools

6. **Service Quality Management** **(4 hrs)**
   6.1 Products and services
   6.2 Classification of Services
   6.3 Service Quality

7. **Leadership in TQM and Continuous Improvement** **(7 hrs)**
   7.1 Leadership elements
   7.2 Tasks of a leader for quality
   7.3 Customer-supplier chain
   7.4 Continuous improvement

Reference Books

- Bedi K. (Eighth edition 2011), Quality Management, Oxford University Press, India.
- Besterfield, et al. Total Quality Management. PHI
- Ehresman, Terry (1996). Small Business Success through TQM. Tata McGraw-Hill Publishing Company Limited, Delhi, India.
- Hansen and Ghare (latest ed.). Quality control and application. PHI
- Suganthi & Samuel. Total Quality Management. PHI
- Zairi, Mohamed (1992 /or latest one). Total Quality Management for Engineers. Aditya Books Private Limited, Delhi, India.

Marks Distribution

Chapter	Time allocated in hour	Marks Distribution Final (60)
1	6	8
2	8	10
3	9	12
4	6	8
5	5	8
6	4	6
7	7	8
Total	**45 hr**	**60**

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks/Question	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

ROCK ENGINEERING (ELECTIVE I)

BCI7812

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objective:

To provide students with advanced knowledge, practical skills, and analytical tools required for the characterization, analysis, and design of rock masses and underground structures. Emphasis is placed on applications in hydropower utilizing the rock mechanics principles.

Course Content:

1. Background **(2 hrs)**

1.1. Brief history on the development of rock engineering
1.2. The role of rock engineering in hydropower development
1.3. Main elements of underground hydropower plants

2. Properties of Rocks and Rock Masses **(6 hrs)**

2.1. Physical properties of rocks
2.2. Time-dependent behaviours: creep, swelling, squeezing
2.3. Mechanical Properties: drillability, blastability, cuttability, abrasivity
2.4. Rock anisotropy and heterogeneity
2.5. Discontinuity characterization: spacing, orientation, roughness (JRC, JCS)
2.6. Weakness zones and faults

3. Fundamentals of Rock Mechanics **(6 hrs)**

3.1. Stress and strain in rock mechanics
3.2. Failure criteria: Mohr-coulomb, Hoek-Brown
3.3. Uniaxial compressive and tensile strength of rocks

3.4. Deformation behaviour: modulus of elasticity, Poisson's ratio, anisotropy
3.5. Shear strength of discontinuities (Barton's and Mohr-Coulomb models)
3.6. Laboratory testing: UCS, triaxial, direct shear, point load
3.7. Field tests: Plate load test, shear box, in-situ deformability

4. Rock Stresses and its Measurement (4 hrs)

4.1. Origin of rock stresses
4.2. Stress redistribution around openings
4.3. Stability problems due to stress
4.4. Measurement of rock stress: flat jack, overcoring, hydro-fracturing

5. Groundwater in Rock Masses (4 hrs)

5.1. Hydrological characterization in fractured media
5.2. Groundwater inflow prediction methods
5.3. Problems caused by groundwater
5.4. Sealing of water leakage: grouting and seepage control techniques

6. Engineering Geological Investigation for Underground Structures (4 hrs)

6.1. Investigation stages
6.2. Preconstruction phase investigations
6.3. Construction phase investigations
6.4. Engineering geological documentation- Engineering Geological Report, Method statement, Face mapping, As-built map

7. Rock Mass Classification and Support Estimation (6 hrs)

7.1. Quality rating and support estimation
7.2. RMR System
7.3. NGI Q System
7.4. Geological Strength Index (GSI)
7.5. The RMi – support method
7.6. Comparison of classification systems for rock support estimates

8. Design Approach and excavation of Underground Openings (6 hrs)

8.1. Design philosophy and approaches
8.2. Shallow seated and deep seated openings
8.3. Design procedures
8.4. Drill and Blast method

8.5. Tunnel Boring Machine
8.6. Sequential excavation methods: SEM, NATM

9. Tunnel Support Systems **(5 hrs)**

9.1. Support philosophy and design
9.2. Rock bolts, lattice girders, steel ribs
9.3. Shotcrete (including fiber-reinforced), concrete segments
9.4. Use of yielding elements and ductile lining
9.5. Monitoring of deformation and ground behavior
9.6. Smart support systems and instrumentation

10. Improved and Cost Saving Solutions **(2 hrs)**

10.1. Unlined high – pressure Tunnels and shafts
10.2. Unlined air cushion surge chamber
10.3. Innovative and sustainable support materials

Tutorial:

(i) Failure criteria and shear strength
(ii) Stresses surrounding underground opening
(iii) Estimation of water leakages in rock mass
(iv) Presentation of geological data: joint rossete
(v) Estimation of the rock support for underground structures

Practical:

- Field visit to underground hydropower project in vicinity
- Field report and group presentation

References:

- Nilsen, B. and Thidemann, A. 1993. Rock Engineering.
- Nilsen, B. and Palmstrom, A. 2000. Engineering Geology and Rock Engineering.
- Palmstrom, A. and Stille, H. 2015. Rock Engineering, Second edition.

