Purbanchal University

Faculty of Engineering, Biratnagar, NEPAL

Sixth Semester's Course Structure

Program: Bachelor in Civil Engineering

Effective from 2021 (2078) Batch

Year-III **Semester-VI**

S.N.	Course code	Subject	Credit Hours	L	T	P	Total	Internal		Final		Total
								Th.	P	Th.	P	
1	BCI 6024	**Foundation Engineering**	3	3	3	-	6	40		60	-	100
2	BCI 6025	**Irrigation Engineering**	3	3	3	-	6	40		60	-	100
3	BCI 6026	**Sanitary Engineering**	3	3	2	2/2*	6	40	25	60	-	125
4	BCI 6027	**Transportation Engineering-II**	3	3	2	2/2*	6	40	25	60	-	125
5	BCE 6013	**Numerical Methods**	3	3	2	2	7	40	25	60	-	125
6	BSH 6001	**Engineering Economics**	3	3	2	-	5	40		60	-	100
7		**Total**	**18**	**18**	**14**	**5**	**36**					**675**

Note- **L:** Lecture **T:** Tutorial **P:** Practical **Th. :** Theory

Foundation Engineering

BCI 6024

Year: III **Semester: VI**

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

Course objective:

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

Course Contents:

1.0 Introduction (1 hrs)

1.1 Foundation Engineering, Importance and Purpose.
1.2 Soil/foundation interaction
1.3 Function of foundation and its types
1.4 Factors influencing the choice of a foundation

2.0 Site Investigation (5 hrs)

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

3.0 Earth pressure and Retaining Structures (9 hrs)

3.1 Definition and Types of earth pressure
3.2 Steady state equilibrium and earth pressure at elastic and plastic equilibrium
3.3 Active and passive conditions
3.4 Modified failure envelope of line
3.5 Rankine state of plastic equilibrium
3.6 Strains associated with Rankine's states
3.7 Local state of plastic equilibrium, deformation and boundary conditions
3.8 Rankine's earth pressure theory
3.9 Active earth pressure on cohesion less backfill
3.10 Active and passive earth pressure on backfill
3.11 Active thrust by trial wedges and limitations of the method
3.12 Influence of wall friction

3.13 Coulomb's earth pressure theory and its graphical solution
3.14 Limitations of Coulomb's wedge theory
3.15 Selection of soil parameters for earth pressure computations
3.16 Stability analysis of an earth retaining structure

4.0 Arching in Soils and Braced Cuts (3hrs)

4.1 Arching in Soils and practical application
4.2 Braced Excavation
4.3 Earth pressure against Bracings in Cuts
4.4 Strut Loads

5.0 Bearing capacity and Settlement of Shallow Foundations (7 hrs)

5.1 Types of failures
5.2 Types of bearing capacity, and influencing factors
5.3 Pauker, Rankine, Bells theories, Prandlt's theory
5.4 Modes of foundation failure
5.5 Terzaghi's general bearing capacity theory
5.6 Effects of water table on bearing capacity
5.7 Extension of Terzaghi's theory (Meyerhof, Hanson and Vesic Theory)
5.8 Introduction to recent bearing capacity theories
5.9 Ultimate bearing capacity of cohesion less and cohesive soils
5.10 Types of settlement and their relationship
5.11 Calculation of bearing capacity based on settlement
5.12 Limitations of the methods for predicting settlement
5.13 Bearing capacity from In-situ tests (Plate Load Test)
5.14 Allowable settlement and Allowable bearing Pressure
5.15 Steps involved in the Proportioning of Footings for uniform settlement
5.16 Ultimate bearing capacity on layered soil
  5.16.1 Foundation on layered sand (dense sand over loose sand)
  5.16.2 Foundation on dense sand overlying soft clay

6.0 Mat Foundations (3 hrs)

6.1 Types of mat foundation and their uses
6.2 Bearing capacity and settlement of mat foundation
6.3 Design of mat foundation in sand and clay
6.4 Compensated Foundation
6.5 Analysis of Mat Foundation
6.6 Construction of mat foundations

7.0 Pile Foundation (6 hrs)

7.1 Classification of piles, advantages and disadvantages
7.2 Factors affecting Pile selection
7.3 Soil-pile interaction
7.4 Load Carrying capacity of piles in clay and sand

7.5 Pile driving formulae
7.6 Group action of pile
7.7 Bearing capacity and settlement of pile group
7.8 Negative skin friction
7.9 Piles resisting uplift
7.10 Piles resistance under the action of inclined loading
7.11 Pile load test
7.12 Construction of pile foundation
7.13 Damage, alignment and effect of pile driving

8.0 Pier Foundations (2 hrs)

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

9.0 Well or caisson Foundation (2 hrs)

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

10.0 Sheet piles and coffers Dams (5 hrs)

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

11.0 Geo-technical processes (2 hrs)

11.1 Ground water in excavation and methods of its control
11.2 Foundation Soil stabilization (mechanical compaction, dynamic compaction, preloading, sand compaction piles and stone column, soil stabilization by use of admixtures, soil stabilization by use of grouts
11.3 Underpinning
11.4 Machine Foundation

Field Visit:

One day local site visit based on site investigation project and each student to prepare a brief report on the basis of prescribed data-format.

References:

1. "Soil Mechanics and Foundation Engineering", K.R. Arora, CBS Publishers and Distributors, New Delhi, 1988.
2. "A Text Book of Soil Mechanics and Foundation Engineering in SI Units", V.N.S. Murthy, UBS Publishers Distributors Ltd.
3. "A Text Book of Foundation Engineering", Dr.R.K.Poudel and R.Neupane.
4. "Soil Mechanics in Engineering practice", Terzaghi, K and Peck, R.B. John Wiley, 2nd Edition, New York, 1967.
5. "Foundation Engineering" B.M. Das.
6. "Foundation Analysis and Design" Joseph E.Bowels, McGraw-hill International Editions.
7. "Principles of Foundation Engineering", Braja M.Das, Thomson/Brookscole.
8. "Basic and Applier Soil Mechanics", G.Ranjan & ASR Rao. New Age International Publishers.

**Latest edition will be preferable.*

Evaluation Scheme: Marks Division

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

Detailed Course Contents:

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
1	**Introduction**	1.1	Foundation Engineering, Importance and Purpose	✔	✔							**1**	
		1.2	Soil/foundation interaction		✔								
		1.3	Function of foundation and its types		✔								
		1.4	Factors influencing the choice of a foundation		✔								
2	**Site Investigation**	2.1	Objectives, stages and methods of site investigation	✔	✔							**5**	
		2.2	Sampling of soils, samplers, sample area		✔				✔		✔		
		2.3	Field measurement of consistency and relative density		✔								
		2.4	Plate loads test, Penetration Test (SPT,DCPT, SCPT), In-situ permeability test	✔	✔								
		2.5	Ground water observation		✔								
		2.6	Bore Hole logs		✔				✔				
		2.7	Preservation, transportation and storage of samples		✔								
		2.8	Laboratory tests on soils		✔				✔				
		2.9	Preparation of site investigation reports		✔								

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
3	**Earth pressure and Retaining Structures**	3.1	Definition and Types of earth pressure	✔	✔							**9**	
		3.2	Steady state equilibrium and earth pressure at elastic and plastic equilibrium	✔	✔								
		3.3	Active and passive conditions		✔								
		3.4	Modified failure envelope of line		✔								
		3.5	Rankine state of plastic equilibrium		✔								
		3.6	Strains associated with Rankine's states		✔								
		3.7	Local state of plastic equilibrium, deformation and boundary conditions		✔								
		3.8	Rankine's earth pressure theory		✔	✔					✔		
		3.9	Active earth pressure on cohesion less backfill		✔	✔					✔		
		3.10	Active and passive earth pressure on backfill		✔	✔					✔		
		3.11	Active thrust by trial wedges and limitations of the method		✔	✔					✔		
		3.12	Influence of wall friction		✔	✔					✔		

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
		3.13	Coulomb's earth pressure theory and its graphical solution		✔	✔					✔		
		3.14	Limitations of Coulomb's wedge theory		✔						✔		
		3.15	Selection of soil parameters for earth pressure computations		✔						✔		
		3.16	Stability analysis of an earth retaining structure	✔	✔	✔			✔		✔		
4	**Arching in Soils and Braced Cuts**	4.1	Arching in Soils and practical application	✔	✔				✔			**3**	
		4.2	Braced Excavation		✔								
		4.3	Earth pressure against Bracings in Cuts	✔	✔								
		4.4	Strut Loads		✔								
5	**Bearing capacity and Settlement of Shallow**	5.1	Types of failures	✔	✔							**7**	
		5.2	Types of bearing capacity, and influencing factors		✔								
		5.3	Pauker, Rankine, Bells theories, Pandlt's theory		✔	✔							
		5.4	Modes of foundation failure		✔								

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
	Foundations	5.5	Terzaghi's general bearing capacity theory		✔	✔					✔		
		5.6	Effects of water table on bearing capacity		✔						✔		
		5.7	Extension of Terzaghi's theory (Meyerhof, Hanson and Vesic Theory)		✔						✔		
		5.8	Introduction to recent bearing capacity theories		✔						✔		
		5.9	Ultimate bearing capacity of cohesion less and cohesive soils		✔	✔					✔		
		5.10	Types of settlement and their relationship		✔						✔		
		5.11	Calculation of bearing capacity based on settlement		✔	✔					✔		
		5.12	Limitations of the methods for predicting settlement		✔								
		5.13	Bearing capacity from In-situ tests (Pile Load Test)		✔				✔				
		5.14	Allowable settlement and Allowable bearing Pressure		✔				✔				
		5.15	Steps involved in the Proportioning of Footings for uniform settlement		✔								
		5.16	Ultimate bearing capacity on layered soil 5.16.1 Foundation on layered sand (dense sand over loose sand)		✔	✔							

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
			5.16.2 Foundation on dense sand overlying soft clay										
6	**Mat Foundations**	6.1	Types of mat foundation and their uses	✔	✔				✔			**3**	
		6.2	Bearing capacity and settlement of mat foundation		✔						✔		
		6.3	Design of mat foundation in sand and clay		✔								
		6.4	Compensated Foundation		✔						✔		
		6.5	Analysis of Mat Foundation		✔						✔		
		6.6	Construction of mat foundations		✔								
7	**Pile Foundation**	7.1	Classification of piles, advantages and disadvantages	✔	✔				✔			**6**	
		7.2	Factors affecting Pile selection		✔								
		7.3	Soil-pile interaction		✔								
		7.4	Lod Carrying capacity of piles in clay and sand		✔	✔					✔		
		7.5	Pile driving formulae		✔						✔		
		7.6	Group action of pile		✔	✔					✔		
		7.7	Bearing capacity and settlement of pile group		✔	✔					✔		
		7.8	Negative skin friction		✔	✔					✔		

