

Tribhuvan University
Institute of Engineering
Pulchowk, Lalitpur

Course Structure 2024

MSc in Construction Engineering and Management

Year : I

Part I

Teaching Schedule				Examination Scheme			Total	Remarks
SN	Course Code	Course Title	Credit	Assessment Marks	Final Exam			
					Duration Hours	Marks		
1	ENCECM501	Physical Infrastructure Planning and Management	4	40	3	60	100	
2	ENCECM502	Construction Quality and Safety Engineering	4	40	3	60	100	
3	ENCECM503	Construction Technology	4	40	3	60	100	
4	ENCECM504	Principles and Practices of Construction Management	4	40	3	60	100	
Total			16	160	-	240	400	

Year : I

Part II

Teaching Schedule				Examination Scheme			Total	Remarks
SN	Course Code	Course Title	Credit	Assessment Marks	Final Exam			
					Duration Hours	Marks		
1	ENCECM551	Procurement and Contract Administration	4	40	3	60	100	
2	ENCECM552	Infrastructure Economics and Project Finance	4	40	3	60	100	
3	ENCECM56X	Elective-I	4	40	3	60	100	
4	ENCECM57X	Elective-II	4	40	3	60	100	
Total			16	160	-	240	400	

Tribhuvan University

Institute of Engineering
Pulchowk, Lalitpur
Course Structure 2024
MSc in Construction Engineering and Management

Year : II

Part I

Teaching Schedule				Examination Scheme			Total	Remarks
SN	Course Code	Course Title	Credit	Assessment Marks	Final Exam			
					Duration Hours	Marks		
1	ENCECM61X	Elective -III	4	40	3	60	100	
2	ENCECM62X	Elective -IV	4	40	3	60	100	
3	ENCECM601	Project	4	100	-		100	
Total			12	180	-	120	300	

Year: II

Part II

Teaching Schedule				Examination Scheme			Total	Remarks
SN	Course Code	Course Title	Credit	Assessment Marks	Final Exam			
					Duration Hours	Marks		
1	ENCECM651	Thesis	16	100	-	-	100	

Note: Students will write a thesis in the fourth semester. However, the thesis work must start from the beginning of third semester, which may be associated to the project work. Students can carry out the research thesis with one or more supervisors.

Elective Courses

Elective courses will be offered as per the availability of resource persons. The lists of electives are as follows:

Elective I

1. Research Methodology and Statistical Analysis [Code: ENCECM561]
2. Operations Research and Optimization Techniques [Code: ENCECM562]
3. Application of Information Technology in Construction [Code: ENCECM563]
4. Natural Resources Safeguard in Infrastructure Development [Code: ENCECM564]

Elective II

1. Uncertainty and Risk Management [Code: ENCECM571]
2. Alternative Dispute Resolution [Code: ENCECM572]
3. Heritage Conservation and Demolition Engineering [Code: ENCECM573]
4. Sustainable Urban Planning and Development [Code: ENCECM574]

Elective III

1. Construction Engineering of Building Projects [Code: ENCECM611]
2. Construction Engineering of Water Supply and Sanitation Projects [Code: ENCECM612]
3. Construction Engineering of Bridge and Tunnel Projects [Code: ENCECM613]
4. Construction Engineering of Hydropower and Irrigation Projects [Code: ENCECM614]
5. Construction Engineering of Transportation Projects [Code: ENCECM615]

Elective IV

1. Sustainable Green Construction [Code: ENCECM621]
2. Infrastructure Asset Management [Code: ENCECM622]
3. Post-Disaster Construction Management [Code: ENCECM623]
4. Sustainable Project Operation and Maintenance [Code: ENCECM624]

Further Explanation about Project and Thesis works

The project and thesis component theme could be one of the following:

- Industrial/organizational problem assessment (Mainly done at industry/organization)
- Community based problem assessment (Mainly done at community)
- Literature based problem assessment (Mainly done at institution)
- Analytical or experimental or prototype based problem assessment (Mainly done at institution)
- Case study based problem assessment (Mainly done at case specific site)
- Field work based problem assessment (Mainly done at specific site)

- Any other relevant and deemed suitable by department
- The project component will be of approximately 3 months (Full - time) duration

Eligibility and Degree Award

Eligibility: **BE in Civil Engineering**

Degree Award: **MSc in Construction Engineering and Management (Civil Engineering)**

PHYSICAL INFRASTRUCTURE PLANNING AND MANAGEMENT
ENCECM501

Credits: 4

Year: I

Part: I

Course Objectives

The objective of this course is to provide students with a comprehensive understanding of infrastructure planning, project preparation, Development in Public sector and Private sector. Students will explore key concepts such as infrastructure planning, project preparation, sustainable development, and asset management.

1 Introduction [10 hours]

- 1.1 Definition and examples of infrastructure
- 1.2 Categories of infrastructures (Social, economic and revenue generating)
- 1.3 Typical infrastructure planning steps
- 1.4 Evolution of infrastructure planning process
- 1.5 Infrastructure and spatial organization
- 1.6 Principles for project designs in developing countries
- 1.7 Role of infrastructure in economic development

2 Overview of Infrastructure Sectors [16 hours]

- 2.1 Concept of development and innovative model of development
- 2.2 Development linkage sectors: human development, sustainable development, climate change, inclusive development, poverty alleviation, world trade and localization
- 2.3 Concept of green infrastructure development and disaster resilient development
- 2.4 Nepal's constitution and federal, provincial and local infrastructure development
- 2.5 Sectoral development policies and strategies
- 2.6 Evolution of planned development in Nepal and recent NPC plan
- 2.7 Planning and budgeting process for public infrastructure development in Nepal
- 2.8 Cooperation and coordination among federal government, provincial government and local government for infrastructure planning and development
- 2.9 Concept of local economic development and local economic infrastructure

3 Infrastructure Planning and Project Preparation [12 hours]

- 3.1 Goals and objectives of infrastructure planning
- 3.2 Federal, provincial and local government infrastructure planning
- 3.3 Identification and quantification of the casual factors influencing the demand for infrastructure

- 3.4 Review and forecast of demand and supply of infrastructure
- 3.5 Project preparation process: Project Idea Note (PIN), pre-feasibility study, feasibility study, final design and preparation of detailed project report
- 3.6 Nepal’s consulting industry: project preparation
- 3.7 Public Private Partnership (PPP) project planning and preparation
- 3.8 Concept of Project Development Agreement (PDA) in PPP Projects

4 Challenges in Sustainable Infrastructure Development in Nepal [10 hours]

- 4.1 Principals of sustainable infrastructure development
- 4.2 Mapping of risks in infrastructure planning
- 4.3 Challenges in project preparation
- 4.4 Social, cultural, political, legal issues in the project development
- 4.5 Challenges in operation and management of infrastructure

5 Infrastructure Asset Management [12 hours]

- 5.1 Historical overview and evolution
- 5.2 Asset performance requirements
- 5.3 Theory and methods for infrastructure asset management
- 5.4 Management of infrastructure: Individual and network/system level
- 5.5 Sustainable operation and management modalities

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	10	10
2	16	16
3	12	12
4	10	10
5	12	12
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Goodman, A.S., Makarand H. (2015). Infrastructure Planning, Engineering, and Economics. 2nd ed. New York: McGraw-Hill Education.
2. Dutta, D., Majumdar, A. K. (2016). Infrastructure Planning and Management: An Integrated Approach. Springer.
3. Ocampo-Martinez, C. A. (2015). Civil Infrastructure Systems: Modern Planning, Management, and Optimization. CRC Press.

CONSTRUCTION QUALITY AND SAFETY ENGINEERING

ENCECM502

Credits: 4**Year: I****Part: I****Course Objectives**

This course aims to equip students with comprehensive knowledge and practical skills in ensuring quality and safety within the construction industry. Students will learn to apply quality control principles, implement safety management systems, and adhere to regulatory standards.

- | | | |
|----------|---|------------------|
| 1 | Introduction | [6 hours] |
| | 1.1 Meaning and importance of quality engineering and quality management system | |
| | 1.2 Total Quality Management (TQM) | |
| | 1.3 Roles and responsibilities of a quality engineer | |
| 2 | Construction Quality Planning | [6 hours] |
| | 2.1 Quality planning for construction projects | |
| | 2.2 Quality Assurance Plan (QAP) | |
| | 2.3 Quality Function Deployment (QFD) | |
| 3 | Quality Standards and Certifications | [8 hours] |
| | 3.1 Overview of quality standards relevant to construction business | |
| | 3.2 ISO 9000 series standards and their application | |
| | 3.3 ISO 9001(2015) and its relevance to construction | |
| 4 | Quality Control and Inspection | [8 hours] |
| | 4.1 Quality control techniques and tools | |
| | 4.2 Inspection and testing methodologies | |
| | 4.3 Destructive and Non-Destructive Testing (NDT) | |
| | 4.4 Statistical Process Control (SPC) in construction | |
| | 4.5 Quality audits and inspections | |
| 5 | Occupational Health and Safety in Construction | [6 hours] |
| | 5.1 Definition, scope, importance and historical overview of occupational health; Importance of modern safety concept | |
| | 5.2 Key objectives, roles and responsibilities of stakeholders | |
| | 5.3 International Labor Organization (ILO) conventions and occupational health and safety | |

6 Modern Safety Concepts and Legislation [8 hours]

- 6.1 International safety standards and best practices
- 6.2 The impact of globalization on safety laws and legislation
- 6.3 Penalties, enforcement, and compliance with safety standards
- 6.4 Emerging trends and challenges in safety
- 6.5 Incorporating sustainable and green safety practices

7 Workplace Safety Management Systems [6 hours]

- 7.1 Development and implementation of safety policies and procedures
- 7.2 Safety training and education programs
- 7.3 Safety documentation and record-keeping
- 7.4 Monitoring, evaluation, and continuous improvement of safety performance

8 Safety Measures for Construction Equipment and Machinery [8 hours]

- 8.1 Equipment and machinery hazards in construction
- 8.2 Safe operation and maintenance practices for construction equipment
- 8.3 Safe use of hand tools and power tools
- 8.4 Safety measures for material handling and lifting
- 8.5 Vehicle and traffic safety on construction sites

9 Safety Management [4 hours]

- 9.1 Incentive for accident reporting
- 9.2 Safety economics

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	6	6
2	6	6
3	8	8
4	8	8
5	6	6
6	8	8
7	6	6
8	8	8
9	4	4
Total	60	60

*There may be minor deviation in marks distribution.

References:

1. Ashford, J. L. (2002). The management of quality in construction. Routledge
2. Rumane, A. R. (2017). Quality management in construction projects. CRC press.
3. Thorpe, B., Sumner, P. (2004). Quality management in construction. Gower Publishing Ltd.
4. Tang, S. L., Ahmed, S. M., Aoieong, R. T., Poon, S. W. (2005). Construction quality management (Vol. 1). Hong Kong University Press.
5. Holt, A. S. J. (2008). Principles of construction safety. John Wiley & Sons.
6. Hughes, P., Ferrett, E. D. (2016). Introduction to health and safety in construction. Routledge.
7. Rowlinson, S. (2004). Construction safety management systems. Routledge

CONSTRUCTION TECHNOLOGY

ENCECM503

Credits: 4**Year: I****Part: I****Course Objectives**

This course covers various construction techniques and technologies, including ground engineering, masonry, concrete production, pipe laying, highway construction, hydraulic structures, tunnel construction, bridge construction, and modern construction methods. It aims to equip students with the necessary knowledge and skills to excel in the industry, including site analysis, construction methods, and emerging trends.