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks/Question	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

Final Examination Scheme:		
Chapters	**Marks**	**Remarks**
1	**2**	**Th**
2	**6**	**Th**
3	**8**	**Th+N**
4	**6**	**Th+N**
5	**6**	**Th+N**
6	**4**	**Th**
7	**10**	**Th+N**
8	**8**	**Th**
9	**6**	**Th**
10	**4**	**Th+N**
Total	**60**	
Note: There might be minor deviation in mark distribution. ***Mandatory: Marks should be evaluated based on solving steps.***		

PURBANCHAL UNIVERSITY
SEMESTER FINAL EXAMINATION – 2025 (MODEL QUESTION)

LEVEL: B. E. (Civil)
SUBJECT: Elective I Rock Engineering — FULL MARKS: 60
TIME: 03:00 hrs — PASS MARKS: 24

Attempt all questions

Group A **(2*4=8)**

1. List out medium scaled underground hydropower plant with suitable diagram.
2. Classify weakness zone qualitatively.
3. Calculate the tangential stress at the roof and wall of an unlined pressure shaft with an inverted-D shape, given the following parameters: Roof factor (A) = 3.1, Wall factor (B) = 2.7, Vertical stress (σz) = 25 MPa, and Poisson's ratio of the rock (ν) = 0.3.
4. List out the support systems used for squeezing tunnels.

Group B **(4*7=28)**

5. Explain tunnel squeezing.
6. Explain origin of rock stresses.

OR

Explain bore hole relief - over coring methods for rock stress measurement in tunnels.

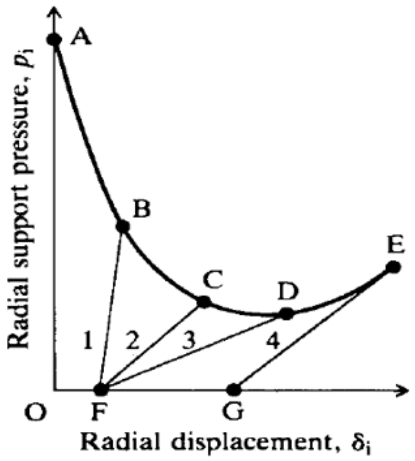
7. Discuss the issues associated with groundwater during underground excavation and describe methods for sealing groundwater in tunnels.

OR

Calculate the water flow into tunnel in liter/min/meter for following conditions:

S.N.	Description	Value
1	Length of tunnel	600 m
2	Potential Active Head	3.8 Mpa
3	Distance between length axis and ground water table	32 m
4	Equivalent radius	5 m
5	Specific Permeability	1.5x10-15 m^2
6	μw	0.001308 kg/m/s

8. Explain construction phase engineering geological site investigation.
9. Interpret the following stereo net plot in light of wedge failure.
10. Discuss the appropriateness of supports 1, 2, 3, and 4 for the conditions depicted in the figure below.



11. Explain design considerations for unlined pressure tunnel and shafts.

Group C **(8*3=24)**

12. Describe the empirical method of estimating shear strength using Barton's criterion. How are the input parameters determined in the field?

OR

Plot the joint rosette from following data. Draw suitable alignment in joint Rosette and explain the reasons behind it.