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
		7.9	Piles resisting uplift		✔								
		7.10	Piles resistance under the action of inclined loading		✔								
		7.11	Pile load test		✔				✔				
		7.12	Construction of pile foundation		✔								
		7.13	Damage, alignment and effect of pile driving		✔								
8	**Pier Foundations**	8.1	Function of piers and their types	✔	✔					✔		**2**	
		8.2	Bearing capacity and settlement of piers		✔	✔							
		8.3	Skin friction on pier shafts		✔	✔							
		8.4	Design of piers in sand and clay		✔	✔							
		8.5	Construction of pier foundations		✔								
9	**Well or caisson**	9.1	Use of caisson foundation and their types	✔	✔					✔		**2**	

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
	Foundation	9.2	Bearing capacity of caissons in sand and clay		✔								
		9.3	Design of caissons		✔								
		9.4	Sinking of caissons		✔								
10	**Sheet piles and coffers Dams**	10.1	Common types of sheet piles and their uses	✔	✔							**5**	
		10.2	Classification of sheet piled walls		✔					✔			
		10.3	Design of Cantilever and Anchored sheet piled walls		✔	✔					✔		
		10.4	Construction of sheet piled walls		✔								
		10.5	Common types of coffer dams and their uses	✔	✔				✔				
		10.6	Design of braced coffer dams		✔								
		10.7	Construction of braced coffer dams		✔								
11	**Geo-technical processes**	11.1	Ground water in excavation and methods of its control	✔	✔							**2**	
		11.2	Foundation Soil stabilization (mechanical compaction, dynamic compaction, preloading, sand compaction piles and stone column, soil stabilization	✔	✔				✔				

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
			by use of admixtures, soil stabilization by use of grouts										
		11.3	Underpinning	✔	✔				✔				
		11.4	Machine Foundation		✔								
Note: Define(SD), Description (D), Derive (D), Illustration (I), Explanation (E), Application (A), Experimentation (Ex), Numerical (N)													

Final Examination Scheme:		
Chapters	Marks	Remarks
1	2	Th
2		
3	4	Th.+N
4	12	Th+N
5	8	TH+N
6	4	Th+N
7	12	Th+N
8	2	Th
9	2	Th
10	12	Th+N
11	2	Th
Total	60	Th: Theory/N: Numerical
Note: There might be minor deviation in mark distribution. Mandatory: Evaluation should be based on solving approach and steps.		

Chapter wise marks division in final examination:

Chapter	No of Short Questions (2M)	No of Medium Questions (4M)	No of Long Question (8M)
1	1	1	
2	1	1	
3	1	1	
4	1	1	1
5	1	1	1
6	1	1	1
7	1	1	1
8	1	1	
9	1	1	
10	1	1	1
11	1	1	

Note: *Only 4 short questions and 7 medium questions will be asked from all chapters; 3 long questions will be asked from mentioned chapters in the table.*


पूर्वाञ्चल विश्वविद्यालय
1995
PURBANCHAL UNIVERSITY
GOTHGAUN, MORANG, NEPAL
Faculty of Engineering

PURBANCHAL UNIVERSITY
SEMESTER FINAL EXAMINATION – 2024 (MODEL QUESTION)

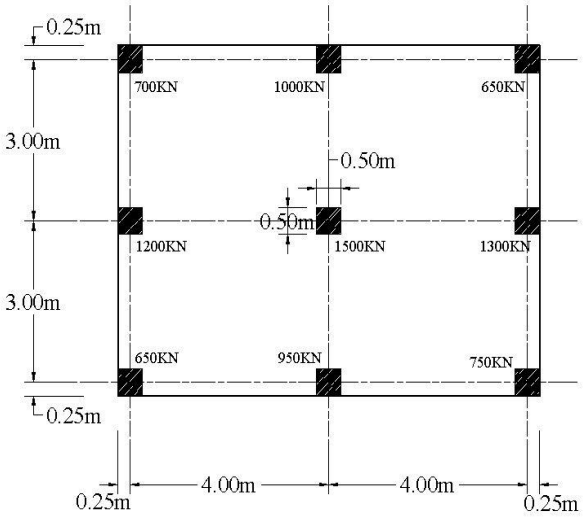
LEVEL: B. E. (Civil)
SUBJECT: Foundation Engg. FULL MARKS: 60
TIME: 03:00 hrs PASS MARKS: 24

Attempt all questions

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

1. What is Arching in Soils ? Explain types of foundation in short.
2. Describe briefly the components of well foundation
3. Write briefly about Soil stabilization.
4. Describe different types of Pier foundation.

(4*7=28)



5. W ıe method of
6. De Rankine ac
7. De for strip fo
8. A 4m x 6m foundation is placed at the depth of 2.4m below GL. The soil above and below the base of the foundation is clay having C = 10KPa, Φ = 40° and γ = 15KN/m3. The water is at base level of the foundation and the soil in this level has unit weight of 19KN/m3. For Φ = 40°, Nc = 95.7, Nq = 81.3 and Nγ = 100.4. Calculate the net allowable load the foundation can carry with factor of safety of 4

OR

Determine the net ultimate bearing capacity of the square footing 2m with a depth of 1.3m.

Take γ = 20 KN/m3, Ø = 30° and C=0. When

i. The water table rises to the base level of foundation.

ii. The water table rises to the ground surface and

iii. The water table is 1m below the base.

9. The plan of a Mat Foundation with 9 columns is shown in fig. Assuming that the mat is rigid, determine the soil pressure distribution of four corners of the Mat. All the columns are of the size 0.5m X 0.5m.

10. How do you classify the pile foundations on the basis of:
    i. materials
    ii. method of installation
    iii. load transfer?

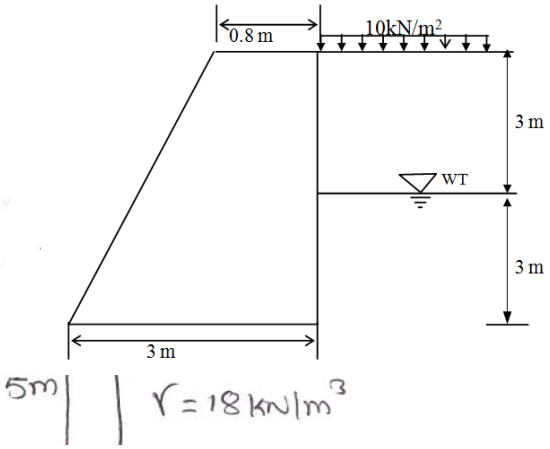
OR

Define negative skin friction with its effect on the piles

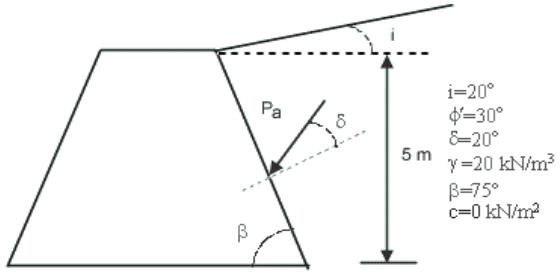
11. Explain about different types of Coffer Dam

Group C (8*3=24)

12. The proposed retaining wall shown in fig. below is to be constructed in masonry of unit weight 22kN/m3. Determine the minimum pressure under the base of the wall and also the FOS against sliding, overturning & bearing. The shear strength parameters for soil are C = 0, Ø = 32º. The unit weight of soil is 18kN/m3.The safe bearing capacity of soil is 250 kN/m2 and coefficient of base friction = 0.5



Check stability of masonry retaining wall against sliding, overturning & bearing. Safe bearing capacity of soil is 200kn/m2 & take friction angle = 20^0 between wall and soil. Ht. of wall = 5m, base width of wall = 3.5m, γ_{wall}= 23KN/m^3.



13. A square pile group of 16 piles penetrates through a filled up soil of 4m depth. The side of square pile is 250mm and pile spacing is 0.75m. The unit cohesion of the material is 18kN/m^2 and the unit weight of soil is 15kN/m^3. Compute the negative skin friction on the group. Take $\alpha = 0.40$

14. Determine the depth of embedment of the anchored sheet pile shown in fig.below. Also determine the force in the anchor per meter of the wall. Assume free earth-support condition.

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

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

IRRIGATION ENGINEERING

BCI6025

Year: III **Semester: VI**

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

Course Objective:

The objective of this course is to make the students aware about the layout and planning of irrigation projects, and equip them with knowledge to design major components of canal irrigation system with a diversion headwork.

Course Content:

1. **Introduction (3 hours)**
   - 1.1 Function, advantage and disadvantage of irrigation
   - 1.2 Status of irrigation development in Nepal
   - 1.3 Irrigation methods and their suitability: surface, sub-surface, sprinkler, and drip
   - 1.4 Principal crops in Nepal: Names, seasons, cropping pattern, cropping intensity
   - 1.5 Irrigation commanded areas: GCA, CCA, NCA

2. **Irrigation Water Requirements (6 hours)**
   - 2.1 Terminologies: Crop period, base period, kor period, kor depth, paleo irrigation, crop rotation, time factor, capacity factor
   - 2.2 Duty and delta: Definition; duty-delta relationship; factors affecting duty; delta of major crops; duty at various places.
   - 2.3 Crop water and irrigation water requirements: Consumptive use of water, factors affecting consumptive use; effective rainfall; irrigation water requirement; irrigation scheduling (irrigation frequency and depth)
   - 2.4 Soil-Moisture-Irrigation relationship
   - 2.5 Design discharge of canals: Irrigation efficiencies; estimation of design discharge of canals

3. **Canal Irrigation System (3 hours)**
   - 3.1 Classification of canals according to function, discharge, alignment, lining and soil
   - 3.2 Components: head works, major canal, branch canal, distributary and water courses
   - 3.3 Factors affecting canal alignments
   - 3.4 Canal losses: major and minor losses

4. **Design of Canals (7 hours)**

4.1 Canal sections: Cross section, longitudinal section, and balancing depth
4.2 Semi-theoretical approaches of canal design; design of stable canal in alluvium
4.3 Design of alluvial canals: Kennedy and Lacey's theory
4.4 Lined canals: Various types of lining, advantages and economics of lining
4.5 Design of lined canals: Manning's equation, Chezy's equation

5. Diversion Headworks (8 hours)

5.1 Headworks and their types: Storage, diversion
5.2 Function and components of diversion head works
5.3 Principle of design for surface flow: Location, waterway, shapes, crest level, length
5.4 Principle of design for sub-surface flow of structure: Bligh's, Lane's and Khosla's seepage theory
5.5 Design of silt excluder and ejector

6. Regulating Structures and Modules (5 hours)

6.1 Functions of regulating structures
6.2 Distributary heads regulator and cross regulator, their design
6.3 Escapes and their types
6.4 Falls, their types and design of vertical drop fall (crest, length and thickness of impervious floor)
6.5 Canal outlets and types, design of pipe outlet (free and submerged)