- | | | |
|----------|--|------------------|
| 1 | Excavation and Ground Preparation | [4 hours] |
| | 1.1 Site investigation techniques | |
| | 1.2 Excavation methods and equipment | |
| | 1.3 Dewatering | |
| | 1.4 Soil compaction and stabilization | |
| | 1.5 Pile driving techniques and foundation systems | |
| | 1.6 Shoring and earth retention systems | |
| 2 | Masonry Works | [3 hours] |
| | 2.1 Masonry materials and mortar mixtures | |
| | 2.2 Masonry bonds and joints | |
| | 2.3 Reinforced masonry and lintels | |
| | 2.4 Masonry maintenance, repair, and restoration | |
| 3 | Concrete Production | [6 hours] |
| | 3.1 Concrete mix design and proportioning | |
| | 3.2 Batching and mixing techniques | |
| | 3.3 Placing, compaction, and finishing of concrete | |
| | 3.4 Curing and protection of concrete | |
| | 3.5 Non-destructive testing and quality control of concrete | |
| 4 | Woodworks, Steel, Aluminum and PVC Works for Openings | [3 hours] |
| | 4.1 Types of wood and their properties | |
| | 4.2 Wood framing techniques and joinery | |
| | 4.3 Doors and windows installation | |
| | 4.4 Steel, aluminum and PVC framing techniques | |

- 5 Construction of Steel Structures [6 hours]**
- 5.1 Structural steel materials and properties
 - 5.2 Steel framing systems and connections
 - 5.3 Steel trusses and beams
 - 5.4 Steel columns
 - 5.5 Construction techniques of specialized steel structures
- 6 Techniques of Pipe Laying and Underground Utilities [6 hours]**
- 6.1 Pipe jointing techniques: Concrete, steel, GI, CI, polythene pipes
 - 6.2 Underground pipe installation and trenchless methods
 - 6.3 Sewer and drainage systems
 - 6.4 Water supply and distribution systems
 - 6.5 Communication utilities/corridor
- 7 Highway and Pavement Construction Techniques [10 hours]**
- 7.1 Construction survey and layout of alignment
 - 7.2 Earthwork and grading for roads
 - 7.3 Flexible and rigid pavement design review and construction
 - 7.4 Asphalt and concrete pavement techniques
 - 7.5 Maintenance and rehabilitation of roads
 - 7.6 Traffic management and safety considerations during construction
- 8 Construction Techniques of Hydraulic Structures [10 hours]**
- 8.1 Dams, reservoirs and spillways
 - 8.2 Weirs, barrages with sediment control structures and fish ladder
 - 8.3 Powerhouses and turbines
 - 8.4 Canals and water distribution systems
 - 8.5 Sedimentation tanks and water treatment facilities
 - 8.6 River training works
- 9 Construction Techniques of Bridge and Tunnels [6 hours]**
- 9.1 Concrete bridges: RCC and Pre-stressed concrete
 - 9.2 Steel bridges
 - 9.3 Design and construction of scaffoldings
 - 9.4 Bridge inspection and assessment
 - 9.5 Tunnel excavation and construction methods
 - 9.6 Tunneling equipment and machinery
 - 9.7 Tunnel support systems

- 9.8 Tunnel ventilation and safety considerations
- 9.9 Tunnel inspection, maintenance and rehabilitation

10 Modern Construction Techniques and Resource Optimization [6 hours]

- 10.1 Prefabrication and modular construction
- 10.2 Selection of appropriate plants and equipment
- 10.3 Efficient management of plants and equipment

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapters	Hours	Marks distribution*
1 and 2	7	7
3	6	6
4	3	3
5	6	6
6	3	3
7	6	6
8	10	10
9	10	10
10	3	3
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Harris, F. Construction Plant: Ground Engineering Equipments and Methods. Granada Publishing. London
2. Harris, F. Construction Plant: Excavating and Materials handling equipment and Methods. Granada Publishing. London
3. Neville, A.M., Properties of Concrete, Pitman.
4. Chen, S.-H., Chen, M. L. (2015). Hydraulic structures. Springer.
5. Maidl, B., Thewes, M., Maidl, U. (2013). Handbook of Tunnel Engineering I: Structures and Methods, Somerset. NJ, USA, John Wiley & Sons.
6. Zhao, J. J., Tonia, D. E. (2012). Bridge engineering: design, rehabilitation, and maintenance of Modern Highway Bridges. McGraw-Hill Education

PRINCIPLES AND PRACTICES OF CONSTRUCTION MANAGEMENT

ENCECM504

Credits: 4**Year: I****Part: I****Course Objectives**

The objective of this course is to provide students with a foundational understanding of construction project management principles and practices. The objective of the course is to equip students with the basic knowledge and skills required to effectively plan, and manage the construction projects, including aspects of scheduling, materials management and documentation.

- | | | |
|----------|---|-------------------|
| 1 | Introduction | [4 hours] |
| | 1.1 Evolution of management concept | |
| | 1.2 Management functions | |
| | 1.3 Management styles | |
| | 1.4 SWOT analysis in construction business | |
| | 1.5 Project lifecycle | |
|
 | | |
| 2 | Project Scheduling, Monitoring and Control | [10 hours] |
| | 2.1 Project scheduling techniques and tools | |
| | 2.2 Critical path method and network analysis | |
| | 2.3 Resource allocation and leveling | |
| | 2.4 Progress monitoring and control | |
| | 2.5 Earned Value Analysis (EVA) | |
| | 2.6 Multitask scheduling and multi-project scheduling | |
| | 2.7 Delay analysis technique | |
|
 | | |
| 3 | Construction Material Market Analysis | [4 hours] |
| | 3.1 Market analysis in construction: assessing market conditions, competition | |
| | 3.2 Supply and demand dynamics in construction industry | |
| | 3.3 Market forecasting and trends in construction | |
| | 3.4 Pricing strategies and competitive analysis in construction | |
|
 | | |
| 4 | Risk Management | [6 hours] |
| | 4.1 Definition and importance of risk management | |
| | 4.2 Risk identification, assessment, and prioritization | |
| | 4.3 Risk response strategies | |
| | 4.4 Risk monitoring and control | |

- 5 Construction Insurance [6 hours]**
- 5.1 Meaning and importance of project insurance
 - 5.2 Third party and Group Personal Accident (GPA) insurance
 - 5.3 Construction All Risks (CAR) and Erection All Risks (EAR) insurance
- 6 Materials and Inventory Management [8 hours]**
- 6.1 Significance and objectives of material management
 - 6.2 Functions involved in material management – planning, purchasing, receiving, inspecting, storing, dealing with surpluses and scraps, reducing reclamation and surpluses
 - 6.3 Material Management Organization (MMO) – linkage with project organization, typical material management organization, authority and responsibility in the hierarchy
 - 6.4 Sources of materials, its principles and practices – introduction, principles of locating source, practice of locating source, vendor evaluation and rating
 - 6.5 Inventory management – introduction, cost of inventory, economic order quantity, ABC analysis in material management
- 7 Value Engineering and Constructability [8 hours]**
- 7.1 Principles of value engineering
 - 7.2 Value engineering process and techniques
 - 7.3 Innovation in construction projects
 - 7.4 Lean construction and productivity improvement
- 8 Construction Site Management [6 hours]**
- 8.1 Site planning and site operation
 - 8.2 Construction safety
 - 8.3 Construction management plan
- 9 Documentation and Reporting [8 hours]**
- 9.1 Meaning and importance of good documentation and reporting
 - 9.2 Resource deployment plan, daily progress report, periodical inspection/ walk down report, materials control report, progress control documentation, monthly progress report, quality control report, material testing report, equipment deployment report, man power report
 - 9.3 Work measurement record, progress payment records, Interim Payment Certificate (IPC), site instructions, letters, Variation Orders (VO), regular communication records

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	4	4
2	10	10
3	4	4
4	6	6
5	6	6
6	8	8
7	8	8
8	6	6
9	8	8
Total	60	60

*There may be minor deviation in marks distribution.

References:

1. Ramasamy, T. (2010). Management: Principles and Practices. Himalaya Publishing House.
2. Koontz, H., Weihrich, H. (2010). Principles of Management. McGraw-Hill Education.
3. Robbins, S. P., Coulter, M. (2021). Management: Principles and Practice (15th ed.). Pearson.
4. Koontz, H., Weihrich, H., Cannice, M. (2019). Essentials of Management (10th ed.). McGraw-Hill Education.

PROCUREMENT AND CONTRACT ADMINISTRATION
ENCECM551

Credits: 4

Year: I

Part: II

Course Objectives

This course equips students with essential knowledge and skills to proficiently manage construction contracts. Through theoretical foundations and practical case studies, students learn to administer contracts, and maintain standards, preparing them for successful careers in the construction industry.

1 Introduction [5 hours]

- 1.1 Concept of procurement
- 1.2 Principles of procurement
- 1.3 Role of public procurement monitoring office (PPMO)
- 1.4 Current trends in public procurement
- 1.5 Overview of public procurement law and contract documents

2 Procurement Planning [8 hours]

- 2.1 Procurement need identification
- 2.2 Development of procurement strategy
- 2.3 Slicing, packaging and lot size determination
- 2.4 Project delivery methods
- 2.5 Preparation of procurement plan
- 2.6 Pre-qualification and post qualification

3 Standard Bid Document [4 hours]

- 3.1 Introduction
- 3.2 Components of bid document
- 3.3 Bid document preparation

4 Procurement of Consultancy Services [10 hours]

- 4.1 Need identification
- 4.2 Terms of reference and cost estimate preparation
- 4.3 Procurement methods
- 4.4 Different selection methods
- 4.5 Overall procedure for procurement of consulting service
- 4.6 Preparation of expression of interest (EOI) and request for proposal (RFP) documents
- 4.7 Opening and evaluation of proposals
- 4.8 Negotiation and contract award

- 4.9 Practical exercise and case
- 5 Procurement of Goods and Works [9 hours]**
- 5.1 Preparation of cost estimate and specification
- 5.2 Procurement methods
- 5.3 Bid evaluation and contract award
- 5.4 Procurement guidelines of development partners
- 6 Types of Contract and Standard Contract Documents [6 hours]**
- 6.1 Types of contracts: Conventional contracts; Turnkey/EPC contracts; Management contracts; Target cost/Reimbursable contracts; Build-Own-Operate-Transfer (BOOT) contracts; Design and build contracts; Piece work contracts; Lump sum and unit rate contracts
- 6.2 Selection of appropriate contract
- 6.3 Standard contract documents: Institution of civil engineers (ICE); Fédération Internationale des Ingénieurs-Conseils (FIDIC); New engineering contract (NEC)
- 7 Contractual Provisions [7 hours]**
- 7.1 Delay analysis and extension of time
- 7.2 Price adjustment and mechanism of application
- 7.3 Variation order (VO) and its provisions
- 7.4 Insurance and its coverage
- 7.5 Contract termination and closing of contract
- 8 International Commercial Terms (INCOTERMS) [4 hours]**
- 8.1 Meaning and importance of INCOTERMS
- 8.2 Explaining INCOTERMS
- 9 Fraud and Corruption in Public Procurement [4 hours]**
- 9.1 Meaning and significance of fraud and corruption
- 9.2 Fraud and corruption in bid and contract documents
- 9.3 Conflict of interest and procurement governance
- 10 Complaint Handling [3 hours]**
- 10.1 Meaning of complaint handling
- 10.2 Complaint handling procedure