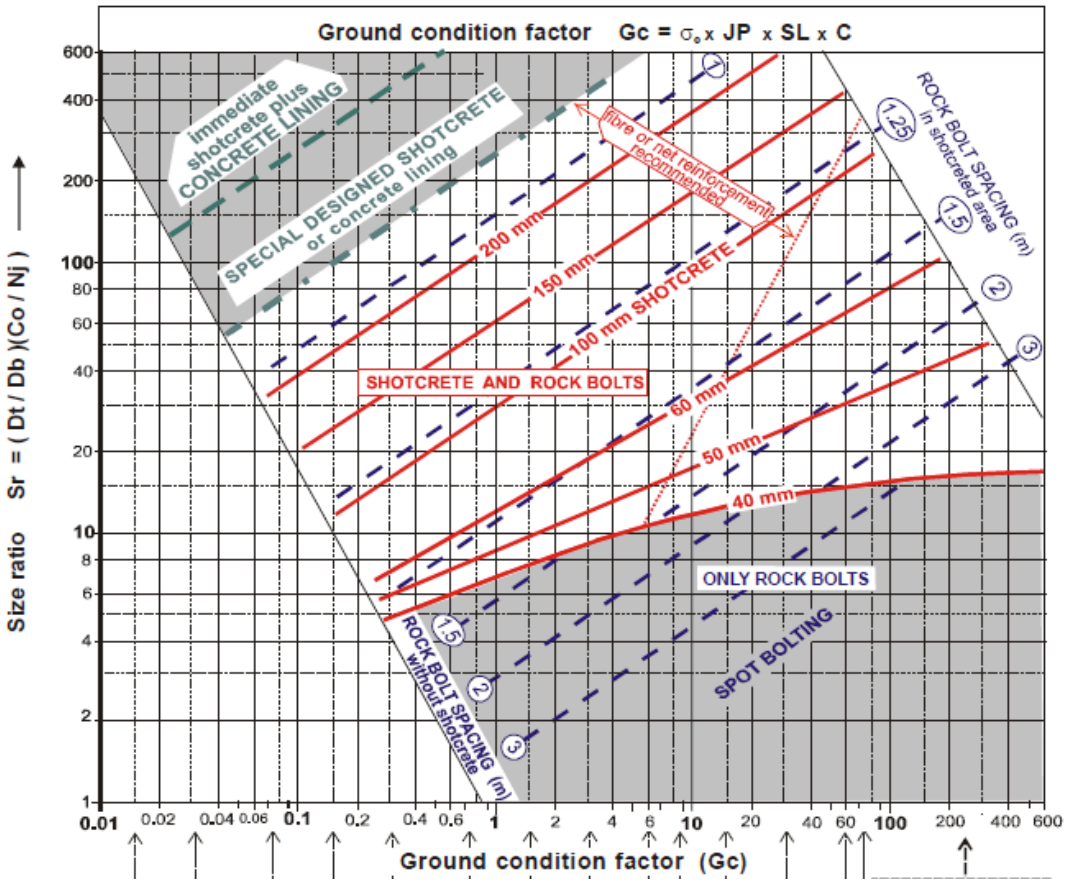
Dip/Dip direction	Dip/Dip direction	Dip/Dip direction	Dip/Dip direction
75,190	80,170	50,290	85,170
80,020	83,090	30,290	65,017
83,100	80,100	80,340	80,090
30,290	70,080	65,200	70,090
40,060	10,010	20,330	65,110
82,150	76,140	20,320	80,205
85,100	65,070	75,060	82,040
30,190	40,100	68,070	80,210
70,165	55,070	78,060	30,330
27,280	70,072	75,240	70,080
82,260	15,290	25,290	70,085
85,190	25,025	78,200	70,065
40,300	75,070	15,290	12,290
65,090	78,340	82,160	83,160
75,165	20,290	22,280	73,330
25,280	75,190	78,190	40,270

Dip/Dip direction	Dip/Dip direction	Dip/Dip direction	Dip/Dip direction
22,285	75,200	30,290	45,290
10,280	15,330	80,000	42,280
12,280	80,190	78,090	

13. A circular tunnel with a diameter (Dt) of 6 m with block volume (Vb) of 0.48m^3 is with the following characteristics. Compressive strength of intact rock mass (σc) = 150 MPa, Joint Roughness condition: smooth and undulating (jR = 2); Joint Alteration condition: clean fresh joints (jA = 1); medium continuous joint of length 8 m (jL = 1) ; Number of joint sets: Two sets (Nj = 1.5); Orientation for roof and wall: fair (Co = 1.5); Overburden: 250m (SL = 1). Compute RMi value and also suggest appropriate support system for roof and wall of the tunnel as per RMi – support method from the provided graph below.
14. Describe in detail the design procedure of a hydropower tunnel.

----------XXX----------

Note: *Number of alternative questions may be different from those in the above model question.*



SOLID WASTE MANAGEMENT (ELECTIVE I)
BCI7813

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objectives:

- After successful completion of this course student will be able to describe main features and processes involved with technologies and processes available for treatment of solid wastes.
- Develop insight into the collection, transfer, and transport of municipal solid waste.
- Explain the design and operation of a municipal solid waste landfill.
- Examine the design and operation of a resource recovery facility.