7. Cross Drainage Works (3 hours)

7.1 Functions of cross drainage works
7.2 Types of cross drainage structures
7.3 Design of aqueduct and siphon aqueduct

8. River Training Works (4 hours)

8.1 Stages of rivers and meandering of river
8.2 River training and its necessity
8.3 Methods of river training
8.4 Design of guide bund and launching apron
8.5 Design of spurs (layout geometry, length, spacing and cross-section)

9. Water Logging and Drainage (3 hours)

9.1 Water logging, Causes and effects of water logging
9.2 Preventive measures of water logging
9.3 Surface drainage, sub-surface drainage and their design
9.4 Reclamation of water-logged areas by different methods

10. Planning & Management of Irrigation System (3 hours)

10.1 Irrigation system planning process
10.2 Institutional aspects of irrigation system management: FMIS, AMIS and JMIS
10.3 Operation and maintenance of irrigation systems
10.4 Introduction to relevant policies and acts

Field Visit:

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

References*:

1. Arora, K.R. (2018). *Irrigation, Water Power and Water Resources Engineering*. 5th edition, Standard Publishers Distributors
2. Garg, S. K. (2019). *Irrigation Engineering and Hydraulic Structures*. 35th edition, Khanna Publishers
3. Punmia, B. C. & Basilal, P. B. (2021). *Irrigation and Water Power Engineering*. 17th edition, Laxmi Publications
4. GoN, *Water Resources Act, National Water Plan, Water Resources Strategy*

**Latest edition will be preferable.*

Evaluation Scheme: Marks Division

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

Detailed Course Contents:

Ch. No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
1	**Introduction**	1.1	Function, advantage and disadvantage of irrigation	✓	✓							3
		1.2	Status of irrigation development in Nepal		✓							
		1.3	Irrigation methods and their suitability: surface, sub-surface, sprinkler, and drip		✓							
		1.4	Principal crops in Nepal: Names, seasons, cropping pattern, cropping intensity		✓							
		1.5	Irrigation commanded areas: GCA, CCA, NCA	✓	✓		✓					
2	**Irrigation Water Requirements**	2.1	Terminologies: Crop period, base period, kor period, kor depth, paleo irrigation, crop ration, time factor, capacity factor	✓	✓							6
		2.2	Duty and delta: Definition; duty-delta relationship; factors affecting duty; delta of major crops; duty at various places.		✓	✓					✓	
		2.3	Crop water and irrigation water requirements: Consumptive use of water, factors affecting consumptive use; effective rainfall; irrigation water requirement; irrigation scheduling (irrigation frequency and depth)	✓	✓						✓	
		2.4	Soil-Moisture-Irrigation relationship		✓				✓			
		2.5	Design discharge of canals: Irrigation efficiencies; estimation of design discharge of canals	✓	✓						✓	

Ch. No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
3	Canal Irrigation System	3.1	Classification of canals according to function, discharge, alignment, lining and soil		✓		✓					3
		3.2	Components: head works, major canal, branch canal, distributary and water courses		✓		✓					
		3.3	Factors affecting canal alignments		✓							
		3.4	Canal losses: major and minor losses		✓							
4	Design of Canals	4.1	Canal sections: Cross section, longitudinal section, and balancing depth		✓		✓					7
		4.2	Semi-theoretical approaches of canal design; design of stable canal in alluvium		✓						✓	
		4.3	Design of alluvial canals: Kennedy and Lacey's theory	✓	✓	✓					✓	
		4.4	Lined canals: Various types of lining, advantages and economics of lining		✓	✓					✓	
		4.5	Design of lined canals: Manning's equation, Chezy's equation		✓						✓	
5	Diversion Headworks	5.1	Headworks and their types: Storage, diversion	✓	✓		✓					8

Ch. No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
		5.2	Function and components of diversion head works		✓			✓				
		5.3	Principle of design for surface flow: Location, waterway, shapes, crest level, length		✓		✓				✓	
		5.4	Principle of design for sub-surface flow of structure: Bligh's, Lane's and Khosla's seepage theory		✓		✓				✓	
		5.5	Design of silt excluder and ejector		✓		✓				✓	
6	**Regulating Structures and Modules**	6.1	Functions of regulating structures		✓							5
		6.2	Distributary heads regulator and cross regulator, their design	✓	✓		✓				✓	
		6.3	Escapes and their types	✓	✓		✓					
		6.4	Falls, their types and design of vertical drop fall (crest, length and thickness of impervious floor)	✓	✓		✓				✓	
		6.5	Canal outlets and types, design of pipe outlet (free and submerged)	✓	✓		✓				✓	
7	**Cross Drainage Works**	7.1	Functions of cross drainage works	✓	✓							3
		7.2	Types of cross drainage structures		✓							
		7.3	Design of aqueduct and siphon aqueduct		✓						✓	
8	**River Training Works**	8.1	Stages of rivers and meandering of river	✓	✓							4
		8.2	River training and its necessity	✓	✓		✓					
		8.3	Methods of river training		✓		✓					
		8.4	Design of guide bund and launching apron		✓		✓				✓	
		8.5	Design of spurs (layout geometry, length, spacing and cross-section)		✓		✓					

Ch. No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
9	Water Logging and Drainage	9.1	Water logging, Causes and effects of water logging	✓	✓							3
		9.2	Preventive measures of water logging		✓							
		9.3	Surface drainage, sub-surface drainage and their design	✓	✓						✓	
		9.4	Reclamation of water-logged areas by different methods		✓							
10	Planning and Management of Irrigation System	10.1	Irrigation system planning process		✓							3
		10.2	Institutional aspects of irrigation system management: FMIS, AMIS and JMIS		✓							
		10.3	Operation and maintenance of irrigation systems		✓							
		10.4	Introduction to relevant policies and acts		✓							

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

Chapter wise marks division in final examination:

Chapter	No of Short Questions (2M)	No of Medium Questions (4M)	No of Long Question (8M)
1	1		
2	1	1	
3	1		
4	1	1	
5	1	1	1
6		1	1
7		1	1
8	1	1	
9	1	1	
10	1	1	

Note: *Only 4 short questions and 7 medium questions will be asked from all chapters; 3 long questions will be asked from mentioned chapters in the table.*

PURBANCHAL UNIVERSITY
SEMESTER FINAL EXAMINATION – 2024 (MODEL QUESTION)

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

Attempt all questions

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

1. Define FMIS, AMIS and JMIS. What differentiates AMIS from JMIS?

2. Starting from Lacey's basic equation, derive the equation for wetted perimeter.

3. List of the major components of diversion headworks and write function of divide wall.

4. Why river training works are required?

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

5. Writing various methods of surface irrigation, discuss the suitability of drip and sprinkler irrigation.
6. After how many days should we supply water to soil in order to ensure sufficient irrigation of the given crop if:
   a. Field capacity of the soil = 28%
   b. Permanent wilting point = 13%
   c. Dry density of soil = 1.3 gm/cc
   d. Effective depth of root zone = 70 cm
   e. Daily consumptive use of water for the given crop = 12 mm
7. Explain different types of canal alignments with neat sketch and suitability.

8. Design the following components of guide bund for river discharge of 4000 cumec of flood height 5.0m and silt factor 1.1.
   a. Length of guide bund
   b. Thickness of pitching
   c. Width of launching apron (at shank only)
   d. Depth of launching apron (at shank only)

9. Design a canal using Lacey's Theory carrying a discharge of 20 cumecs, silt factor = 1.5 and side slope is 0.5:1 (H:V).

10. What is meant by water-logging? Write down the principal causes and effects of water-logging in a canal irrigated farm.

    OR

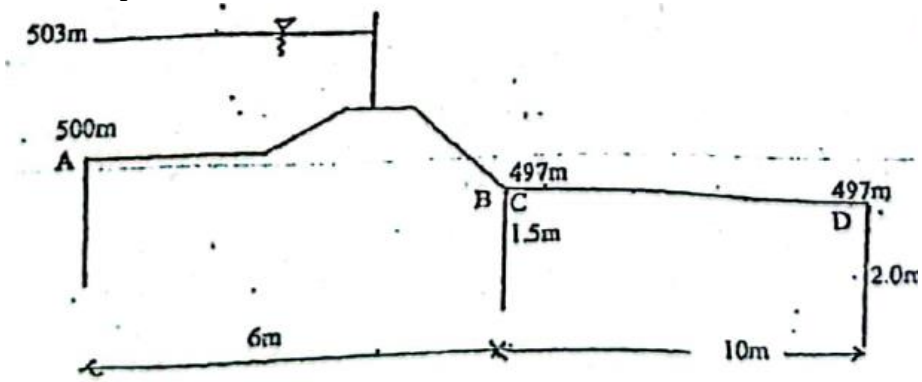
    A field channel has a culturable command area of 2000 hectares. The intensity of irrigation for gram is 30% and for wheat is 50%. Gram has a kor period of 18 days and kor depth of 12cm, while wheat has a kor period of 15 days and a kor depth of 15 cm. Calculate the discharge of the field channel.
11. Describe the steps of involved in planning of an irrigation project.

OR

Design a stable irrigation canal carrying a discharge of 50m3/s, which passes through alluvium (dmean = 0.50mm). Draw a sketch of the designed section.

Group C (8*3=24)

12. For the figure shown below ignoring floor thickness and slope corrections, find the percentage pressure at the key points of the piles using Khosla's theory. The floor thickness may not be less than 30 cm anywhere. If permissible exit gradient is 0.15, check the floor against piping failure. Also find the thickness of floor at A, B, C and D points.



13. Design crest, length and thickness of impervious floor of a vertical drop structure for the following data:

    Discharge = 5.2 m3/s
    Side slope of the channel = 1:1
    FSL U/S = 206.10 m
    Bed level U/S = 205.15 m
    Bed level D/S = 204.45 m
    Bed width U/S and D/S = 1.5m
    Cd = 0.415
    Sp. Gr. of masonry drop structure = 2.25
    Bligh's coefficient = 6.0

    Assume suitable data if necessary.

14. A canal carrying $30m^3/s$ of discharge with a bed width of 30m and bed level at dam stream is 310.0m is crossing the natural drainage having bed level 30.8.m and the high flood level of 311.0m which carries the 50 year return period flood as 550 cumecs. The full supply depth of canal is 2.1m and side slope is 1.5:1. Design appropriate cross drainage structure with determining the drainage waterway, canal waterway and bed and full supply level at four different section of the canal trough.

    OR

    Neatly sketch a guide bank and design the following components of guide bund for river discharge of 4000 cumec of flood height 5.0m and silt factor 1.1.