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapters	Hours	Marks distribution*
1	5	5
2	8	8
3	4	4
4	10	10
5	9	9
6	6	6
7	7	7
8	4	4
9	4	4
10	3	3
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Phillips, C. S. (1999). Construction contract administration. SME.
2. Greenhalgh, B. (2016). Introduction to construction contract management. Routledge.
3. Blake, S., Browne, J., Sime, S. (2016). A practical approach to alternative dispute resolution. Oxford University Press.
4. राजेन्द्रप्रसाद अधिकारी, सुशासन र प्रभावकारिताको कसीमा सार्वजनिक खरिद र निर्माण आयोजना व्यवस्थापन, पशुपति बुक्स, पुरानो बानेश्वर चोक

INFRASTRUCTURE ECONOMICS AND PROJECT FINANCE

ENCECM 552

Credits: 4**Year: I****Part: II**

Course Objectives

This course aims to equip students with a comprehensive understanding of the principles, practices, and techniques involved in economic evaluation and financing of infrastructure projects. By the end of the course, students will be able to select appropriate project, bankable project preparation, project appraisal, economic analysis, financial analysis, risk assessment, project financing structure and make informed decisions regarding project economics and financing.

1 Economics, Finance and Projects [4 hours]

- 1.1 Basic concepts of economics
- 1.2 Finance and its role in productive activities
- 1.3 Project as an instrument of economic development
- 1.4 Concept of project financing and entity financing
- 1.5 Financial structuring of project

2 Project Economics [4 hours]

- 2.1 Economic analysis of project
- 2.2 Economic analysis indicators: Internal rate of return (IRR); Benefit cost analysis; Net present value (NPV)
- 2.3 Social and environmental impacts in economic analysis of projects

3 Cost Estimation and Control [4 hours]

- 3.1 Cost estimation techniques in construction
- 3.2 Cost control and management in construction projects
- 3.3 Life cycle costing in construction decision-making
- 3.4 Earned value analysis (EVA) in construction economics
- 3.5 Value engineering and value management in construction

4 Project Financing [6 hours]

- 4.1 Evolution of project financing in infrastructure projects
- 4.2 Brief outlines of project financing process
- 4.3 Parties involved in project financing and their roles
- 4.4 Rationale of project financing in infrastructure projects
- 4.5 Infrastructure financing institution in Nepal: Town development fund (TDF) and Nepal infrastructure bank (NIFRA)

4.6 Challenges and opportunities in infrastructure financing

5 Bankable Project and Project Appraisal [18 hours]

- 5.1 Concept of project bank and bankable project
- 5.2 Principles of bankable project preparation
- 5.3 Project appraisal: Technical appraisal; Environment and social appraisal; Legal and institutional appraisal; Financial appraisal
- 5.4 Revenue stream of project; Operation and maintenance cost; Cash flow in project
- 5.5 Financial appraisal indicators: Cost-benefit analysis; Payback period; NPV; IRR; Debt service coverage ratio; Weightage average cost of capital
- 5.6 Risk appraisal, sensitivity analysis and sustainability analysis of project
- 5.7 Concept of project due diligence

6 Financing Tools for Infrastructure Development [6 hours]

- 6.1 Infrastructure financing tools: Grant; Loan and grant mix financing; Debt financing; Municipal financing; PPP financing; Blended financing; Hybrid annuity model (HAM); Climate financing
- 6.2 Sources of funds for infrastructure development: Government of Nepal; Multilateral development banks (MDBs); Development partners (DPs); Municipal bond; Infrastructure bond; Project specific bond; Green bond; Asset monetization
- 6.3 Selection of appropriate financial tools based on type of infrastructure
- 6.4 Concept of special proposed vehicle (SPV) company and infrastructure development
- 6.5 Concept of foreign direct investment (FDI) in infrastructure development

7 Public Private Partnership for Infrastructure Development [8 hours]

- 7.1 Public private partnership (PPP), Investment Board Nepal (INB) act and other legal instruments
- 7.2 Concept and importance of PPP for infrastructure development
- 7.3 Understanding of PPP project and future opportunities
- 7.4 PPP project preparation, procurement and implementation
- 7.5 Types of PPP model used in infrastructure (Build-Transfer (BT); Build-Operate-Transfer (BOT); Build-Own-Operate-Transfer (BOOT); Build-Transfer-Operate (BTO)
- 7.6 Selection of Appropriate PPP Models

8 Project Appraisal Report: Review and Analysis (Group Work) [8 hours]

- 8.1 Project finance by Town Development Fund (TDF)
- 8.2 Project financed by NIFRA bank
- 8.3 FDI project by Investment Board Nepal

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapters	Hours	Marks distribution*
1	4	4
2	4	4
3	4	4
4	6	6
5	18	18
6	8	8
7	8	8
8	8	8
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Gatti, S. (2012). Project finance in theory and practice: designing, structuring, and financing private and public projects. Academic Press
2. Yescombe, E. R. (2013). Principles of project finance. Academic Press
3. Myers, D. (2022). Construction economics: A new approach. Routledge
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5. De Valence, G. (2010). Modern construction economics: Theory and application. Routledge

RESEARCH METHODOLOGY AND STATISTICAL ANALYSIS
ENCECM561**Credits: 4****Year: I****Part: II****Course Objectives**

This course aims to equip students with necessary knowledge and skills on research design, data collection methods, statistical analysis techniques, and research proposal as well as research report/paper writing. By the end of the course, students will be prepared to conduct high-quality research for their projects and theses, enabling them to contribute to the advancement of knowledge in construction management.

1 Research Problem Formulation [9 hours]

- 1.1 Introduction and types of research: Introduction of research; Empiricism, Deductive and inductive processes; Quantitative and qualitative research
- 1.2 Research process
- 1.3 Research questions formulation: Identifying and defining research problems; Setting research questions and/or objectives
- 1.4 Hypothesis testing: Setting null and alternative hypothesis; Logic and importance of hypothesis testing

2 Research Design [12 hours]

- 2.1 Literature review: Importance of literature review; Identifying suitable literatures; Identifying research gap; Synthesizing literature review; Systematic review versus general review
- 2.2 Preparation of research design: Features of a good research design; Development of a theoretical/ conceptual/ methodological framework
- 2.3 Types of research design: Concept, types, and use of exploratory, descriptive, and experimental research design
- 2.4 Design of qualitative and quantitative research

3 Data Collection [9 hours]

- 3.1 Types and sources of data both quantitative and qualitative research
- 3.2 Sample size determination: Concept of research population and sample; Determination of sample size; Sampling errors; Practical considerations in sampling
- 3.3 Measurement and scaling techniques: Scale and level of measurements; Validity and reliability
- 3.4 Implementation of data collection methods: Tools, techniques and practical considerations

4 Data Analysis and Interpretation [18 hours]

- 4.1 Descriptive and univariate analysis: Descriptive analysis, trend analysis and graphical visualization
- 4.2 Bivariate analysis: Correlation, regression analysis and their interpretation
- 4.3 Multivariate analysis: Multiple regression, factor analysis, principal component analysis and their interpretation
- 4.4 Inferential statistics: Estimation and hypothesis testing for mean and proportion tests (t-test, Z-test, chi-square test, ANOVA); Non-parametric tests for single and two populations; Interpretation of inferential statistics

5 Research Proposal and Report/Paper Writing [12 hours]

- 5.1 Research proposal writing: Parts of a research proposal; Setting proper story-line; Practical considerations for research proposal writing
- 5.2 Research report writing: Parts of a research report/thesis; Practical considerations for research report writing
- 5.3 Research paper writing: Layout of a research paper; Understanding journal and their qualities (including impact factor, citation, predatory journals), Strategy for journal selection and effective story-formulation; Responding to reviewer’s queries
- 5.4 Tools for research paper writing: Citation and referencing styles; Reference management tools (Zotero, Mendeley); Research/publishing ethics and plagiarism

Assignment

Each student will select a research topic of interest and will be guided to develop a good proposal at the end of the course. At the mean-time, potential dummy data related to their research will be prepared and guided to perform data analysis and interpretation to fulfil learning objective of the course. Finally, each student will present their proposal, results (based on dummy data), interpretation, conclusions as well as recommendations based on the analysis of data provided to them. By this process, students will learn to write a research proposal as well as data analysis, the intended learning objective of this course.

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapters	Hours	Marks distribution*
1	9	9
2	12	12
3	9	9
4	18	18
5	12	12
Total	60	60

*There may be minor deviation in marks distribution.

References

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2. Kumar, R. (2018). Research methodology: A step-by-step guide for beginners. Sage.
3. Field, A. (2017). Discovering statistics using IBM SPSS statistics, 4th edition, SAGE publication
4. Gaur, A. S., Gaur, S. S. (2006). Statistical methods for practice and research: A guide to data analysis using SPSS. Sage.
5. Marczyk, G., DeMatteo, D., Festinger, D. (2005). Essentials of Research Design and Methodology, John Wiley and Sons, Inc.
6. Kothari, C.R. (2004). Research Methodology Methods and Techniques, New Age international publishers.
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8. Ronald E. Walpole., Raymond H. Myers. Sharon L. Myers. (2012) Probability and Statistics for Engineers and Scientists. 9th edition, Prentice Hall
9. Neil A. Weiss. Elementary. (2015). Statistics 9th edition, Pearson Publication

OPERATION RESEARCH AND OPTIMIZATION TECHNIQUES
ENCECM562**Credits: 4****Year: I****Part: II****Course Objectives**

This course aims to introduce students to the fundamental concepts and techniques of Operations Research and their application in construction management. The course will cover basic concepts of optimization and linear programming, supported by numerous practical examples and intensive hands-on exercises using computer software. It also develops skills in formulating, modeling, and analyzing management systems, ultimately enhancing their ability to apply operation research techniques effectively in construction projects real-world scenario.