Course Content:

1. Introduction **(3 hrs)**

1.1. Definitions and terminologies: waste, solid waste
1.2. Waste Management
1.3. Global Scenario of Waste
1.4. Solid Waste, Environment and Public Health
1.5. Holistic Solid Waste Management
1.6. Integrated Solid Waste Management
1.7. 3R Principle

2. Source and Types of Solid Waste **(7 hrs)**

2.1 Sources of waste
2.2 Classification of waste (Solid Waste, Hazardous Waste, Medical Waste and Special Waste)

2.3 Types of Solid waste (Based on Source, Component Composition and Regulatory Definition)
2.4 Composition of solid waste
2.5 Characteristics of solid waste
2.6 Properties of solid waste (physical, chemical and biological)
2.7 Waste generation, sampling and characteristics, factors affecting solid waste generation rate

3. Collection, Transfer and Transport (7 hrs)

3.1 Waste collection planning
3.2 On-site management
3.3 Handling, storage and processing
3.4 Collection-service, analysis of collection system
3.5 Transfer station, processing and transport

4. Disposal of Municipal Solid Waste (10 hrs)

4.1 Land filling, sanitary landfills, land filling methods and operations
4.2 Leachate collection and removal systems
4.3 Final cover system for MSW landfills
4.4 Gas generation and management
4.5 Design and operation of landfills
4.6 Ground water monitoring
4.7 Incineration

5. Resource Recovery (8 hrs)

5.1 Material separation and processing techniques
5.2 Materials recovery facilities
5.3 Conversion technology for recovery
5.4 Biological transformation: Composting, Vermicomposting
5.5 Recovery of thermal conversion products (incineration, types and design Consideration)
5.6 Wasteland Reclamation
5.7 Life Cycle Assessment

6. Institutional and Regulatory Framework (5 hrs)

6.1. National level organization structure
6.2. Human resource management
6.3. Community mobilization
6.4. Financial management of SWM
6.5. Private sector
6.6. Policy, law and regulations, strategies related to SWM in Nepal
6.7. Solid Waste Management Act 2011 and Regulations 2013 in Nepal
6.8. Local governance operation act

7. SWM Practices and Challenges in Nepal (5 hrs)

7.1.Current status of MSWM in major municipalities
7.2.Case studies of Kathmandu, Pokhara, Lalitpur, Dhankuta, Bharatpur, Dharan, etc.
7.3.Sustainable practices
7.4.Public awareness
7.5.SWM and climate change issue in Nepal

Field Visit:

- Field observation visit to observe collection, transport and landfill operation of SWM of nearest municipalities
- Field observation of compost facility, biogas plant, recycling facilities, etc.

References:

- G. Tchobanoglous, H. Theisen, and S. Vigil, "Integrated Solid Waste Management", McGraw-Hill Inc, New York.
- H. S. Peavy, D. R. Rowe, and G. Tchobanoglous, "Environmental Engineering", McGraw-Hill Inc Editions, New York.
- ADB (2013). Solid Waste Management in Nepal: Current Status and Policy Recommendations.
- SWM Act 2011 and related Policies, Government of Nepal

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks/Question	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

STRUCTURAL DYNAMICS (ELECTIVE I)
BCI7814

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objectives:

The main objective of this course is to introduce the fundamental concepts of structural dynamics, and the dynamic behavior of structures along with the underlying principles. After the completion of the course, the students are expected to know the mathematical description of the response of SDOF systems with and without damping to free vibration, harmonic, and arbitrary excitations as well as to compute the dynamic response of structural components and structural systems under dynamic loads.

Course Content:

1. Introduction (4 hrs)

1.1. Time dependent problems
1.2. Types of dynamic loadings
1.3. Degrees of freedom
1.4. Force and displacement measurement
1.5. Structural Vibration
1.6. Damping
1.7. Behavior of structure to vibration

2. Matrices in Structures (7 hrs)

2.1. Flexibility and Stiffness matrices
2.2. Generation of Flexibility and Stiffness matrix
2.3. Partioned matrix and its use in structure
2.4. Gauss-Jordan method
2.5. Eigen value problems and Eigen vector

3. Single Degree of Freedom (SDOF) System (12 hrs)

3.1. Equation of Motion and Natural Frequency
3.2. Modeling of SDOF structures
3.3. Undamped free vibration response
3.4. Critically- damped, under- damped and over- damped systems