    (a) Length of guide bund
    (b) Thickness of pitching
    (c) Width of launching apron
    (d) Depth of launching apron

*****

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

SANITARY ENGINEERING

BCI6026

Year: III **Semester: VI**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	2/2	40	25	3	60	-	-	125

Course Objective:

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

Course Content:

1.0 Introduction (2 hrs)

- **1.1** Definition of common terms:
- **1.2** Importance of wastewater and solid waste management
- **1.3** Wastewater and solid waste management methods
- **1.4** Objectives of sewage disposal
- **1.5** Sanitation systems: conservancy system and water carriage system
- **1.6** Types of sewerage systems: combined, separate and partially separate systems

2.0 Quantity of waste water (4 hrs)

- **2.1** Dry weather flow and Wet weather flow
- 2.2 Sources of sanitary sewage
- 2.3 Factors affecting sanitary sewage
- 2.4 Determination of quantity of sanitary sewage
- 2.5 Methods of determination the quantity of storm water

3.0 Characteristics and Examination of Wastewater (5 hrs)

- **3.1** Wastewater sampling
- **3.2** Different characteristics of wastewater: physical, chemical and biological.
- **3.3** Decomposition of wastewater, aerobic and anaerobic decomposition
- **3.4** Biochemical oxygen demand (BOD) and chemical oxygen demand (COD)
- **3.5** Examination of volatile, fixed and total solids, settleable and non-settleable solids, BOD with and without dilution, COD

4.0 Design and Construction of Sewers (5 hrs)

- **4.1** Sewer design criteria: Design periods, Minimum and maximum velocity, Hydraulic formulae for calculation of velocity, Hydraulic elements of sewers for

partial flow condition, Partial flow diagrams

4.2 Shape of sewers

4.3 Sewer materials

4.4 Construction of sewer

4.5 Design of the sewer for separate and combined systems

5.0 Sewer Appurtenances (2 hrs)

- **5.1** Definition and necessity of Sewer
- **5.2** Manholes, drop-manholes and lamp-holes
- **5.3** Street inlets
- **5.4** Catch basins
- **5.5** Flushing devices
- **5.6** Sand, Grease and oil traps
- **5.7** Inverted siphons
- **5.8** Sewer outlets
- **5.9** Ventilating shaft

6.0 Disposal of Wastewater (6 hrs)

- **6.1** Necessity of wastewater disposal
- **6.2** Method of wastewater disposal
- **6.3** Disposal of wastewater by dilution: Process, essential conditions for dilution, Self-purification of streams, factors affecting self-purification, oxygen sag curve, Streeter-Phelps equation, Numerical exercises on self-purification of streams
- **6.4** Disposal of wastewater by land treatment: Suitability of land treatment, methods of land treatment- Broad irrigation, over land flow and rapid filtration
- **6.5** Sewage sickness and its preventive measures

7.0 Wastewater Treatment (14 hrs)

- **7.1** Objectives of wastewater treatment and different treatment methods: physical, chemical, biological
- **7.2** Wastewater treatment processes and typical layout of wastewater treatment plant
- **7.3** Preliminary/primary treatment processes: screening, skimming tanks, grit chamber, sedimentation, and chemical precipitation
- **7.4** Secondary treatment processes: Principle of biological treatment processes, principle of suspended and attached growth processes
- **7.5** Wastewater filtration: Intermittent sand filter, contact bed and tricking filters, and design of trickling and bio-filters
- **7.6** Activated sludge process: Principles and processes, aeration methods, advantages and disadvantages of the activated sludge process
- **7.7** Oxidation ponds: Theory, construction, operation and maintenance

8.0 Sludge Treatment and Disposal (5 hrs)

- **8.1** Sources of sludge and necessity of sludge treatment
- **8.2** Characteristics of sludge
- **8.3** Sludge volume-moisture relationship
- **8.4** Methods of sludge treatment: grinding and blending, thickening, stabilization (digestion), dewatering, drying, compositing and incineration
- **8.5** Methods of sludge disposal: spreading on land, dumping, lagooning, and land filling

9.0 Disposal of Sewage from Isolated Buildings (4 hrs)

9.1 Necessity, onsite sanitation system and offsite sanitation system- definition
9.2 Privies (purpose, construction and design criteria): Pit privy, ventilation improved pit latrine, and pour-flush latrine
9.3 Septic Tank: design, construction, working and maintenance
9.4 Disposal of septic tank effluent: drain field, soak pits, Leaching cesspool, Evapotranspiration mounds

10.0 Solid Waste Disposal **(1 hrs)**

10.1 Types and characteristics of solid waste, Quantity of solid waste

10.2 Collection, transport and disposal

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

Laboratories:

(i) Bio-chemical Oxygen Demand Test

(ii) Chemical Oxygen Demand Test

(iii) Examination of volatile, fixed solid and total solids

(iv) Examination of settleable and non-settleable solids

Field Visit:

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

References:

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

**Latest edition will be preferable.*

Evaluation Scheme: Marks Division

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

Detailed Course Contents:

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
1	**Introduction**	1.1	Definition of common terms: Sewage/wastewater, Domestic Sewage, Industrial Sewage, Sanitary Sewage, Strom Sewage, Sullage, Sewer, Sewerage, Rubbish, Garbage, Refuse/solid waste.	✓								**2**	
		1.2	Importance of waste water and solid waste management	✓	✓		✓	✓					
		1.3	Wastewater management methods: collection, Conveyance, Treatment and disposal		✓		✓	✓					
		1.4	Objectives of sewage disposal	✓	✓		✓	✓					
		1.5	Sanitation systems: Conservancy system with merit and demerit Water carriage system with merit and demerit	✓	✓		✓	✓	✓				
		1.6	Types of sewerage systems: Combined: Favorable condition, merit and demerit, Separate: Favorable condition, merit and demerit, Partially separate systems: Favorable condition, merit and demerit,		✓	✓	✓		✓				
		2.1	Dry weather flow (DWF) and Wet weather	✓	✓			✓			✓		

			flow (WWF)										
2	**Quantity of waste water**	2.2	Sources of sanitary sewage: Private and Public water supplies, Ground water infiltration, Unauthorized connections,		✓		✓	✓				**4**	
		2.3	Factors affecting sanitary sewage		✓			✓					
		2.4	Determination of quantity of sanitary sewage, variation in rate of flow of domestic sewage, peak factor, values of peak factor for different sewer and contributory population		✓			✓			✓		
		2.5	Methods of determination the quantity of storm water: Rational method and its limitation, Overall runoff coefficient, British Ministry health formula for intensity of rainfall, Time of concentration: Time area graph method (time of entry and time of travel)		✓			✓			✓		
3	**Characteristics and Examination of Wastewater**	3.1	Wastewater sampling: Grab and composite samples, preservation and storing of samples	✓	✓			✓				**5**	
		3.2	Different characteristics of wastewater: Physical: colour, odour, temperature and turbidity, solids (types of solid: settleable and non-settleable, Suspended, colloidal and dissolved solids) Chemical: pH, organic and inorganic matters,	✓	✓	✓		✓		✓			

			Biological: Algae, bacteria, viruses										
		3.3	Decomposition of wastewater, aerobic and anaerobic decomposition,	✓	✓			✓					
		3.4	Biochemical oxygen demand (BOD): Definition of BOD and its significance, Expression of BOD equation, rate reaction, ultimate BOD and relation with temperature, Chemical oxygen demand (COD): definition and significance	✓	✓			✓			✓		
		3.5	Examination of volatile, fixed and total solids, settleable and non-settleable solids, BOD with and without dilution (DO consumed, dilution factor), COD	✓	✓	✓		✓		✓	✓		
Ch. No.	**Topic**		**Subtopic**	**Depth**								**Hour**	**Remarks**
				SD	**D**	**DR**	**I**	**E**	**A**	**EX**	**N**		
4	**Design and Construction of Sewers**	4.1	Sewer design criteria: Design periods, Minimum and maximum velocity, self-cleansing velocity by shield formula (derivation not required) Hydraulic formulae for velocity- Manning's, chezy's and Hazen Williams formulae, Hydraulic elements of sewers for full flow, half full flow and partial flow condition, Partial flow diagrams	✓	✓	✓		✓			✓	**5**	
		4.2	Shape of sewers: circular and non-circular with merits and demerits		✓		✓	✓					
		4.3	Sewer materials: Requirements of sewer materials,		✓		✓	✓					

			Types of sewer materials: Brick, Cement concrete (Crown corrosion and its prevention), vitrified clay, cast iron sewer, plastic sewer										
		4.4	Construction of sewer: setting out sewer centerline, alignment and gradient of sewer, excavation of trenches, timbering and dewatering, laying and jointing of pipe sewer, testing of sewer (test for straightness and obstruction, water test, air test, smoke test), backfilling of trench		✓		✓	✓					
		4.5	Design of the sewer for separate and combined systems		✓			✓			✓		
5	**Sewer Appurtenances**	5.1	Definition and necessity of Sewer Appurtenances	✓	✓		✓	✓				**2**	
		5.2	Manholes (Objective, location, component and Types: shallow, normal and deep manhole) drop-manholes and lamp-holes	✓	✓		✓	✓					
		5.3	Street inlets	✓	✓		✓	✓					
		5.4	Catch basins	✓	✓		✓	✓					
		5.5	Flushing devices	✓	✓		✓	✓					
		5.6	Sand, Grease and oil traps	✓	✓		✓	✓					
		5.7	Inverted siphons	✓	✓		✓	✓					
		5.8	Sewer outlets	✓	✓		✓	✓					
		5.9	Ventilating shaft	✓	✓		✓	✓					
		6.1	Necessity of wastewater disposal	✓	✓		✓	✓					

6	**Disposal of Wastewater**	6.2	Method of wastewater disposal: dilution and land treatment		✓		✓	✓				**6**		
		6.3	Disposal of wastewater by dilution: Process, essential conditions for dilution, Self-purification of streams/river, factors affecting self-purification (dilution, current, sunlight, sedimentation, temperature, oxidation, reduction) oxygen sag curve, Streeter-Phelps equation (derivation not required),	✓	✓	✓	✓	✓			✓			
		6.4	Disposal of wastewater by land treatment:	✓	✓		✓	✓						