- | | | |
|----------|--|-------------------|
| 1 | Introduction | [4 hours] |
| 1.1 | Historical development | |
| 1.2 | Scope of operation research | |
| 1.3 | Operation research and decision making | |
| 1.4 | Operation research techniques | |
| 2 | Mathematical Programming and their Applications | [16 hours] |
| 2.1 | Linear programming | |
| 2.2 | Graphical method | |
| 2.3 | Simplex method | |
| 2.4 | Modelling and solving linear programming problems in a spreadsheet | |
| 2.5 | Big M method | |
| 2.6 | Modeling and solving linear programming problems using computer software | |
| 2.7 | Duality | |
| 2.8 | Sensitivity analysis | |
| 3 | Network Modeling | [10 hours] |
| 3.1 | Transportation problems | |
| 3.2 | Assignment problems / Hungarian algorithm | |
| 3.3 | Transshipment problems | |
| 3.4 | Flow problems | |
| 3.5 | Shortest path problems | |
| 3.6 | Minimum spanning tree | |
| 4 | Network Models and Project Scheduling Techniques | [8 hours] |
| 4.1 | Network representation of construction projects | |

- 4.2 Critical path method (CPM)
- 4.3 Program evaluation and review technique (PERT)
- 4.4 Applications in construction scheduling

5 Integer Linear Programming [8 hours]

- 5.1 Branch and bound method
- 5.2 Travelling salesman problem
- 5.3 Chinese postman problem
- 5.4 Vehicle routing problem
- 5.5 Heuristic and metaheuristic techniques

6 Decision Theory and Risk Management [8 hours]

- 6.1 Decision-making under certainty and uncertainty
- 6.2 Decision-making under risk
- 6.3 Decision trees
- 6.4 Multi-criteria optimization
- 6.5 Multi-objective optimization

7 Simulation and Queuing Models [6 hours]

- 7.1 Monte Carlo simulation
- 7.2 Fundamentals of a queuing system
- 7.3 Simulation of construction processes
- 7.4 Markov chains

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	4	4
2	16	16
3	10	10
4	8	8
5	8	8
6	8	8
7	6	6
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Hamdy, T. (2021). Operations Research, An Introduction (10th Edition)
2. Hillier, F., Lieberman, G. (2021). Introduction to Operations Research (11th Edition)
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4. Murthy, P.R. (2007). Operations research, New Age International (P) Ltd., Publishers, Second Edition

APPLICATION OF INFORMATION TECHNOLOGY IN CONSTRUCTION
ENCECM 563

Credits: 4

Year: I

Part: II

Course Objectives

The course equips students with skills to integrate Information Technology (IT) into construction management for improved efficiency, collaboration, decision-making, and sustainability. It focuses on tools like Building Information Modeling (BIM), clash detection, and Common Data Environments (CDE) for project lifecycle management, scheduling, and cost estimation. Emerging technologies such as drones, Artificial Intelligence (AI), Internet of Things (IOT) and sustainable IT practices are also explored.

- | | | |
|----------|--|-------------------|
| 1 | Introduction | [2 hours] |
| | 1.1 Overview of IT applications in construction | |
| | 1.2 Evolution of digital tools and technologies in the industry | |
| | 1.3 Benefits and drawbacks of IT application usage | |
| 2 | Building Information Modeling | [4 hours] |
| | 2.1 Concept, processes and dimensions | |
| | 2.2 Standards and regulations | |
| | 2.3 Utilization and use cases of BIM in project management | |
| | 2.4 BIM vs Computer Aided Drafting | |
| 3 | BIM in Design | [10 hours] |
| | 3.1 Existing information capture through point clouds | |
| | 3.2 BIM in architectural design | |
| | 3.3 BIM in structural design | |
| | 3.4 BIM in Mechanical, Electrical and Plumbing (MEP) design | |
| | 3.5 BIM based simulation and analyses | |
| | 3.6 BIM and generative design | |
| 4 | BIM in Facility Management | [4 hours] |
| | 4.1 BIM for operations and maintenance | |
| | 4.2 Predictive maintenance | |
| 5 | Construction Documentation and Information Management | [6 hours] |
| | 5.1 Introduction | |
| | 5.2 Document control software for managing drawings, contracts, and specifications | |

- 5.3 Collaboration and communication tools for construction projects
- 5.4 Electronic Document Management Systems (EDMS)
- 5.5 Information sharing and coordination platforms

6 Geographic Information System and Remote Sensing in Construction [12 hours]

- 6.1 Geographic Information System (GIS) and Remote Sensing (RS); Applications of GIS and RS in construction
- 6.2 Spatial data management and visualization
- 6.3 Site selection for infrastructure project using GIS analysis
- 6.4 Vulnerable and risk management using GIS/RS
- 6.5 Integration of GIS/RS with other construction management applications

7 Quality Assurance [6 hours]

- 7.1 Quality assurance methods: Checking and analysis
- 7.2 Federated model and clash detection
- 7.3 Information validation

8 Advanced Project Management Tools [12 hours]

- 8.1 Overview of project management tools in construction industry
- 8.2 Construction scheduling software and management tools
- 8.3 Resource allocation and scheduling techniques
- 8.4 Cost control software for budgeting and cost tracking
- 8.5 Situation awareness: information visualization and reporting

9 Emerging Technologies in Construction [4 hours]

- 9.1 Overview of emerging technologies in construction
- 9.2 Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) in construction
- 9.3 Drones and laser scanning in construction
- 9.4 Internet of Things (IOT) in construction
- 9.5 Artificial Intelligence (AI) and Machine Learning (ML) in construction

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	2	2
2	4	4
3	10	10
4	4	4
5	6	6
6	12	12
7	6	6
8	12	12
9	4	4
Total	60	60

*There may be minor deviation in marks distribution.

References

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2. Sacks, R., Eastman, C., Lee, G., Teicholz, P. (2018). BIM handbook: A guide to building information modeling for owners, designers, engineers, contractors, and facility managers. John Wiley and Sons.
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7. Krygiel, E., Nies, B. (2008). Green BIM: successful sustainable design with building information modeling. John Wiley and Sons.
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NATURAL RESOURCE SAFEGUARD IN INFRASTRUCTURE DEVELOPMENT
ENCECM 564

Credits: 4

Year: I

Part: II

Course Objectives

This course aims to equip students with a comprehensive understanding of biodiversity and natural resource (NR) safeguarding in sustainable infrastructure development. It focuses on analyzing impacts of linear infrastructure on ecosystems and introducing mitigation principles. Students will learn to plan, implement, and monitor natural resources safeguarding measures effectively. The course emphasizes to evaluate risks, challenges, and trade-offs, and proposing innovative solutions. Practical understanding is enhanced through national and international case studies.

- 1 Introduction [10 hours]**
- 1.1 Concept, status, and significance of biodiversity and natural resource safeguards
 - 1.2 Protected areas and biodiversity conservation approaches
 - 1.3 Ecology and behavior of wildlife species
 - 1.4 National and international legal framework
- 2 Impacts of Linear Infrastructure on Biodiversity [6 hours]**
- 2.1 Types of linear infrastructure and their spatial configurations
 - 2.2 Direct and indirect impacts of linear infrastructures
- 3 Mitigation Principles and Measures [10 hours]**
- 3.1 Mitigation hierarchy
 - 3.2 Mitigation measures
 - 3.3 Natural resources safeguard measures in linear infrastructure projects
- 4 Components of Natural Resources Safeguard Measures [12 hours]**
- 4.1 Underpasses, overpasses, bird diverters, and ramps
 - 4.2 Selection of appropriate wildlife passages
 - 4.3 Signage and awareness
 - 4.4 Use of vegetation in infrastructure safeguards
- 5 Planning, Construction, Monitoring, and Evaluation of Natural Resources Safeguard Measures [10 hours]**
- 5.1 Integration of natural resources safeguard measures during planning and construction phases
 - 5.2 Post-construction integration

6 Risks, Challenges and Mitigation Measures [6 hours]

- 6.1 Different types of risks and mitigation measures
- 6.2 Different types of challenges and strategies to address them
- 6.3 Economic analysis to address the risks and challenges

7 Technology and Innovation to Conserve Bio-diversity [6 hours]

- 7.1 Digitalization and data-driven system
- 7.2 Internet of things (IOT) and sensor technologies
- 7.3 Augmented reality (AR) and virtual reality (VR) applications
- 7.4 Automation and robotics to conserve bio-diversity

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	10	10
2	6	6
3	10	10
4	12	12
5	10	10
6	6	6
7	6	6
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Altmann, J. (1974). Observational study of behavior: Sampling methods. Behaviour, 49(3), 227–267. PubMed
2. Eco-Friendly Measures to Mitigate Impacts of Linear Infrastructure on Wildlife. Wildlife Institute of India, Dehradun, India, 2016. Wildlife Institute of India

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UNCERTAINTY AND RISK MANAGEMENT

ENCECM571

Credits: 4**Year: I****Part: II****Course Objectives**

This course equips students with a comprehensive understanding of risk management in alignment with Project Management Body of Knowledge 7 (PMBOK 7). It covers risk identification, assessment, and response strategies, incorporating practical tools and methods. The course also explores legal, ethical, and emerging trends and prepares student for adaptive and innovative real-world applications.

1 Introduction**[10 hours]**

- 1.1 Understanding uncertainty and risk
- 1.2 Historical context and lessons learned
- 1.3 Importance of uncertainty and risk management
- 1.4 Role of stakeholders in uncertainty and risk management
- 1.5 Types and sources of uncertainties: Design uncertainties, technical uncertainties, financial uncertainties and external uncertainties
- 1.6 Identifying and assessing uncertainties in construction projects
- 1.7 Uncertainty mapping and visualization techniques

2 Risk Identification, Common Construction Risks and Analysis**[14 hours]**

- 2.1 Potential sources of risk
- 2.2 Expert judgment and historical data analysis
- 2.3 Risk registers and matrices
- 2.4 Methods for identifying uncertainties and risks, their assessment and prioritization
- 2.5 Common risks in construction projects: Schedule delays and disruptions; Cost overruns; Budget uncertainties; Quality and performance risks; Safety and security risks; Social and environmental risks
- 2.6 Social and community impacts of construction projects
- 2.7 Prioritizing risks in construction projects
- 2.8 Quantitative and qualitative risk assessment techniques
- 2.9 Risk analysis and evaluation: Probability theory and its application in risk analysis; Decision tree analysis; Sensitivity analysis; Monte Carlo simulation

3 Risk Management and its Techniques**[14 hours]**

- 3.1 Concept and importance of risk management
- 3.2 Risk sharing and distribution
- 3.3 Risk response strategies

- 3.4 Risk monitoring and control
- 3.5 Risk assessment techniques: Principles and concepts of risk assessment in construction; Qualitative and quantitative risk assessment methods
- 3.6 Insurance and surety bonding
- 3.7 Identification and evaluation of common hazards in construction
- 3.8 Hazard analysis: Job hazard analysis (JHA); Failure mode and effects analysis (FMEA)
- 3.9 Involvement of stakeholders in risk assessment and hazard identification

4 Risk Mitigation, Response Planning, and Monitoring [12 hours]

- 4.1 Risk mitigation strategies and techniques
- 4.2 Developing risk response plans, contingency planning, and reserves
- 4.3 Insurance and contractual mechanisms for risk transfer
- 4.4 Establishing risk monitoring systems, early warning indicators and triggers
- 4.5 Performance measurement and evaluation
- 4.6 Legal and ethical aspects of risk management
- 4.7 Legal framework and regulations related to risk management
- 4.8 Ethical considerations in risk management decisions

5 Stakeholder Engagement and Documentation of Risk Management [6 hours]

- 5.1 Engaging stakeholders in risk identification and response planning
- 5.2 Effective communication strategies for risk management
- 5.3 Documentation and reporting of risk management activities

6 Emerging Trends and Technologies in Risk Management [4 hours]

- 6.1 Agile and hybrid risk management approaches
- 6.2 Use of artificial intelligence, machine learning, and data analytics in risk management

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	10	10
2	14	14
3	14	14
4	12	12
5	6	6
6	4	4
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Jha, K.N. (2011). Construction project management: Theory and practice. Pearson Education India
2. Cretu, O., Stewart, R. B., Berends, T. (2011). Risk management for design and construction (Vol. 75). John Wiley and Sons
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ALTERNATIVE DISPUTE RESOLUTION
ENCECM 572

Credits: 4

Year: I

Part: II

Course Objectives

This course aims to provide students with a comprehensive understanding of various methods for resolving disputes outside of traditional litigation. Through theoretical exploration, practical applications, and case studies, students will develop the knowledge and skills necessary to effectively navigate negotiation, mediation, arbitration, adjudication, and other ADR processes.