3.5. Damped free vibration response
3.6. Logarithmic decrement
3.7. Forced harmonic response
3.8. Vibration Isolation and Force transmissibility
3.9. Vibration measuring instruments
3.10. Energy dissipation by damping
3.11. Forced vibration response to periodic forces
3.12. Forced vibration response to Impulsive forces
3.13. Force vibration response to general dynamic loading
3.14. Convolution integral and Duhamel integral
3.15. Time domain analysis
3.16. Frequency domain analysis

4. Multi Degree of Freedom (MDOF) System (14 hrs)

4.1. Simple MDOF systems
4.2. Reduction of DOF's and static condensation
4.3. Modeling of MDOF system structures
4.4. Concept of generalized co-ordinates
4.5. Lagrange's equation of motion
4.6. Free vibration analysis of undamped MDOF system
4.7. Natural vibration frequencies and mode shapes
4.8. Modal expansion
4.9. Free vibration response of MDOF systems
4.10. Normal co-ordinates and Normal mode theory
4.11. Uncoupled equation of motion
4.12. Mode superposition method
4.13. Dynamic analysis of Linear MDOF systems
4.14. Modal response analysis of undamped and damped systems
4.15. Element forces
4.16. Modal contribution factors
4.17. Forced vibration response of MDOF system
4.18. Practical methods to determine natural frequencies and mode shapes (Rayleigh's Method, Stodola's method, Holzer's method)

5. Continuous Systems (8 hrs)

5.1. Partial differential equations of motion (for string, bar, beam)
5.2. Transverse vibration of string
5.3. Transverse vibration of beam
5.4. Axial vibration of a bar
5.5. Approximate methods to determine natural frequencies and mode shapes in cases Where orthogonality conditions are not satisfied

References:

- Clough R.W., Penzien J, Dynamics of Structures, 2nd edition: McGraw Hill 1993.
- Chopra A.K., Dynamics of Structures: Theory and Applications to Earthquake Engineering, Prentice Hall, 2007
- Paz, M., and Leigh, W., Dynamics of Structures- Theory and Computation, 5th Academic Publishers, 2004. Edition
- Thompson, W.T., Theory of Vibration with Applications, Prentice-Hall, Fourth Edition, 1993.

Marks Distribution

Chapter	Time allocated in hour	Marks Distribution Final (60)
1	4	5
2	7	10
3	12	15
4	14	20
5	8	10
Total	45 hr	60

Evaluation Scheme: Marks Division for Final Examination

Question Type	**No. of Questions**	**Marks/Question**	**Total Marks**
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

TRANSPORT PLANNING AND ENGINEERING (ELECTIVE I)
BCI7815

Year: IV **Semester: VII**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	-	40	-	3 hrs	60	-	-	100

Course Objective:

The main objective of the course "Transport Planning and Engineering" is to impart knowledge about transport planning process. Furthermore, the course includes the new topics which are not included in the regular course of Transportation Engineering I & II. These topics are Airport Engineering and Railway Engineering. Transport planning as an issue of high importance for the developing country, it should be followed by the future transport demand analysis. Key topics of the course attempt to impart knowledge in the following contemporary concepts:

- Conceptual knowledge in transportation system;
- Issues, relative importance and methods of Transport Planning;
- Introductory knowledge on Airport Engineering, Railway Engineering and Ropeways;

This course may be good platform for the Graduate (Masters' degree) course in Transportation Engineering.

1.0 Introduction (4 hrs)

1.1 Transport planning and modeling
1.2 Scope of Transportation planning and system engineering
1.3 Overview of existing system and future trend
1.4 Transport related problems in cities
1.5 Organizational structure of Ministry of Physical planning and works and its departments
1.6 National Transport Policy, Five Year Plans
1.7 Urban and Regional Planning

2.0 Transport Survey (2 hrs)

2.1 Sample size and Sampling method
2.2 Transport demand surveys and studies

2.3 Travel demand forecasting

3.0 Urban transport planning process (10 hrs)

3.1 The conventional approach
3.2 Four step transport planning
3.3 Other recent approaches to transportation planning

4.0 Transportation System analysis (4 hrs)

4.1 Generation of alternatives
4.2 Evaluation of alternatives
4.3 Selection criteria: capital and operating expenditures

5.0 Introduction to Airport Engineering (8 hrs)

5.1 Airport classification:
5.2 Aircraft type
5.3 Predicting air travel demand
5.4 Selection airport sites
5.5 Layout of airfield and their geometric standards
5.6 Terminal facilities and their space requirement
5.7 Introduction to the design of airfield pavements