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
			Suitability of land treatment, methods of land treatment: Broad irrigation, over land flow and rapid filtration, sewage farming (by flooding, surface irrigation, ridge and furrow methods, subsurface irrigation and spray irrigation)										
		6.5	Sewage sickness and its preventive measures	✓	✓		✓	✓					
7	**Wastewater Treatment**	7.1	Objectives of wastewater treatment and different treatment process: physical, chemical, biological		✓		✓	✓				**12**	
		7.2	Wastewater treatment processes and typical layout of wastewater treatment plant				✓	✓					
		7.3	Preliminary/primary treatment processes: screening (bar, coarse and fine), skimming tanks (purpose and construction), grit chamber (purpose construction and design criteria), sedimentation, and chemical precipitation (numerical only from grit chamber)	✓	✓		✓	✓			✓		
		7.4	Secondary treatment processes: objective of biological treatment processes, principle of biological treatment processes: suspended and attached growth processes	✓	✓		✓	✓					
		7.5	Wastewater filtration: Filter type, Intermittent sandfilter (purpose	✓	✓		✓	✓			✓		

			construction, working and cleaning with merit and demerit), contact bed (purpose construction, working and cleaning with merit and demerit) and trickling filters (types: standard rate and high rate, purpose construction, working and cleaning with merit and demerit, recirculation, two stage trickling filter, efficiency calculation by NRC equation), and Numerical on design of trickling.										
		7.6	Activated sludge process (ASP): Principles and processes, construction, aeration methods, design criteria, advantages and disadvantages of the activated sludge process, HRT, VBL, SVI, SDI, MLSS, MLVSS, F/M, MCRT, recycle ratio	✓	✓		✓	✓			✓		
		7.7	Oxidation ponds: Zone of stabilization pond (aerobic, anaerobic and facultative) Theory, construction, commissioning, advantage and disadvantage	✓	✓		✓	✓					
8	**Sludge Treatment and**	8.1	Sources of sludge and necessity of sludge treatment	✓	✓							**4**	
		8.2	Characteristics of sludge: from sedimentation tank, ASP, Trickling filter		✓		✓	✓					

Ch. No.	Topic		Subtopic	Depth								Hour	Remarks
				SD	D	DR	I	E	A	EX	N		
	Disposal	8.3	Sludge volume-moisture relationship		✓	✓					✓		
		8.4	Methods of sludge treatment: - Grinding and Blending, - Thickening (Purpose and types of thickening: gravity, flotation and centrifugation) - Stabilization or Digestion: Aerobic and anaerobic digestion (stage of anaerobic digestion: acid formation, acid regression and alkaline fermentation technique), factor affecting digestion, - Dewatering: drying bed method and mechanical method, - Compositing: Composting by trenching, Open windrow composting, Mechanical composting, - Incineration: Types: Flash type incinerator and Multiple hearth type incinerator:	✓	✓		✓	✓			✓		
		8.5	Methods of sludge disposal: Spreading on land, dumping, lagooning, and land filling with merit and demerit	✓	✓		✓	✓			✓	**4**	

9	**Disposal of Sewage from Isolated Buildings**	9.1	Necessity, onsite sanitation system and offsite sanitation system- definition	✓	✓		✓	✓				**4**	
		9.2	Privies (Purpose, construction and design criteria): Pit privy, ventilation improved pit latrine, and pour-flush latrine	✓	✓		✓	✓					
		9.3	Septic Tank: design, construction, working and maintenance	✓	✓			✓			✓		
		9.4	Disposal of septic tank effluent (Purpose, construction and design criteria): Drain Field,soak pits, Leaching cesspool, Evapotranspiration mounds		✓			✓			✓		
10	**Solid Waste Disposal**		10.1 Types and characteristics of solid waste, Quantity of solid waste 10.2 Collection, transport and disposal 10.3 Methods of solid waste disposal: dumping, sanitary landfill, incineration and composting										
Note: Define(SD), Description (D), Derive (DR), Illustration (I), Explanation (E), Application (A), Experimentation (Ex), Numerical (N)													

Final Examination Scheme:		
Chapters	Marks	Remarks
1	2-4	Th
2	4-6	Th + N
3	4-6	Th
4	8-10	Th + N
5	4	Th
6	12	Th + N or N/Th
7	16-18	Th + N or Th/N
8	4-6	Th + N
9	8-10	Th + N
10	2	Th
Total	60	Th: Theory/N: Numerical
Note: There might be minor deviation in mark distribution. Mandatory: Evaluation should be based on solving approach and steps.		

Chapter wise marks division in final examination:

Chapter	Group A No of Short Questions (2Marks)	Group B No of Medium Questions (4Marks)	Group C No of Long Question (8 Marks)
1		1	
2	1	1	
3	1	1	
4	1		1
5		1	
6		1	1
7	1	2	1
8	1	1	
9	1		1
10	1		

Note:

Note:. Attempt any four questions from group A, seven questions from group B and there questions form

Group C


पूर्वाञ्चल विश्वविद्यालय
1995
PURBANCHAL UNIVERSITY
GOTHGAUN, MORANG, NEPAL
Faculty of Engineering

PURBANCHAL UNIVERSITY
2024
Model Question with answer pattern

B.E. (Civil)/ Sixth Semester / Final
Time: 03:00 hrs. Full Marks:60 / Pass Marks :24
BEG……: Sanitary Engineering (*New Course)*
Candidates are required to give their answers in their own words as far as practicable.
All questions carry equal marks. The marks allotted for each sub-question is specified along its side.
*Attempt **all** questions.*

Q.N.	Questions	Marks	Units	Remarks
	Group A [2*4=8]			
1	Write different sources of sanitary sewage.	**2**	**2**	Theory
2	Define Biochemical oxygen demand (BOD).	**2**	**3**	Theory
3	Write down the objective of wastewater treatment	**2**	**7**	Theory
4	What are the methods of sludge treatment?	**2**	**8**	Theory
	Or			
	Write down the methods of solid waste disposal.	**2**	**10**	Theory
	Group B [4*7=28]			
5	Differentiate between of separate and combined sewerage system.	**4**	**1**	Theory
6	A population of 30000 is residing in a rural area of 60 hectares. If the average coefficient of runoff for this area is 0.60, time required to the entry port is 25 minutes and the time of travel from the entry port to the section of sewer under consideration for design is 5 minutes. What will be the design discharge for a combined sewer at the section to be considered if the average flow of sewage in rural is 45 lpcd and peak factor is 2.7	**1+3**	**2**	Numerical
7	If water from Bagmati river was tested for BOD at 20°C and the following observation was made:	**2+2**	**3**	Numerical

	BOD_5 =280mg/l, BOD_7 =319.88mg/l. determine the ultimate BOD and 3-day BOD at 25°C.			
8	Describe about a manhole with a neat sketch.	**4**	**5**	Theory
9	Define sewage sickness. Write different methods to prevent sewage sickness	**4**	**6**	Theory
10	Describe about design criteria of grit chamber.	**4**	**7**	Theory
11	Write down different types of biological treatment process.	**4**	**7**	Theory
	Or			
	A sewage treatment plant produces sludge having a moisture content of 92% with a dry solids of 500kg/day in which 70% solids are volatile. The specific gravity of volatile and fixed solids are 1.02 and 2.65 respectively. Assuming parabolic digestion of 30 days and 12 days of monsoon storage, calculate the volume of conventional rate digester required to produce digested sludge with moisture content of 90%.	**4**	**8**	Numerical
Group C [8*3=24]				
12	Calculate the size of combined sewerage system for the following data: Rate of water supply = 375 lpcd, population density = 160/hectare, peak factor = 1.5, area = 5000 hectare consisting 40% roof and pavement with runoff coefficient as C=0.65 and 60% lawns and gardens with runoff coefficient = 0.4, time of entry =5 minutes and time of travel=20 minutes. The sewer running 0.7 depth.	**8**	**4**	Numerical
13	A stream saturated with DO has a flow of 1.2 m3/s and BOD =4 mg/l and rate constant of 0.3 per day. It receives an effluent discharge of 0.25 m3/s having BOD of 20 mg/l and DO of 5 mg/l and rate constant 0.13 per day. If the average velocity of flow is 0.18m/s and depth of flow is 1.2m. Calculate the DO deficit at point 30 KM and 50 KM downstream. Assume that the temperature is 20°C throughout and BOD is measured at 5 days. Take saturated DO at 20°C as 9.17 mg/l.	**8**	**6**	Numerical
	Or			
	Design a septic tank and soak pit for the following data:	**8**	**9**	Numerical

	No. of person= 200, sludge cleansing period = 3 year, soil infiltration rate= 30 l/m^2/d.			
14	Calculate the effluent BOD_5 of a two stage trickling filter with the following flows, BOD_5 and dimensions, using NRC formula: Q = 5000 m^3/day, BOD_5 = 300 mg/l, volume of primary filter =1200 m3, volume of secondary filter = 1000 m^3, filters depth = 2 m, recirculation ratio for primary filter = 1.5 and recirculation ratio for secondary filter = 1.25.	**8**	**7**	

Transportation Engineering II
BCI 6027

Year: III **Semester: VI**

Teaching Schedule Hours/week			Examination Scheme						Total Marks
			Final				Internal Assessments		
			Theory		Practical		Theory	Practical	
L	T	P	Duration	Marks	Duration	Marks			
3	2	2/2	3	60	-	-	40	25	125

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

Course Contents:

1.0 Introduction and Scope of Traffic Engineering (4 hrs)
- 1.1 Definition of Traffic Engineering
- 1.2 Scope of Traffic Engineering
- 1.3 Traffic Characteristics
  - 1.3.1 Driver Characteristics
  - 1.3.2 Pedestrian Characteristics
  - 1.3.3 Vehicle Characteristics
- 1.4 Traffic Simulation and its application in Transportation Engineering

2.0 Traffic Studies (7 hrs)
- 2.1 Traffic Volume Studies
- 2.2 Traffic Speed Studies
- 2.3 Origin And Destination Studies
- 2.4 Traffic Flow and Capacity Studies
- 2.5 Parking Studies
- 2.6 Crash Studies

3.0 Road Intersection and Traffic control Devices (6 hrs)
- 3.1 Introduction and Basic Requirements of Intersections
- 3.2 Types of Intersections And Their Configuration
- 3.3 Channelized And Unchannelized Intersections
- 3.4 Rotary Intersection
- 3.5 Grade Separated Intersections
- 3.6 Warrants For Signalization And Choice Of Traffic Control Devices
- 3.7 Traffic Control Devices
  - 3.7.1 Traffic Signals And Its Design
  - 3.7.2 Traffic Signs
  - 3.7.3 Road Marking
  - 3.7.4 Traffic Island

4.0 Road lighting (2 hrs)

4.1 Introduction and Importance of road lighting
4.2 Factors influencing night visibility
4.3 Requirements of level of illumination in roads
4.4 Design of the lighting system: selection of height of lamps, spacing between light poles, height and overhang of light poles, lateral placement, etc.