1 Introduction [8 hours]

- 1.1 Definition and overview of Alternate Dispute Resolution (ADR)
- 1.2 Advantages and disadvantages of ADR methods
- 1.3 Standard contract documents: Public Procurement Monitoring Office (PPMO), Standard Bidding Documents (SBD) and International Federation of Consulting Engineers (FIDIC) conditions of contract
- 1.4 Contract formation, priority of contract documents and interpretation of contract

2 Other ADR Methods [12 hours]

- 2.1 Conciliation and facilitation techniques
- 2.2 Expert determination and early neutral evaluation
- 2.3 Mini-trials and mock trials
- 2.4 Med-Arb and Arb-Med processes
- 2.5 Online Dispute Resolution (ODR) and its applications
- 2.6 Cross-fertilization between ADR and litigation
- 2.7 Amicable settlement

3 Claim and Dispute [10 hours]

- 3.1 Meaning of claim and dispute
- 3.2 Claim document preparation

4 Adjudication [10 hours]

- 4.1 Overview of adjudication
- 4.2 Adjudication procedure
- 4.3 Enforcement of adjudicator's decision

5 Arbitration [12 hours]

- 5.1 Introduction to arbitration and arbitration act

- 5.2 Selection and appointment of arbitrators
- 5.3 Arbitration proceedings
- 5.4 Arbitral awards
- 5.5 Arbitration rules: ICC; UNCITRAL; NEPCA; SIAC

6 Enforcement of Arbitral Awards

[8 hours]

- 6.1 New York convention
- 6.2 Practical aspects of enforcement of arbitral award

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	8	8
2	12	12
3	10	10
4	10	10
5	12	12
6	8	8
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Blake, S., Browne, J., Sime, S. (2016). A practical approach to alternative dispute resolution. Oxford University Press.
2. Levin, P. (1998). Construction contract claims, changes and dispute resolution. American Society of Civil Engineers.
3. Bantekas, I. (2015). An introduction to international arbitration. Cambridge University Press.

HERITAGE CONSERVATION AND DEMOLITION ENGINEERING

ENCECM573

Credits: 4**Year: I****Part: II**

Course Objectives

This course covers theories, principles and approaches of conservation and management of built heritage – monuments and historic buildings. It also deals with conservation issues, legal aspects, management and documentation of heritage related projects. In addition, it also explores the applications of demolition and construction waste management of the heritage structures.

1 Introduction to Heritage Conservation [4 hours]

- 1.1 Definition and concepts of conservation, values, attitudes, and principles
- 1.2 History and present state of conservation in Nepal
- 1.3 Importance of conservation, conservation sites and areas, basic techniques of urban conservation
- 1.4 Principles and approaches of conservation
- 1.5 Degrees of intervention in conservation

2 Conservation Issues and Legal Aspects [8 hours]

- 2.1 Conservation and economy
- 2.2 Conservation and tourism
- 2.3 Conservation and transportation
- 2.4 Conservation and development
- 2.5 Conservation and disaster
- 2.6 Conservation and climate change
- 2.7 Legal, policies and administrative aspects
- 2.8 Archeological acts/charters pertaining to conservation

3 Conservation and Management, Documentation, Recording and Inventories [5 hours]

- 3.1 Concept of conservation and management, parties involved and their responsibilities
- 3.2 Management process, problems, and remedial measures for conservation of historic buildings
- 3.3 Types of contracts and agreements; Tenders; Evaluation and award; Contract administration
- 3.4 Methods of documentation and recording of historic structures
- 3.5 Preparing an inventory of cultural resources

4 Case Studies of Conservation Management Projects and Conservation Master Plan [4 hours]

- 4.1 Case Studies of various conservation management projects undertaken in Nepal and abroad

4.2 Case studies of conservation master plans of different conservation sites and areas

5 World Heritage Sites [5 hours]

- 5.1 Introduction to world heritage sites (WHS)
- 5.2 Organizations working on conservation and WHS
- 5.3 World heritage center
- 5.4 World heritage sites of Nepal and abroad
- 5.5 Issues related to the management and conservation of the ‘living’ world heritage sites

6 Guthi System [2 hours]

- 6.1 Introduction to the Guthi system
- 6.2 Traditional conservation management through the Guthi system in Nepal

7 Archaeological Techniques [8 hours]

- 7.1 Origins and development of archaeology
- 7.2 Theory and principles of archaeology; links with social anthropology
- 7.3 Archaeological methods and techniques
- 7.4 Salvage and rescue archaeology
- 7.5 Community archaeology and participatory approach for conservation
- 7.6 Management of archaeological sites: legislation, institutions, and operations

8 Structural Health Monitoring, Repair and Restoration of Heritage Structures [10 hours]

- 8.1 Structural health monitoring and its classification
- 8.2 Types of monitoring systems: strain gauge, temperature probe, and pressure cells
- 8.3 Selection of sensors and structural survey
- 8.4 Causes of damage to heritage structures
- 8.5 Vulnerability of heritage structures via man-made and natural disasters
- 8.6 Repair mortars for heritage structures
- 8.7 Surface protective treatment coatings for heritage structures
- 8.8 Strengthening techniques for heritage structures

9 Planning, Legislation and Documentation of Demolition [6 hours]

- 9.1 Prevailing regulations and acts related to demolition and construction waste management
- 9.2 Stakeholders and their roles in managing demolition and construction waste
- 9.3 Planning sequence in demolition; Equipment to be used; Estimating, quantifying and pricing the demolition project
- 9.4 Documentation: Importance and types of documentation required for demolition and construction waste management

10 Execution, Monitoring, Evaluation and Controlling of Demolition [4 hours]

- 10.1 Demolition techniques: Demolition by machines, demolition by explosives, advanced techniques in demolition (Robotic machines)
- 10.2 Safety precautions in demolition and handling of explosives
- 10.3 Monitoring and evaluation of the process

11 Risk, Challenges, and Mitigation Measures for Demolition [4 hours]

- 11.1 Mapping and facing the landscape of risks in demolition
- 11.2 Challenges faced in demolition and construction waste management
- 11.3 Legal and contractual issues of demolition

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapters	Hours	Marks distribution*
1	4	4
2	8	8
3	5	5
4	4	4
5	5	5
6	2	2
7	8	8
8	10	10
9	6	6
10	4	4
11	4	4
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Amatya, S., (2009). Conservation in Nepal
2. Bonapace, C., Sestini V. (2003). Traditional Material and Construction Technologies used in the Kathmandu Valley. UNESCO, Paris.
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12. Slusser M. (1982). Nepal Mandala. Princeton University Press
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14. Building Bylaws for the Kathmandu Valley
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SUSTAINABLE URBAN PLANNING AND DEVELOPMENT
ENCECM574

Credits: 4

Year: I

Part: II

Course Objectives

This course aims to provide an understanding of complex urban systems and their challenges, fostering critical analysis and informed decision-making in the context of sustainable development. It equips students with the knowledge and skills required to integrate sustainable practices in urban planning. The focus is on creating self-sustaining, livable environments aligned with global sustainable development goals.

1 Introduction [5 hours]

- 1.1 Definitions, history, theories, and rationality of urban planning
- 1.2 Understanding world civilization, urbanization, and its pros and cons
- 1.3 Dimensions, components, and principle of urban sustainability
- 1.4 Institutions and legislations for sustainable urban development

2 Functionality of City and its Complexity [8 hours]

- 2.1 Understanding urban system
- 2.2 Municipal, regional, and national governance
- 2.3 Urban utilities and services
- 2.4 Urban public finance and taxation
- 2.5 Law, order, and conflict
- 2.6 Land use planning and management
- 2.7 Urban risks and vulnerabilities

3 Sustainable Urban Planning and Development [10 hours]

- 3.1 Trends of urbanization in Nepal
- 3.2 Historical urban form of Nepal and principle of sustainability addressed in traditional urban system
- 3.3 Modern urban and regional planning practices in Nepal
- 3.4 Overview of sustainable development goals in the case of Nepal
- 3.5 National, urban, and regional policies and strategies for sustainable urban planning and development
- 3.6 Grid framework and localization efforts of sustainable urban planning and development

4 Urban Planning and Environment [6 hours]

- 4.1 Climate change and built environment

- 4.2 Nature based solutions and local indigenous wisdom
- 4.3 Resilient city concept
- 4.4 Urban rural linkages
- 4.5 Risk sensitive land use planning and disaster management
- 4.6 Urban regeneration

- 5 Sustainable Infrastructure and Service Management [5 hours]**
 - 5.1 Sustainable material and waste management (Circularity in waste management)
 - 5.2 Sustainable mobility (Clean, safe, and inclusive mobility: Public transportation, integrating land use and transportation network, intelligent transport system)
 - 5.3 Sustainable energy system (Clean energy system, existing energy system in Nepal)

- 6 Urban Governance for Sustainable Urban Planning and Development [5 hours]**
 - 6.1 Planning and governance
 - 6.2 Collaborative planning, partnerships, and decentralization
 - 6.3 Existing institutions, legislations, and policies for urban governance in Nepal

- 7 Applications of Geographical Information System and Digital Technology [5 hours]**
 - 7.1 Application of geographical information system for urban mapping and analysis
 - 7.2 Application of digital technologies for efficiency, analysis, and decision-making in development processes

- 8 Inclusive City Planning and Development Approach [4 hours]**
 - 8.1 Concept, dimensions, perspectives, challenges and pathways
 - 8.2 People-centric planning and development approach (Gender equality and social inclusion in planning and development)

- 9 Sustainable Land, Housing and Real Estate Development [6 hours]**
 - 9.1 Public/private land and housing development (Planning tools: land pooling, guided land development, site and services, regulatory and development controls)
 - 9.2 Green buildings and sustainable housing (Green building materials and technology, socio-economic aspects of green buildings, green building technology in housing project)
 - 9.3 Real estate management (Introduction, legislations policies, and financing)

- 10 Financing for Sustainable Urban Development [6 hours]**
 - 10.1 Financial needs for urban planning and development
 - 10.2 Urban public finance, revenues, taxation, and insurance
 - 10.3 Public- private financing

10.4 International development agencies, national government, local government financial mechanism

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	5	5
2	8	8
3	10	10
4	6	6
5	5	5
6	5	5
7	5	5
8	4	4
9	6	6
10	6	6
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Anthony, G., Dahiya, B. (2004). Urban Environment and Infrastructure, Towards Livable Cities. The world Bank.
2. Brundtland, G.H., (1987). Our Common Future: Report of the World Commission on Environment and Development.
3. Jain, A.K., (2018). Town Planning, principles, process and Practice. Khanna Book Publishing CO. (P) Ltd.
4. Joshi, J. (2019). Urban Planning in Nepal, Approaching sustainability
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9. Sanyo, S. (2023). *Green resilient and Inclusive development in Nepal*. The World Bank Group.
10. UN- Habitat, (2010). *Planning Sustainable Cities, UN-Habitat Practices and Perspectives*.
11. United Nations (2017). *The New Urban Agenda*. Habitat III, UN conference on Housing and Sustainable urban development.
12. United Nations. (2023) *Crisis resilient Urban Futures, The future of Asian and pacific cities*. United Nations Publications.
13. Wheeler, S. M., (Ed) (2023). *The sustainable Urban Development Reader, fourth Edition, The Routledge Urban Reader Series*

CONSTRUCTION ENGINEERING OF BUILDING PROJECTS

ENCECM611

Credits: 4**Year: II****Part: I****Course Objectives**

This course equips students to manage different categories of building projects by mastering fundamentals and innovative trends. Students will gain knowledge of legal compliance, documentation, and risk management. The course also highlights sustainable and efficient management in building construction.