6.0 Introduction to Railway engineering (6 hrs)

6.1 Classification of railways
6.2 Components of railway section
6.3 Geometric design of Railway Track
6.4 Design of track structure
6.5 Railway switches and crossings
6.6 6.6 Railway side tracks and yards

7.0 Ropeways (3 hrs)

7.1 Classification
7.2 Gravity ropeways
7.3 Components of Gravity Ropeways
7.4 Design of Gravity Ropeway

8.0 Case studies and Transport Modeling exercises (8 hrs)

8.1 Transport modeling
8.2 Air demand forecasting and pavement design
8.3 Design of gravity ropeways
8.4 Others emerging issues

References:

- Traffic Engineering and Transport Planning. L.R. Kadiyali, Khanna Publishers, Delhi, 2000.
- Transportation Engineering & Planning, Third Edition (Indian Reprint). C. S. Papacostas & P. D. Prevedouros. Prentice-Hall of India, New Delhi.2002.
- Urban Transportation planning. Michael D. Meyer & Eric J. Miller. Mc Graw Hill, 2002.

Evaluation Scheme: Marks Division for Final Examination

Question Type	No. of Questions	Marks/Question	Total Marks
Very Short	4	2	8
Short	7	4	28
Long	3	8	24
Total			**60**

PURBANCHAL UNIVERSITY

SEMESTER FINAL EXAMINATION – 2025 (MODEL QUESTION)

LEVEL: B. E. (Civil)

SUBJECT: Elective I Transportation Planning and Engineering FULL MARKS: 60

TIME: 03:00 hrs PASS MARKS: 24

Candidates are requested to give their answers in their own words as far as practicable. Assume any missing data suitably.

Attempt any ALL questions.

GROUP A **(2 x 4 = 8)**

Q.1. Define Transport Planning. (Chapter 1)

Q.2. What do you mean by trip generation (Chapter 3)

Q.3. Define sample size. (Chapter 2)

Q.4. Define Generation of alternative. (Chapter 4)

GROUP B **(4 x 7 = 28)**

Q.5. Explain about Transport related problems in cities (Chapter 1)

Q.6. Discuss the method of conducting home interview with sample question. (Chapter 2)

Q.7. Write down the characteristics of evaluation. (Chapter 4)

Q.8. Explain about any four components of ropeway. (Chapter 7)

Q.9. Write down the factors affecting airport site selection. (Chapter 5)

Q.10. Explain different layout of airport terminal with figure. (Chapter 5)

Q.11. Explain about the component of railway track with figure. (Chapter 6)

GROUP C **(8 x 3 = 24)**

Q.12. A small town has been divided into three traffic zones. The present trip distribution matrix is:

Zone	A	B	C
A	11	13	17
B	16	18	14
C	21	24	13

The number of trips produced and attracted in each zone is shown in the table below. [8]

Zone	A	B	C
Trip Produced	340	610	390

Trip Attracted	340	610	390

Find future trip distribution matrix by using average growth factor method. (Chapter 3)

OR

A mode choice model was developed with the observable utility functions for auto, bus and train shown below: U_{car} = 0.10 – 0.3 IVTT – 0.5 OVTT – 0.04C, U_{bus} = -0.20 – 0.3 IVTT – 0.5 OVTT – 0.04C, U_{micro} = -0.3 IVTT – 0.5 OVTT – 0.04 C Where IVTT = in-vehicle travel time (min) OVTT = out-of-vehicle travel time (min) C = cost (Rs.) The table below contains data for one individual.

	IVTT (min)	OVTT (min)	C
Car	14	0	230
Bus	30	10	50
Microbus	25	7	60

Using the multinomial logit model and the given data, calculate the probability that this individual will choose each mode (car, bus, and microbus). What will be the probability of mode choice if bus fare increase by 10% but waiting time decrease by 20%? (Chapter 3)

Q.13. The runway length required under standard conditions is 1800m. The airport is situated at the elevation of 200 m elevation. The effective runway gradient is 0.5%. Determine the actual runway length to be provided after correction recommended by ICAO and FAA. Average value of daily temperature and maximum temperature for extreme months are 13 and 15 degrees for month X and 40 and 50 degrees for month Y. (Chapter 5)

Q.14. The maximum sanctioned speed on a BG track for a circular curve is 130 km/hr. Determine length of transition curve to be provided. The actual cant provided and the cant deficiencies are 145 and 75 mm respectively. (Chapter 6)