5.0 Road Pavement (10 hrs)

5.1 Definition and types of pavements
5.2 Differences between flexible and rigid pavement structures
5.3 Loads and other factors controlling pavement
5.4 Design methods for flexible pavements-CBR, Road Note 31, DoR Guidelines, AASTHO, Asphalt Institute Method
5.5 Design methods for rigid pavements and Westergaard's theory
5.6 Stresses due to load, temperature differential and subgrade friction
5.7 Details of the DoR and IRC method of design of rigid pavements for highways

6 Road Construction Technology (7 hrs)

6.1 Activities and techniques used in road construction
6.2 Tools, equipment and plants used in road construction
6.3 Preparation of road bed: excavation, fill compaction, soil stabilization, etc.
6.4 Construction of low cost roads
6.5 Construction of asphalt concrete layers, including prime coats, tack coats and seal coats
6.6 Construction of surface dressing
6.7 Construction of otta-seal
6.8 Construction of grouted or penetration macadam
6.9 Construction of different types of bituminous premixes
6.10 Construction of cement concrete pavement

7.0 Highway Maintenance, Repair and Rehabilitation (5 hrs)

7.1 Classification of maintenance activities for road pavement and road facilities
7.2 Inspection, prioritization and planning of maintenance operations
7.3 Evaluation of pavement distress and pavement condition
7.4 Types of road failure and its causes: Typical Road failures in flexible and rigid pavements
7.5 Types and methods of pavement repair
7.6 Types of overlays and strengthening of existing pavements

8.0 Introduction to Bridge and Tunnel Engineering (4 hrs)

8.1 Choice of location of bridge site
8.2 Classification of bridges and component parts of a bridge
8.3 Component parts of tunnels and tunnel cross-section
8.4 Type of road and railway tunnel
8.5 Drainage, Lighting and Ventilation required for Tunnel
8.6 Methods of Tunneling (Firm ground, Soft soil, Rock)
8.7 Tunnel Lining

8.8 Survey for tunnel alignment

Laboratories:

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

(i) Traffic volume study and preparation of flowmap.
(ii) Measurement of spot speed and data analysis.
(iii) Skid Resistance Test
(iv) Measurement of deflection of pavement surface.

References:

1. Sehgal S.B. and Bhanot K.I., "A Text-book on Highway Engineering and Airports", S. Chand and Co. Publishers Ltd., New Delhi
2. Sharma S.K., "Principles, Practice and Design of Highway Engineering", S. Chand and Co. Publishers Ltd., New Delhi
3. Khanna S.K. and Justo C.E.G., "Highway Engineering", Nem Chand & Bros Roorkee (U.P.)
4. Kardiyali L.R., "An Introduction to Highway Engineering", Khanna Publishers, Delhi
5. Shrestha, D.K and Marsani, A, "Highway Engineering Part II", Heritage Publishers and Distributors
6. Relevant Publication by Department of Road(DoR), Department of Local Infrastructure(DoLI)

**Latest edition will be preferable.*

Evaluation Scheme: Marks Division

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

Detailed Course Contents:

Ch. No.	Topic		Sub-topic	Depth								Hour
				SD	D	DR	I	E	A	Ex	N	
1	**Introduction and Scope of Traffic Engineering**	1.1	Definition of traffic engineering	✓	✓							4
		1.2	Scope of traffic engineering		✓		✓					
		1.3	Traffic characteristics	✓	✓							
		1.4	Traffic Simulation and its application in Transportation Engineering	✓	✓							
2	**Traffic Studies**	2.1	Traffic volume studies	✓	✓						✓	7
		2.2	Traffic speed studies	✓	✓						✓	
		2.3	Origin and destination studies		✓			✓				
		2.4	Traffic flow and capacity studies		✓	✓		✓			✓	
		2.5	Parking studies	✓	✓							
		2.6	Crash studies	✓	✓							
3	**Road Intersection and Traffic control Devices**	3.1	Introduction and Basic requirement of intersections	✓	✓							6
		3.2	Types of intersections and their configuration	✓	✓							
		3.3	Channelized and Unchannelized intersections	✓	✓							
		3.4	Rotary Intersection	✓	✓	✓	✓				✓	
		3.5	Grade separated intersections	✓	✓							
		3.6	Warrants for signalization and choice of traffic control devices	✓	✓							
		3.7	Traffic Control Devices									
			3.7.1 Traffic Signal and its Design	✓	✓		✓				✓	
			3.7.2 Traffic Signs	✓	✓		✓					

			3.7.3 Road Marking	✓	✓		✓					
			3.7.4 Traffic Island	✓	✓		✓					
4	**Road Lighting**	4.1	Introduction and Importance of road lighting	✓	✓							2
		4.2	Factors influencing night visibility		✓							
		4.3	Requirements of level of illumination in roads		✓		✓					
		4.4	Design of the lighting system: selection of height of lamps, spacing between light poles, height and overhang of light poles, lateral placement, etc.		✓		✓				✓	
5	**Road Pavement**	5.1	Definition and types of pavements	✓								10
		5.2	Differences between flexible and rigid pavement structures	✓	✓							
		5.3	Loads and other factors controlling pavement	✓	✓			✓				
		5.4	Design methods for flexible pavements-CBR, Road Note 31, DoR Guidelines, AASTHO, Asphalt Institute Method	✓	✓			✓			✓	
		5.5	Design methods for rigid pavements and Westergaard's theory	✓	✓			✓			✓	
		5.6	Stresses due to load, temperature differential and subgrade friction	✓	✓			✓			✓	
		5.7	Details of the DoR and IRC method of design of rigid pavements for highways	✓	✓			✓			✓	
6	**Road Construction Technology**	6.1	Activities and techniques used in road construction	✓	✓							7
		6.2	Tools, equipment and plants used in road construction	✓	✓							
		6.3	Preparation of road bed: excavation, fill compaction, soil stabilization, etc.	✓	✓							
		6.4	Construction of low cost roads	✓	✓			✓				
		6.5	Construction of asphalt concrete layers, including prime coats, tack coats and seal coats		✓			✓				
		6.6	Construction of surface dressing		✓			✓				

		6.7	Construction of otta-seal		✓			✓				
		6.8	Construction of grouted or penetration macadam		✓			✓				
		6.9	Construction of different types of bituminous premixes		✓			✓				
		6.10	Construction of cement concrete pavement		✓			✓				
7	**Highway Maintenance, Repair and Rehabilitation**	7.1	Classification of maintenance activities for road pavement and road facilities	✓								5
		7.2	Inspection, prioritization and planning of maintenance operations	✓	✓							
		7.3	Evaluation of pavement distress and pavement condition		✓			✓				
		7.4	Types of road failure and its causes: Typical Road Failures in Flexible and Rigid Pavements	✓	✓	✓						
		7.5	Types and methods of pavement repair	✓	✓	✓						
		7.6	Types of overlays and strengthening of existing pavements		✓			✓			✓	
8	**Introduction to Bridge and Tunnel Engineering**	8.1	Choice of location of bridge site	✓	✓							4
		8.2	Classification of bridges and component parts of a bridge	✓	✓							
		8.3	Component parts of tunnels and tunnel cross-section	✓	✓			✓				
		8.4	Type of road and railway tunnel		✓							
		8.5	Drainage, Lighting and Ventilation required for Tunnel	✓	✓			✓				
		8.6	Methods of Tunneling (Firm ground, soft soil, Rock)		✓			✓				
		8.7	Tunnel Lining	✓	✓							
		8.8	Survey for tunnel alignment		✓			✓				

Note: SD=Define, D= Description, Dr=Derive, I=Illustration, E= Explanation, A= Application, Ex= Example, N= Numerical

Final Examination Scheme:		
Chapters	Marks	Remarks
1	4	Th
2	14	Th+N
3	12	Th+N
4	2	Th+N
5	12	Th +N
6	6	Th
7	6	Th
8	4	Th
Total	60	Th: Theory/N: Numerical
Note: There might be minor deviation in mark distribution.		

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

Chapter wise marks division in final examination

Chapter	No of Short Questions (2M)	No of Medium Questions (4M)	No of Long Question (8M)
1		1	
2	1	1	1
3		1	1
4	1	1	
5		1	1
6	1	1	
7	1	1	1
8		1	

Note: *Only 4 short questions, 7 medium questions and 3 long questions will be asked from all chapters.*

PURBANCHAL UNIVERSITY
SEMESTER FINAL EXAMINATION – 2024 (MODEL QUESTION)

LEVEL: B. E. (Civil)
SUBJECT: Transportation Eng-II FULL MARKS: 60
TIME: 03:00 hrs PASS MARKS: 24

Attempt all questions

Group A (2*4=8)

1. How is AADT different from ADT? ***(Chapter 2)***
2. List out the factors affecting night visibility. ***(Chapter 4)***
3. Define mass haul diagram. ***(Chapter 6)***
4. Difference between maintenance and rehabilitation. ***(Chapter 7)***

Group B (4*7=28)

5. Define traffic simulation. Discuss PIEV theory. ***(Chapter 1)***
6. Discuss various methods of carrying out O-D Study. ***(Chapter 2)***
7. List out the requirements of intersection at grade. ***(Chapter 3)***
8. Difference between flexible and rigid pavement. ***(Chapter 5)***
9. List out the various tools and equipment required for road construction. ***(Chapter 6)***
10. List out various typical road pavement failures in flexible pavements. Discuss any two of them. ***(Chapter 7)***
11. Discuss about factors affecting the selection of bridge site. ***(Chapter 8)***

OR

Discuss the method of tunneling in hard rock. ***(Chapter 8)***

One OR question is expected from Chapter 4, Chapter 6 or Chapter 8.

Group C (8*3=24)

12. Assuming a linear speed-density relationship, the mean free speed is observed to be 85 kmph near zero density and the corresponding jam density is 140 veh/km. a) Write down the speed-density and flow-density equations. B) Draw the V-K, V-q and q-K diagrams. C) Compute speed and density corresponding to the flow of 1000 veh/hr. ***(Chapter 2)***
13. The average normal flow of traffic on cross roads 1 and 2 during design period are 400 pcu/hr and 500 pcu/hr. The saturation flow values on these roads are estimated as 1200 pcu/hr and 1400 pcu/hr respectively. The all red time for pedestrian crossing is 12 sec. The amber times for road 1 is 3 secs and road 2 is 4 secs. The starting time loss for road 1 is 2 secs and for road 2 is 3 secs respectively. ***(Chapter 3)***
14. A single lane carriageway carries total traffic of 800 commercial vehicles per day at the end of construction. The traffic growth rate is 8% per annum, design life is 15 years. The vehicle damage factor is 1.5. The subgrade soil sample was obtained from the site and CBR test was conducted giving the following data. Design the pavement section by Road Note 31 method. ***(Chapter 4)***

Penetration	Load (kg)
0	0
0.5	5
1.0	16.2

1.5	28.1
2.0	40
2.5	48.5
3.0	56.5
4.0	67.5
5.0	75.2
7.5	89
10	99.5
12.5	106.5

OR

What are the causes of road failures? Describe the typical road failures in flexible pavements with figures.

One OR question is expected from Chapter 2, Chapter 5 or Chapter 7.