1 Introduction [6 hours]

- 1.1 Fundamentals of building construction and building science
- 1.2 Overview of historical practices and recent trends in building construction in national and international contexts
- 1.3 Types of buildings and their terminologies
- 1.4 Design review of buildings

2 Planning, Appraisal, Legalization and Documentation [12 hours]

- 2.1 Project identification, feasibility studies, setting goals and objectives
- 2.2 Project selection criteria: cost-benefit analysis; internal rate of return; modified internal rate of return; minimum attractive rate of return; environmental and social indicators
- 2.3 Study of legal and contractual frameworks
- 2.4 Detailed Project Report (DPR)
- 2.5 Coordination with different parties involved
- 2.6 Documentation and reporting

3 Construction, Monitoring, Evaluation and Controlling [6 hours]

- 3.1 Standard construction procedures
- 3.2 Project progress performance monitoring: Geotechnical, structural, environmental, and economical
- 3.3 Performance analysis and corrective actions

4 Sustainable Maintenance of Building Projects [10 hours]

- 4.1 Sustainability principles
- 4.2 Technology for sustainable maintenance
- 4.3 Various types of maintenance, rehabilitation, and replacement strategies
- 4.4 Stakeholder engagement and alliances for sustainable maintenance
- 4.5 Life cycle costing for sustainable maintenance

5 Risk Analysis and Mitigation Measures [8 hours]

- 5.1 Risks in different phases of building construction: Earthquake risk, economic risk, construction risk, environmental risk, socio-economic risk and cultural risk of building projects
- 5.2 Mitigation measures of different types of risks

6 Emerging Trends and Technology [4 hours]

- 6.1 Modular construction, integrated project delivery method, advanced building materials, pre-stress construction, green building technologies
- 6.2 Emerging trends and practices: National versus international construction practices

7 Special Considerations [14 hours]

Facility management, waste management, operation and maintenance, risk management and safety considerations in commercial buildings, airport terminals, railway terminals, hospital buildings, high-rise buildings and industrial buildings

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapters	Hours	Marks distribution*
1	6	6
2	12	12
3	6	6
4	10	10
5	8	8
6	4	4
7	14	14
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Nepal National Building Code
2. Yescombe, E. R. (2013). Principles of Project Finance (2nd Edition). Academic Press.
3. Selected research papers and articles

CONSTRUCTION ENGINEERING OF WATER SUPPLY AND SANITATION PROJECTS ENCECM612

Credits: 4**Year: II****Part: I****Course Objectives**

The objective of this course is to familiarize the students with the basic principles, tools and applications of water supply and sanitation projects. It deals with the planning, appraisal, legal aspects, design, monitoring, evaluation, and controlling of such projects. Further, it also focuses on the sustainability and emerging trends in the related field.

1 Introduction [10 hours]

- 1.1 Overview of water supply and sanitation projects, and their importance
- 1.2 Key components and their types
- 1.3 Water supply and sanitation, its relation with sustainable development goals
- 1.4 Public health: relationships between public health, population health, health policy
- 1.5 Water and sanitation and its management
- 1.6 Water demand and water sources
- 1.7 Intake, treatment unit options for rural and urban area
- 1.8 Conventional vs. decentralized system and its management, health aspects of water supply and sanitation

2 Planning, Appraisal, Legislation and Documentation [6 hours]

- 2.1 Project identification, site selection, and feasibility study (Environmental, social, and economical)
- 2.2 Study of the legal and contractual framework
- 2.3 Land acquisition and stakeholder involvement
- 2.4 Documentation and reporting

3 Pipe Network Management [8 hours]

- 3.1 Water transmission
- 3.2 Main transmission, bulk distribution, and distribution system network planning
- 3.3 Review of documents related to design criteria, network analysis, and network design
- 3.4 Optimization network analysis and design
- 3.5 Optimization of pipe and networks
- 3.6 Water quality analysis

- 4 Treatment and Storage System Management [4 hours]**
- 4.1 Water treatment and disinfection
 - 4.2 Storage systems
 - 4.3 Review of design documents related to treatment and storage system
- 5 Conventional and Natural Wastewater Treatment Systems [4 hours]**
- 5.1 Conventional and natural treatment systems and processes
 - 5.2 Wastewater composition and volume
 - 5.3 Wastewater treatment, grey water, and fecal sludge management
- 6 Construction, Monitoring, Evaluation, and Controlling [6 hours]**
- 6.1 Standard construction procedure
 - 6.2 Construction progress and performance monitoring
 - 6.3 Performance analysis and corrective action
- 7 Sustainable Maintenance of Water Supply and Sanitation Projects [6 hours]**
- 7.1 Sustainability principles
 - 7.2 Technology for sustainable maintenance
 - 7.3 Various types of maintenance, rehabilitation, and replacement strategies
 - 7.4 Stakeholder engagement and alliances for sustainable maintenance
 - 7.5 Life cycle costing for sustainable maintenance
- 8 Water Management and Risk Assessment [14 hours]**
- 8.1 Rainwater recharge and harvesting
 - 8.2 Groundwater recharge
 - 8.3 Drip irrigation to conserve water
 - 8.4 Grey water systems evaluation
 - 8.5 Water safety planning: Hazard analysis and control of various treatment units
 - 8.6 Water quality control at various units
 - 8.7 Community-based participatory approaches and their impacts on water, sanitation, and relevant public health policies
 - 8.8 Risks in different phases: Economic risk, construction risk, environmental risk, socio-economic risk and cultural risk
 - 8.9 Mitigation measures of different types of risks
- 9 National/International Emerging Trends for Water Supply and Sanitation Projects [2 hours]**

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	10	10
2	6	6
3	8	8
4	4	4
5	4	4
6	6	6
7	6	6
8	14	14
9	2	2
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Ahmed, M. F., and Rahman Md. M., (2000). Water Supply and Sanitation, Rural and low income urban communities.
2. Sincero, A.P., Sincero, G.A. (2002). Environmental Engineering: A design approach. Prentice-Hall.
3. Oloson, G., Kewell, B. Waste water treatment systems, modelling, diagnosis and control.
4. Davis, M.L., Cornwell, D.A. (1998). Introduction to Environmental Engineering. WCB/McGraw-Hill
5. Lawson, A. B., Biggeri, A., Bohning, D., Lesaffre, E. (1999). Disease Mapping and Risk Assessment for Public Health. John Wiley and Sons, England.
6. Arceivala, S. J. (2003). Waste water treatment for pollution control. Tata McGraw-Hill publishing company Limited.
7. Tsouros, A. (1990). WHO healthy cities projects: a project becomes a movement (Review of progress 1987 to 1990) Copenhagen, WHO/FADL.1990 and SOGESS, Milan.
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9. WHO Guidelines for Drinking-Water Quality.

CONSTRUCTION ENGINEERING OF BRIDGE AND TUNNEL PROJECTS

ENCECM613

Credits: 4**Year: II****Part: I****Course Objectives**

This course provides a comprehensive understanding of construction engineering aspects specific to bridge and tunnel projects. It focuses on planning, design, construction methods, monitoring, and control. The course also addresses risk management, sustainability, and innovative trends in the field.

- 1 Introduction [4 hours]**
 - 1.1 Overview of bridge and tunnel projects
 - 1.2 Importance and benefits of bridges and tunnels
 - 1.3 Classification and types of bridges and tunnels

- 2 Planning and Design Review for Bridge and Tunnel Construction [12 hours]**
 - 2.1 Site selection and alignment studies
 - 2.2 Feasibility studies and economic analysis
 - 2.3 Design standards and parameters
 - 2.4 Load considerations for bridges: Dead, live, seismic, and wind loads
 - 2.5 Geotechnical, hydrologic and hydraulic considerations
 - 2.6 Environmental and social impact assessments
 - 2.7 Stakeholder involvement and land acquisition

- 3 Materials and Techniques used in Bridge and Tunnel Construction [10 hours]**
 - 3.1 Materials used: Concrete, stone, timber, steel, and composites
 - 3.2 Construction methods for bridges: Precast, cast-in-situ, segmental, and cable-stayed
 - 3.3 Tunnel construction methods: New Austrian tunneling method (NATM), Tunnel Boring Machine (TBM), and cut-and-cover method
 - 3.4 Equipment and machinery used

- 4 Structural and Geotechnical Design Review [10 hours]**
 - 4.1 Geotechnical review of tunnels and bridge foundation
 - 4.2 Structural design review of bridges: Piers, girders, foundations
 - 4.3 Review tunnel lining and support systems
 - 4.4 Groundwater control and dewatering techniques in bridges and tunnels
 - 4.5 Seismic design considerations for bridges and tunnels

5 Construction Management and Safety Protocols in Bridge and Tunnel [10 hours]

- 5.1 Project planning and scheduling
- 5.2 Cost estimation and budgeting
- 5.3 Quality assurance and control during construction
- 5.4 Safety protocols
- 5.5 Role and responsibilities of stakeholders

6 Risk Management, Maintenance and Sustainability of Bridge and Tunnel Construction [8 hours]

- 6.1 Risk identification and mitigation strategies
- 6.2 Maintenance and asset management
- 6.3 Sustainable practices in design and construction
- 6.4 Environmental mitigation and corporate social responsibilities

7 Innovative Trends in Bridge and Tunnel Construction [6 hours]

- 7.1 Emerging technologies: Robotics, 3-dimensional (3D) printing, and internet of things
- 7.2 Smart monitoring systems for bridges and tunnels

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	4	4
2	12	12
3	10	10
4	10	10
5	10	10
6	8	8
7	6	6
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Chen, W.-F., Duan, L. (Eds.). (2014). Bridge engineering handbook (2nd ed.). CRC Press.
2. Maidl, B., Thewes, M., Maidl, U. (2014). Handbook of tunnel engineering (Vols. 1 and 2). Wiley.
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6. International Tunnelling and Underground Space Association (ITA). Reports and publications. Retrieved from <https://www.ita-aites.org>
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**CONSTRUCTION ENGINEERING OF HYDROPOWER AND IRRIGATION
PROJECTS
ENCECM614**

Credits: 4

Year: II

Part: I

Course Objectives

This course aims to provide a comprehensive understanding of the construction engineering aspects specific to hydropower and irrigation projects. It focuses on understanding the principles and practices related to planning, legal aspects, design, construction, monitoring and controlling of such projects. It also focuses on risk management and addresses the emerging trends.

- | | | |
|----------|---|-------------------|
| 1 | Introduction | [4 hours] |
| | 1.1 Overview of hydropower and irrigation projects | |
| | 1.2 Importance and benefits | |
| | 1.3 System terminologies of hydropower and irrigation projects | |
| 2 | Planning and Design Considerations | [10 hours] |
| | 2.1 Site selection criteria | |
| | 2.2 Environmental and social impact assessments | |
| | 2.3 Feasibility studies | |
| | 2.4 Design parameters and standards | |
| | 2.5 Integration of hydropower and irrigation projects | |
| | 2.6 Land acquisition and stakeholder involvement | |
| 3 | Construction Materials and Methods | [5 hours] |
| | 3.1 Types of construction materials, their properties, and selection criteria | |
| | 3.2 Construction procedure for coffer dams, dams, canal structures, and hydropower plants | |
| | 3.3 Equipment and machinery used and their calibration | |
| 4 | Construction Management and Techniques | [10 hours] |
| | 4.1 Project management principles | |
| | 4.2 Cost estimation and budgeting | |
| | 4.3 Quality control and quality assurance | |
| | 4.4 Safety management in construction | |
| | 4.5 Contract modalities and dispute resolution | |
| | 4.6 Role and responsibility of stakeholders | |

5 Hydrological and Hydraulic Considerations [9 hours]

- 5.1 Hydrological review of hydropower and irrigation projects
- 5.2 Hydraulic design review of canals, spillways, and penstocks
- 5.3 Water hammer effects and mitigation: Surge tank construction
- 5.4 Sediment management and control
- 5.5 Surface and groundwater conjunctive use

6 Structural Design Review and Analysis [6 hours]

- 6.1 Structural components of dams and hydropower plants
- 6.2 Design review of reinforced concrete structures
- 6.3 Stability analysis and foundation design review
- 6.4 Seismic design considerations

7 Risk Management, Sustainability and Maintenance [10 hours]

- 7.1 Probable risks and their management
- 7.2 Life cycle cost assessment
- 7.3 Corporate social responsibilities
- 7.4 Environmental mitigation measures
- 7.5 Sustainable development practices
- 7.6 Asset management and sustainable maintenance

8 Innovative Construction Techniques and Trends [6 hours]

- 8.1 Emerging trends related to hydropower and irrigation project
- 8.2 Difficulties in the construction field and tackling methods
- 8.3 Multipurpose projects

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	4	4
2	10	10
3	5	5
4	10	10
5	9	9
6	6	6
7	10	10
8	6	6
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Hydrology and Hydraulic Systems: Fourth Edition. (2016). Waveland Press.
2. Design of Small Dams. (1973). United States: U.S. Government Printing Office.
3. Sears, S. K., Sears, G. A., Clough, R. H., Rounds, J. L., Segner, R. O. (2015). Construction Project Management. United Kingdom: Wiley.
4. Williams, T., Williams, T. P. (2010). Construction Management: Emerging Trends and Technologies. United States: Delmar.
5. Garg, S.K. (2013). Irrigation Engineering and Hydraulic Structures. India: Khanna.
6. Selected journals and online platforms

CONSTRUCTION ENGINEERING OF TRANSPORTATION PROJECTS

ENCECM615

Credits: 4**Year: II****Part: I**

Course Objectives

This course provides knowledge of the engineering, construction, and maintenance of highways, railways, and airports. It covers pavement design, construction methods, and maintenance techniques using advanced equipment and materials. Students will explore modern innovations like signaling systems and urban transit solutions. The course emphasizes sustainable practices and adherence to international standards.

1 Construction of Roads [15 hours]

- 1.1 Road construction technology
- 1.2 Equipment for the construction of earthwork, pavement works, road facility works, mass haul diagram and exercise
- 1.3 Types of bitumen and aggregates used in the construction of different types of pavements
- 1.4 Construction of different types of low-cost roads
- 1.5 Construction of different types of bituminous layers practices in Nepal
- 1.6 Construction of cement concrete pavement and joint types

2 Road Maintenance [10 hours]

- 2.1 Road failures and its causes
- 2.2 Condition survey of highway pavements
- 2.3 Types of maintenance
- 2.4 Types of overlays for pavement strengthening
- 2.5 Deflection approach of pavement strengthening and remaining life (Benkelman beam, falling weight/light weight deflection)
- 2.6 Installation and maintenance of road marking, sign and signals

3 Railways [20 hours]

- 3.1 Definition of rail gauge, rail gauges in different parts of world, loading and construction gauge; Permanent way and its components, types of rails, rail metallurgy; Welding of rails and welding methods; Rails wear and methods to reduce it; Renewal of rails, coning of rail wheels; Failure of rails, rail fastenings and joints, rail track and correction; Sleeper and sleeper density; Ballast and requirement of material for ideal ballast, screening of ballast
- 3.2 Stations and yards: Definition, site selection, features, types of stations, definition of yards and its type, station section and block section, depot and workshops
- 3.3 Points and crossing, types of crossing, its technical terms and components, switches and its type

- 3.4 Maintenance of railway tracks, bridges, rolling stock, level crossing, gauge checking, clips rail tracks, track imprest
- 3.5 Signaling and interlocking, classification of signals, signaling systems, mechanical and electrical signaling system, interlocking, system for controlling train movement, modern signaling installations
- 3.6 Urban transit systems: Tramways, surface rail, monorail, underground/elevated construction and maintenance of elevated metro, underground metro and its components

4 Airports [10 hours]

- 4.1 Aircraft characteristics, airport planning, locations and types, site selection, size and capacity, airport layout components, and International Civil Aviation Organization (ICAO) standards
- 4.2 Planning, appraisal, legislation and documentation of airport projects
- 4.3 Airport pavement, construction procedure, management, monitoring and evaluation
- 4.4 Construction and maintenance of apron, terminal, runway, taxiway, hanger
- 4.5 Air traffic control, visual aid, marking sign and signage

5 Risk, Challenges, and Mitigation Measures in Transport Projects [5 hours]

- 5.1 Mapping and facing the landscape of risks
- 5.2 Economic and demand risks
- 5.3 Socio-environmental and cultural risks
- 5.4 Legal and contractual issues

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	15	15
2	10	10
3	20	20
4	10	10
5	5	5
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Satish, C. and Agrawal, M.M. (2013). Railway Engineering (2nd Edition). Oxford University Press.
2. Rangwala and Rangawala (2012). Principles of Railway Engineering (23rd Edition).
3. Mundrey, J.S. (2010). Railway Track Engineering (4th Edition). Mc Graw Hill India publication.
4. Ponnuswamy, S. (2012). Railway Transportation: Engineering, Operation and Management. United Kingdom: Alpha Science International.
5. ICAO Annex 14 Vol 1 (2018). Aerodrome design. 8th edition

SUSTAINABLE GREEN CONSTRUCTION

ENCECM621

Credits: 4**Year: II****Part: I**

Course Objectives

The objective of this course is to equip students with a deep understanding of sustainable construction practices and their application in the built environment. Students will gain expertise in sustainable material selection, advanced construction technologies, green certifications, energy optimization, and innovative approaches to reduce the carbon footprint of construction activities.

1 Sustainability in the Built Environment [8 hours]

- 1.1 Sustainability in construction: Definition, scope, importance, principle, and practices
- 1.2 Triple bottom line: Environmental, economic, and social dimensions
- 1.3 Urbanization and sustainable development: Growth curves and impacts on the built environment
- 1.4 Challenges of rapid urbanization
- 1.5 Global and local efforts in sustainable development

2 Ethics in Sustainability, Stakeholder Engagement and Policy Frameworks [6 hours]

- 2.1 Resource consumption by the construction industry
- 2.2 Environmental and social justice
- 2.3 Collaboration and communication in sustainable projects
- 2.4 Paris agreement and United Nations sustainable development goals (UN SDGs)

3 Sustainable Materials, Green Technologies and Deconstruction [8 hours]

- 3.1 Sustainable construction materials: Green concrete, recycled aggregates, bamboo, and timber
- 3.2 Embodied energy and lifecycle assessment (LCA)
- 3.3 Green Building technologies: Renewable energy systems (solar, wind); Energy-efficient systems; Heating, ventilation and air conditioning (HVAC) systems; Building envelopes
- 3.4 Design for deconstruction: Strategies for material reuse and recycle; Assessing environmental impacts of materials

4 Green Building Design and Certifications [12 hours]

- 4.1 Green building standards and assessments: Leadership in energy and environmental design (LEED); Building research establishment environmental assessment method (BREEAM); WELL certification, and green rating for integrated habitat assessment (GRIHA) certification processes

- 4.2 Eco-labeling and assessment structures
- 4.3 Green building design process: Steps, documentation requirements, and integrated design components
- 4.4 Indoor environmental quality and emissions from building materials
- 4.5 Site sustainability and landscape management: Sustainable site planning, storm water management, and heat island mitigation

5 Resource Management and Energy Optimization [10 hours]

- 5.1 Building energy design strategies
- 5.2 Internal load reduction and renewable energy integration
- 5.3 Strategies for water conservation and recycling
- 5.4 Wastewater and storm water handling systems
- 5.5 Carbon accounting in construction projects
- 5.6 Strategies to reduce operational and embodied carbon

6 Sustainable Procurement, Project Delivery and Green Building Economics [6 hours]

- 6.1 Sustainable procurement principles: Lifecycle costing and value-based procurement
- 6.2 Ethical sourcing and supply chain management
- 6.3 Sustainable project delivery models: Integrated project delivery (IPD) and public-private partnerships (PPPs)
- 6.4 Green building economics: Quantifying economic benefits of sustainable construction and cost-benefit analysis of green projects

7 Environmental Assessment [4 hours]

- 7.1 Initial environmental examinations (IEE)
- 7.2 Environmental impact assessment (EIA)
- 7.3 Provision of environment protection act (EPA) and environment protection rules (EPR)
- 7.4 Strategies for mitigating environmental impacts in construction

8 Emerging Trends in Sustainable Construction [6 hours]

- 8.1 Smart grids and transportation networks
- 8.2 Advanced prefabrication and modular construction
- 8.3 Digital technologies in sustainability, use of artificial intelligence (AI), internet of things and building information modeling (BIM) for sustainable planning and monitoring
- 8.4 Innovations in materials and construction techniques: Bio-based materials, self-healing materials, circular construction practices

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	8	8
2	6	6
3	8	8
4	12	12
5	10	10
6	6	6
7	4	4
8	6	6
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Kibert, C.J., (2013). Sustainable Construction: Green Building Design and Delivery, John Wiley and Sons
2. Steven V. Szokolay, (2007). Introduction to Architectural Science – The Basis of Sustainable Design, Elsevier
3. Sandy Halliday, Routledge, Taylor and Francis Group, (2013). Sustainable Construction
4. Dejan Mumovic and Mat Santamouris, (2009). A Handbook of Sustainable Building Design and Engineering, Earthscan Publishing
5. Osman Attmann, (2010). Green Architecture: Advanced Technologies and Materials, McGraw Hill
6. Kibert, C. J. (2016). Sustainable Construction: Green Building Design and Delivery. John Wiley and Sons
7. McLennan, J. F. (2004). The Philosophy of Sustainable Design. Ecotone Publishing
8. Leadership in Energy and Environmental Design (LEED) Reference Guides
9. Jonathan F. P. Rose. The Well-Tempered City

INFRASTRUCTURE ASSET MANAGEMENT

ENCECM622

Credits: 4**Year: II****Part: I**

Course Objectives

The course provides an overview of managing infrastructure assets through life cycle approaches, legal provisions, and international best practices. It covers planning, delivery, and operation and management stages. It also highlights enabling factors like policies, funding, and stakeholder engagement. The course also introduces integrated systems and focuses on creating sustainable roadmaps for asset management.