*****

Numerical Methods
BCE 6013

Year: III **Semester: VI**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Cr	L	T	P			Duration	Marks	Duration	Marks	
3	3	2	2	40	25	3	60	-	-	125

Course Objective:

After completion of this course, the students will be able to solve the engineering problems by using the theory of numerical Computational procedures

Course Content:

1. Introduction (3 hrs)
- 1.1. Introduction and Importance of Numerical Method
- 1.2. Approximation and Errors in computation
- 1.3. Uses and Importance of Computer programming in Numerical Methods
- 1.4. Application of Numerical Computing in Civil Engineering

2. Solution of non – Linear equation (8 hrs)
- 2.1. Iterative methods and stopping criteria
- 2.2. Bisection method & its Convergence
- 2.3. Newton- Raphson method and its convergence
- 2.4. Secant method and its convergence
- 2.5. Fixed Point method
- 2.6. Evaluation of polynomials using Horner's Rule

3. Curve Fitting (8 hrs)
- 3.1 Interpolation
  - 3.1.1 Linear interpolation
  - 3.1.2 Lagrange interpolation
  - 3.1.3 Newton's Gregory Forward and Backward interpolation
  - 3.1.4 Newton's Divided Difference interpolation
  - 3.1.5 Central Interpolation (Gauss Forward/ Backward Formulae)
- 3.2. Regression

3.2.1 Least Squares Regression
3.2.2 Fitting Transcendental Equations.
3.2.3 Fitting a polynomial function
3.3. Spline Interpolation (Cubic Spline)

4. Numerical Differentiation & Integration (7 hrs)
4.1 Differentiating continuous function
4.1.1 Forward Difference Quotient
4.1.2 Backward Difference Quotient
4.1.3 Central Difference quotient
4.2 Newton cotes methods of integration
4.2.1 Trapezoidal rule and composite trapezoidal rule
4.2.2 Simpson's 1/3 rule & its composite
4.2.3 Simpson's 3/8 rule.
4.3 Romberg integration
4.4 Gaussian integration (Gaussian – Legendre 2 point and 3 point Formula)

5. Linear Algebraic Equations (8 hrs)
5.1 Elimination Approach
5.1.1 Basic Gauss Elimination
5.1.2 Gauss Elimination with partial pivoting
5.1.3 Gauss Jordon method
5.1.4 Finding inverse matrix using Gauss Jordan Method
5.1.5 LU decomposition methods
5.1.5.1 Do Little Method
5.1.5.2 Crout's Method
5.2 Iterative method
5.2.1 Jacobi method
5.2.2 Gauss- Seidal method
5.3 Eigen values and Eigen vectors using power method

6. Solution of ordinary differential equations (7 hrs)
6.1 Euler's method
6.2 Heun's method
6.3 Fourth order Runge-Kutta method
6.4 Systems of differential equations using Heun's method
6.5 2nd order differential equations using Heun's method

7. Solutions of partial differential equations (4 hrs)
7.1 Elliptic equations
7.1.1 Laplace's equations (standard five point formula with iterative method)
7.1.2 Poisson's equations (finite difference formula with iterative method))

7.2 Parabolic Equations (Solution of heat equation by Bender –Schmidt recurrence method)
7.3 Hyperbolic Equations (Solution of wave equation by finite difference method)

Laboratories:

1. Bisection method, N-R method
2. Secant method & Horner's rule
3. Lagrange interpolation
4. Linear Regression
5. Basic Gauss elimination method
6. Finding inverse matrix using Gauss Jordan
7. Trapezoidal rule ,Simpson's 1/3 rule, Simpson's 3/8 rule
8. Solution of differential equation using Euler's , Heun's and R-K method

References

1. E. Balagurusamy " Numerical Methods '' Tatal Mc Graw Hill
2. Dr. B.S. Grewal, "Numerical Methods in Engineering and Science", Khanna Publication
3. S.Yakwitz and F. szidarouszky " An Introduction to Numerical Computations " 2nd Edition Macmillan Publishing co , New York
4. C.F Gerald and P.o. Wheatley " Applied Numerical Analysis ",4th Edition, Addipon wesley publishing co. New york .

**Latest edition will be preferable.*

Evaluation Scheme: Marks Division

Question Type	No. of Questions	Marks	Total Marks
Group A	6	4	24
Group B	6	6	36
Total			60

Detailed Course Contents of Numerical Methods:

Note: Define(D), Description(Des), Derive (DR), Design(DSG), Illustration (I), Algorithm(Alg), Application (A), Experiment[Program (P)/Hardware(H)], Numerical (N)

Ch No.	Topic		Sub-Topic	Depth								Hour	Remarks
				D	Des	DR/ DSG	I	Alg	H/ P	A	N		
1	**Introduction**	1.1	Introduction and Importance of Numerical Method	**D**	**Des**							**3 hrs**	
		1.2	Approximation and Errors in Computations	**D**	**Des**						**N**		
		1.3	Uses and Importance of Computer programming in Numerical Methods	**D**	**Des**								
		1.4	Application of Numerical Computing in Civil Engineering	**D**	**Des**								
2	**Solution of non – Linear equation**	2.1	Iterative methods and stopping criteria	**D**	**Des**							**8 hrs**	
		2.2	Bisection method & its Convergence		**Des**			**Alg**	**P**		**N**		

		2.3	Newton-Raphson method and its convergence		**Des**			**Alg**	**P**		**N**		
		2.4	Secant method and its convergence		**Des**			**Alg**	**P**		**N**		
		2.5	Fixed Point method		**Des**			**Alg**	**P**		**N**		
		2.6	Evaluation of polynomials using Horner's Rule					**Alg**	**P**		**N**		
3	**Curve Fitting**	3.1.1	Linear interpolation		**Des**						**N**	**8 hrs**	
		3.1.2	Lagrange interpolation		**Des**			**Alg**	**P**		**N**		
		3.1.3	Newton's Gregory forward backwad interpolation		**Des**						**N**		
		3.1.4	Newton's divided difference interpolation		**Des**						**N**		
		3.1.5	Central Interpolation (Gauss Forward/ Backward Formulae)		**Des**						**N**		
		3.2.1	Least squares Regression		**Des**			**Alg**	**P**		**N**		

		3.2.2	Fitting Transcendental Equations.		**Des**						**N**		
		3.2.3	Fitting a polynomial function		**Des**						**N**		

4	**Numerical Differentiation & integration** **4.1** Differentiating continuous function **4.2** Newtoncotes methods of integration	4.1.1	Forward Difference Quotient		**Des**						**N**	**7 hrs**	
		4.1.2	Backward Difference Quotient		**Des**						**N**		
		4.1.3	Central Difference quotient		**Des**						**N**		
		4.2.1	Trapezoidal rule and its composite		**Des**			**Alg**	**P**		**N**		
		4.2.2	Simpson's 1/3 rule and its composite		**Des**			**Alg**	**P**		**N**		
		4.2.3	Simpson's 3/8 rule.		**Des**			**Alg**	**P**		**N**		
		4.3	Romberg integration		**Des**						**N**		
		4.4	Gaussian integration		**Des**						**N**		
5	**Linear Algebraic Equations:** **5.1** Elimination Approach	5.1.1	Basic Gauss Elimination		**Des**			**Alg**	**P**		**N**	**8 hrs**	
		5.1.2	Gauss Elimination with partial pivoting		**Des**						**N**		
		5.1.3	Gauss Jordon method		**Des**						**N**		
		5.1.4	Finding inverse matrix using Gauss Jordonmethod		**Des**			**Alg**	**P**		**N**		

		5.1.5	LU decomposition methods:										
	5.2 Iterative method		Do Little method Crout's Method		**Des** **Des**						**N** **N**		
		5.2.1	Gauss Jacobi		**Des**						**N**		
		5.2.2	Gauss- Seidal method		**Des**						**N**		
		5.3	Eigen values and eigen vectors using power method		**Des**						**N**		
6	**Solution of ordinary**	**6.1**	Euler's Method		**Des**			**Alg**	**P**		**N**	**7 hrs**	
		6.2	Heun's method		**Des**			**Alg**	**P**		**N**		
		6.3	Fourth order Runge-kutta method		**Des**			**Alg**	**P**		**N**		

	differential equations	**6.4**	Systems of differential equations using Heun's method		**Des**						**N**		

		6.5	2nd order differential equations using Heun's method		**Des**						**N**		
7	**Solutions of partial differential equations:**	**7.1**	Elliptic equations	**D**	**Des**						**N**	**4 hrs**	
		7.2	Parabolic Equations	**D**	**Des**						**N**		
		7.3	Hyperbolic Equations	**D**	**Des**						**N**		

Final Examination Scheme:

Chapters	Marks	Remarks	Hour
1	4	Th / N	3
2	4+6	Convergence/Algorithm/Program+ N	8
3	4+6	Algorithm/Program + N or N+N	8
4	4+6	Algorithm/Program + N or N+N	7
5	4+6	Algorithm/Program + N or N+N	8
6	4+6	Algorithm/Program + N or N+N	7
7	6	N	4
Total	60	Th: Theory/N: Numerical	45

Note: There might be minor deviation in mark distribution.
Mandatory: Evaluation should be based on solving approach and steps.

Chapter wise marks division in final examination:

Chapter	GroupA (4Marks)	GroupB (6Marks)
1	1	
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7		1

Note: The total (14 marks) of Program and Algorithm of the Methods mentioned in the lab must only be asked in the final examination..

PURBANCHAL UNIVERSITY
SEMESTER FINAL EXAMINATION – 2024 (MODEL QUESTION)

LEVEL: B. E. (Civil)
SUBJECT: Numerical Methods FULL MARKS: 60
TIME: 03:00 hrs PASS MARKS: 24

Attempt all questions

Group A (6*4=24)

1. Write the application of numerical computing in Civil Engineering. Find the roundoff error in storing the number 752.6835 considering four significant digits. [2+2]

2. Write the algorithm to find the root of non linear equation using N-R method.

3. Fit a straight line to the following set of data

x	1	2	3	4	5
y	3	4	5	6	8

4. Use Gauss legendre 3-point formula to evaluate the following integral

$$\int_2^4 (x^4 + 1)dx$$

5. Use Gauss Jordan Method to solve the following system

   2a+4b-6c= -8
   a+3b+c=10
   2a-4b-2c= -12

6. Write a program to solve the ordinary differential equation using R-K method.

Group B (6*6=36)

7. Find the square root of 0.75 using Fixed point method.

8. Given the following set of data points, estimate the value of f(1.5) using Newton's divided difference method.

x	1	2	3	4	5
f(x)	0	7	26	63	124

9. Write the algorithm and program to evaluate the intregral using Trapezoidal rule.

10. Find the largest eigenvalue and the corresponding eigenvector of the following matrix using power method

$$\begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

11. Solve the following equation for y(0.2)
    $\frac{d^2y}{dx^2}$ +2 $\frac{dy}{dx}$ -3y = 6x
    Given y(0)=0, y'(0)=1. Use Heun's method and take h=0.2

12. Solve the Laplace equation: uxx + uyy=0 in the region 0≤x≤3, 0≤y≤3 where u(0,y)=10,u(x,0)=20, u(3,y)=25, u(x,3)=30. Take h=1and use Gauss Seidal iteration method to solve the set of equations.