- 1 Introduction** **[12 hours]**
 - 1.1 Common understanding of infrastructure asset management
 - 1.2 Legal provision of asset management in the context of Nepal: Financial procedures and fiscal accountability act, local governance operation act, constitution of Nepal
 - 1.3 International best practices
 - 1.4 Life cycle approach: Planning phase, delivery phase, operation and management, and end of service life

- 2 Infrastructure Planning Stages** **[10 hours]**
 - 2.1 Strategic planning
 - 2.2 Spatial planning
 - 2.3 Infrastructure planning
 - 2.4 Project preparation

- 3 Infrastructure Delivery Stages** **[10 hours]**
 - 3.1 Project mobilization and delivery
 - 3.2 Procurement (Design and construction)
 - 3.3 Design stage
 - 3.4 Construction stage

- 4 Infrastructure Management Stages** **[6 hours]**
 - 4.1 Operation and maintenance
 - 4.2 Monitoring and evaluation of infrastructure
 - 4.3 End of service life

- 5 Factors Promoting Infrastructure Asset Management Environment** **[14 hours]**
 - 5.1 Policies, laws, and regulations

- 5.2 Institutional arrangements
- 5.3 Processes
- 5.4 Funding and financial management
- 5.5 Knowledge, technical capacities, and resources
- 5.6 Data management
- 5.7 Stakeholder engagement
- 5.8 Monitoring and reporting

6 Integrated Asset Management System

[8 hours]

- 6.1 Public asset management system (PAMS)
- 6.2 Sector wise asset management
- 6.3 Infrastructure asset management road map

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	12	12
2	10	10
3	10	10
4	6	6
5	14	14
6	8	8
Total	60	60

*There may be minor deviation in marks distribution.

References

1. ISO - Asset Management - Management Systems - Guidelines for the application of ISO 55001, ISO 55002: 2014(E), 2014
2. PMBOK Guide (2021), A Guide to Project Management Body of Knowledge (7th ed.), PMI
3. Robert Davis, An Introduction to Asset Management, The Institute of Asset Management
4. Frank J. Fabozzi, Asset Management, Tools and Issues

5. Ignazio Basile, Pierpaolo Ferrari. (2024). Asset Management and Institutional Investors, (Eds) Springer
6. Waheed Uddin, W.Ronald Hudson, Ralph Haas (2013), Public Infrastructure Asset Management, McGraw-Hill Education
7. A Toolkit (2016), Public Asset Management Companies, The World Bank
8. Yaotai Lu (2012), Public Asset Management, Lambert Academic Publishing
9. Managing Infrastructure Assets for Sustainable Development. A Handbook for Local and National Governments.

POST-DISASTER CONSTRUCTION MANAGEMENT

ENCECM623

Credits: 4**Year: II****Part: I**

Course Objectives

This course equips students with the skills to manage post-disaster construction projects using sustainable and resilient approaches. It covers damage assessment, reconstruction planning, resource management, and advanced decision-making tools. Students learn to coordinate with stakeholders like governments, NGOs, and communities for effective collaboration.

1 Introduction [10 hours]

- 1.1 Overview of the types of disasters and their impacts on infrastructure and communities
- 1.2 The role of construction management in post-disaster recovery
- 1.3 Key challenges and opportunities in the reconstruction phase
- 1.4 Disaster recovery framework and principles

2 Damage Assessment and Post-Disaster Planning [10 hours]

- 2.1 Techniques for damage assessment in infrastructure
- 2.2 Rapid needs assessment and recovery planning
- 2.3 Establishing priorities for reconstruction based on available resources
- 2.4 Setting realistic timelines and goals for recovery

3 Stakeholder Engagement and Coordination [10 hours]

- 3.1 Stakeholders in post-disaster reconstruction (GOs, NGOs, community, private sector)
- 3.2 The role of community participation in reconstruction efforts
- 3.3 Effective coordination and communication among stakeholders
- 3.4 Addressing challenges in collaboration and resource allocation
- 3.5 Owner and donor-driven reconstruction approach and supervision

4 Sustainable and Resilient Construction Practices [10 hours]

- 4.1 Principles of sustainable construction in post-disaster settings
- 4.2 Incorporating resilience into building designs and materials
- 4.3 Best practices for constructing disaster-resistant infrastructure
- 4.4 Use of local resources and technologies to enhance resilience

5 Financial, Legal, and Ethical Considerations [10 hours]

- 5.1 Overview of financial planning and funding sources for post-disaster reconstruction
- 5.2 Budgeting, cost estimation, and financial management in reconstruction projects

- 5.3 Legal frameworks for reconstruction and compliance with building codes
- 5.4 GON procedure overview: National Disaster Risk Reduction and Management Authority
- 5.5 Ethical considerations, including equity, transparency, and community involvement

6 Project Management Tools and Techniques for Post-Disaster Reconstruction [10 hours]

- 6.1 Gantt charts, program evaluation and evaluation technique (PERT)/critical path method (CPM), and resource leveling for post-disaster reconstruction
- 6.2 Risk management in post-disaster construction projects
- 6.3 Decision-making techniques and prioritization of reconstruction activities
- 6.4 Geographic information system (GIS); Building information modelling (BIM), and Remote sensing (RS) in post-disaster project management

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	10	10
2	10	10
3	10	10
4	10	10
5	10	10
6	10	10
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Coppola, D. P. (2021). Introduction to international disaster management (4th ed.). Butterworth-Heinemann.
2. Smith, G. P., Wenger, D. (2007). Disaster recovery: Principles and practices. University of Colorado, Institute of Behavioral Science.
3. Shaw, R. (Ed.). (2014). Community-based disaster risk reduction. Emerald Group Publishing
4. Boshier, L. (2008). Hazards and the built environment: Attaining built-in resilience. Routledge
5. Kerzner, H. (2017). Project management: A systems approach to planning, scheduling, and controlling (12th ed.). Wiley.

SUSTAINABLE PROJECT OPERATION AND MAINTENANCE
ENCECM624

Credits: 4

Year: II

Part: I

Course Objectives

This course aims to provide students with a comprehensive understanding of sustainable maintenance principles, strategies, and challenges in construction projects. It covers topics such as preventive, predictive and corrective maintenance, sustainability assessment, stakeholder engagement, technology and innovation, financial considerations, and real-world case studies. Students will be equipped with the knowledge and skills to develop effective maintenance plans and its implementation that enhance sustainability and durability.

- | | | |
|----------|---|------------------|
| 1 | Introduction | [5 hours] |
| | <ul style="list-style-type: none"> 1.1 Definition and importance 1.2 Key principles and concepts 1.3 Sustainable development goals (SDGs) and maintenance aspect 1.4 Relationship between sustainable construction and maintenance 1.5 Life cycle and asset management perspectives | |
| 2 | Types of Maintenance | [5 hours] |
| | <ul style="list-style-type: none"> 2.1 Preventive maintenance 2.2 Predictive maintenance 2.3 Condition-based maintenance 2.4 Reliability-centered maintenance (RCM) 2.5 Total productive maintenance (TPM) 2.6 Green maintenance | |
| 3 | Sustainability Assessment and Performance Measurement | [8 hours] |
| | <ul style="list-style-type: none"> 3.1 Sustainability assessment frameworks 3.2 Key performance indicators (KPIs) 3.3 Life cycle assessment (LCA) for maintenance activities 3.4 Benchmarking in sustainable maintenance performance 3.5 Embodied carbon 3.6 Circular economy | |
| 4 | Sustainable Maintenance Planning and Execution | [7 hours] |
| | <ul style="list-style-type: none"> 4.1 Preparation of maintenance plans and schedules 4.2 Risk assessment and management in maintenance | |

- 4.3 Green procurement and supply chain practices
- 4.4 Efficient procurement system for sustainable maintenance
- 4.5 Performance-based maintenance contract (PBMC)

- 5 Stakeholder Engagement and Collaboration [5 hours]**
 - 5.1 Roles and responsibilities of stakeholders
 - 5.2 Collaboration and communication among stakeholders
 - 5.3 Building operation and maintenance partnerships and alliances

- 6 Financial Considerations in Sustainable Maintenance [8 hours]**
 - 6.1 Cost analysis and optimization in maintenance activities
 - 6.2 Life cycle costing (LCC) for sustainable maintenance
 - 6.3 Return on investment (ROI) and payback period analysis
 - 6.4 Funding mechanisms and incentives for sustainable maintenance
 - 6.5 Public private partnership (PPP) for maintenance project

- 7 Retrofitting Techniques [8 hours]**
 - 7.1 Concept of retrofitting
 - 7.2 Parameters of retrofitting
 - 7.3 Retrofitting process
 - 7.4 Cost analysis for retrofitting
 - 7.5 Retrofitting techniques for different structures: Reinforced concrete and masonry structures
 - 7.6 Retrofitting in historical monuments
 - 7.7 Damage analysis after earthquake

- 8 Post-Disaster Construction Management, Legislation and Challenges [6 hours]**
 - 8.1 Introduction
 - 8.2 Build back better approach
 - 8.3 Special considerations in legislation and technology
 - 8.4 Challenges and opportunities in implementing sustainable maintenance

- 9 Technology and Innovation in Sustainable Maintenance [8 hours]**
 - 9.1 Digitalization and data-driven maintenance
 - 9.2 Building information modeling (BIM) in maintenance
 - 9.3 Internet of things (IoT) and sensor technologies
 - 9.4 Augmented reality (AR) and virtual reality (VR) applications
 - 9.5 Automation and robotics in maintenance processes)

Evaluation Schemes

a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

b. Final Exam

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

Chapter	Hours	Marks distribution*
1	5	5
2	5	5
3	8	8
4	7	7
5	5	5
6	8	8
7	8	8
8	6	6
9	8	8
Total	60	60

*There may be minor deviation in marks distribution.

References

1. Kibert, C. J. (2016). Sustainable construction: green building design and delivery. John Wiley and Sons.
2. Tucker, L. M. (2014). Sustainable building systems and construction for designers. Bloomsbury Publishing
3. Jensen, P. A., Van der Voordt, T. (2016). Facilities management and corporate real estate management as value drivers: How to manage and measure adding value. Taylor and Francis