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Engineering Economics
BSH 6001

Year: III **Semester: VI**

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

Course Objective:

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

Course Content:

1.0 Introduction **(3 hrs)**

1.1 Business and accounting terminology
1.2 Principles of Engineering Economics
1.3 Cash flow diagram
1.4 Economic systems

2.0 Cost Classification and Analysis (5 hrs)

2.1 The elements of cost
2.2 Classification of cost: overhead cost, prime cost
2.3 Cost variance analysis
2.4 Job and process costing

3.0 Interest and the Time Value of Money (6 hrs)

3.1 Introduction- Time value of money
3.2 Simple interest and compound interest
3.3 Factors and its types
3.4 Linear and geometric gradient series
3.5 Nominal and effective interest rates
3.6 Continuous compounding

4.0 Basic Methodologies of Engineering Economic Studies (7 hrs)

4.1 Minimum attractive rate of return
4.2 Present worth, Annual worth and Future worth method
4.3 Internal rate of return method and its drawbacks

4.4 External rate of return method
4.5 Cost/Benefit analysis
4.6 The payback (pay-out) period method

5.0 Investment Decisions: (8 hrs)

5.1 Comparison of alternatives having same useful life
5.2 Comparison of alternatives having different useful life
5.3 Comparison of alternatives using the capitalized worth method
5.4 Definition of mutually exclusive, contingent and independent investment alternatives in terms of combinations of projects
5.5 Comparison of mutually exclusive, contingent and independent alternative

6.0 Replacement analysis (5 hrs)

6.1 Introduction
6.2 Approaches of comparing defender and challenger
6.3 Economic service life of challenger and defender
6.4 Replacement analysis for long service life
6.4.1 Required assumptions and decision framework
6.4.2 Replacement analysis under Finite and Infinite Planning Horizon

7.0 Risk Analysis: (4 hrs)

7.1 Projects operating under conditions of certainty
7.2 Projects operating under conditions of uncertainty
7.3 Break even analysis
7.4 Decision tree
7.5 Sensitivity analysis

8.0 Taxation System and depreciation: (4 hrs)

8.1 Taxation law in Nepal
8.2 Value Added Tax (VAT)
8.3 Depreciation rates for buildings, equipment, furniture, etc
8.4 Methods of depreciation: Straight line, Declining balance, Sinking fund, Sum of year digit, MACRS methods of depreciation

9.0 Inflation: (3 hrs)

9.1 Introduction
9.2 Inflation measurement
9.3 Equivalence calculation under inflation
9.4 Impact of Inflation

References:

- E.P. DeGramo, W.G. Sullivan and J.A. Bontadelli, 8th Edition, Macmillan Publishing Company, 1988
- N.N. Borish and S.Kaplan, "Economic Analysis: For Engineering and

Managerial Decision Making", McGraw-Hill.

Evaluation Scheme: Marks Division

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

Detailed Course Contents:

Ch. No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
1	Introduction	1.1	Business and accounting terminology	√	√							3
		1.2	Principles of Engineering Economics	√	√				√			
		1.3	Cash flow diagram	√	√				√			
		1.4	Economic systems	√	√				√			
2	Cost Classification and Analysis	2.1	The elements of cost	√	√							5
		2.2	Classification of cost: overhead cost, prime cost	√	√				√		√	
		2.3	Cost variance analysis	√	√				√		√	
		2.4	Job and process costing	√	√				√		√	
3	Interest and the Time Value of Money	3.1	Introduction- Time value of money	√	√				√			6
		3.2	Simple interest and compound interest	√	√				√		√	
		3.3	Factors and its types	√	√	√			√		√	

Ch. No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
		3.4	Linear and geometric gradient series	√	√	√			√		√	
		3.5	Nominal and effective interest rates	√	√	√			√		√	
		3.6	Continuous compounding	√	√				√		√	
4	Basic Methodologies of Engineering Economic Studies	4.1	Minimum attractive rate of return	√	√							7
		4.2	Present worth, Annual worth and Future worth method	√	√	√			√		√	
		4.3	Internal rate of return method and its drawbacks	√	√			√	√		√	
		4.4	External rate of return method	√	√			√	√		√	
		4.5	Cost/Benefit analysis	√	√			√	√		√	
		4.6	The payback (pay-out) period method	√	√			√	√		√	
5	Investment Decisions:	5.1	Comparison of alternatives having same useful life	√	√			√	√		√	8
		5.2	Comparison of alternatives having different useful life	√	√			√	√		√	

Ch. No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
		5.3	Comparison of alternatives using the capitalized worth method	√	√			√	√		√	
		5.4	Definition of mutually exclusive, contingent and independent investment alternatives in terms of combinations of projects	√	√			√	√		√	
		5.5	Comparison of mutually exclusive, contingent and independent alternative	√	√			√	√		√	
6	Replacement analysis	6.1	Introduction	√	√							5
		6.2	Approaches of comparing defender and challenger	√	√				√			
		6.3	Economic service life of challenger and defender	√	√				√			
		6.4	Replacement analysis for long service life	√	√			√	√		√	

Ch. No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
		6.4.1	Required assumptions and decision framework	√	√				√			
		6.4.2	Replacement analysis under Finite and Infinite Planning Horizon	√	√			√	√		√	
7	Risk Analysis:	7.1	Projects operating under conditions of certainty	√	√			√	√		√	4
		7.2	Projects operating under conditions of uncertainty	√	√			√	√		√	
		7.3	Break even analysis	√	√			√	√		√	
		7.4	Decision tree	√	√			√	√		√	
		7.5	Sensitivity analysis	√	√			√	√		√	
8	Taxation System and depreciation:	8.1	Taxation law in Nepal	√	√				√			4
		8.2	Value Added Tax (VAT)	√	√				√			
		8.3	Depreciation rates for buildings, equipment, furniture, etc	√	√				√			

Ch. No.	Topic		Subtopic	Depth								Hour
				SD	D	DR	I	E	A	EX	N	
		8.4	Methods of depreciation: Straight line, Declining balance, Sinking fund, Sum of year digit, MACRS methods of depreciation	√	√			√	√		√	
9	Inflation:	9.1	Introduction	√	√							3
		9.2	Inflation measurement	√	√				√			
		9.3	Equivalence calculation under inflation	√	√			√	√		√	
		9.4	Impact of Inflation	√	√			√	√		√	

Final Examination Scheme:		
Chapters	Marks	Remarks
1	4	Th
2	6	Th/N
3	8	Th + N
4	18	Th + N or Th/N
5		
6	4	Th + N or Th/N
7	8	Th + N or Th/N
8	8	Th + N or Th/N
9	4	Th + N
Total	60	Th: Theory/N: Numerical
Note: There might be minor deviation in mark distribution. Mandatory: Evaluation should be based on solving approach and steps.		

Chapter wise marks division in final examination:

Chapter	No of Short Questions (2M)	No of Medium Questions (4M)	No of Long Question (8M)
1	1	1	
2	1	1	
3	1	1	1
4	1	1	1
5	1	1	1
6	1	1	
7	1	1	1
8	1	1	1
9	1	1	

Note: *Only 4 short questions and 7 medium questions will be asked from all chapters; 3 long questions will be asked from mentioned chapters in the table.*

PURBANCHAL UNIVERSITY
SEMESTER FINAL EXAMINATION – 2024 (MODEL QUESTION)

LEVEL: B. E. Civil/Comp/Elex)
SUBJECT: Engineering Economics FULL MARKS: 60
TIME: 03:00 hrs PASS MARKS: 24

Attempt all questions

Group A (2*4=8)

1. Define cash flow and cash flow diagram.
2. Differentiate between prime cost and overhead cost.
3. Define IRR and MARR
4. Differentiate between private sector project and public sector project.

Group B (4*7=28)

5. Based on the following information, Calculate (a) total material cost variance and (b) total wage variance

	Standard	***Actual***
Production (units)	600	500
Direct material (kg)	1800	1740
Direct material cost (Rs)	52000	44000
Direct labor hours	1700	2000
Direct labor cost (Rs)	34000	46000

6. Determine the simple payback period and discounted payback period of following cash flow.

Period	0	1		2	3	4	5
Cash flow	-12500	4000		4000	4000	4000	6500

7. Find the rate of inflation of per year when price of a product has increased from 5,00,000 to 6,30,000 over the period of 3 years.
8. Differentiate between Uniform Series Compound Amount Factor and Capital Recovery Factor
9. Explain the procedure for the replacement analysis when the planning horizon is in infinite.
10. Explain on Beak even analysis

OR

Consider the investment project with the following Net Cash Flows.

Year	Net Cash Flow
0	-150000
1	X
2	65000
3	X

What would be the value of 'X' if the project's IRR is 10%?

11. What is a Decision Tree? Discuss its application in risk analysis? [4]

OR

12. Define VAT. Explain taxation system in Nepal. [4]

Group C (8*3=24)

13. Evaluate the project by B/C ratio using AW formulation for the project with the following cash flow. First investment = Rs 3, 50,000. Project life = 8 years, Salvage value = Rs 50,000, Annual O & M cost = Rs 35,000, Interest rate=10%. The benefits from the project at the end of 1st year is, Rs. 2,75,000 and goes on decreasing each year by Rs 25,000 for the 8 year period.

OR

Consider two alternatives X and Y. They have useful life of 5 and 8 years respectively. Their tabulated cash flow is shown below. Suppose the expected period of required service for X and Y is only 6 years and MARR = 10% per year. Show which alternative is more desirable using co-terminated assumption.

Activities	Alternatives	
	X	Y
Initial investment(Rs.)	40000	60000

Annual revenue (Rs.)	15000	20000
Annual Expenses	5000	7000
Salvage value (Rs.)	10000	150000

14. Perform the sensitivity analysis by investing the PW of the following project of a machine over a range of **±40%** in [i] initial investment, [ii] annual net revenue, [iii] interest rate, and [iv] useful life.

    Initial investment = 1150 Net annual revenue = 300
    Salvage Value = 100 Useful life = 6 years
    MARR = 12%
    Draw also sensitivity diagram.

OR

Suppose that a taxpayer places in service a $10,000 asset that is assigned to the 6 year class (say, a new property class) with half year convention. Develop the MACRS deductions assuming a 200% declining balance rate switching to straight line.

15. A lady is planning to retire in 20 years. She wishes to deposit a regular money every 3 months until she retires so that, beginning 1 year following her retirement, she will receive annual payments of $35,000 for the next 15 years. How much must she deposit if the interest rate is 8% compounded monthly?

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

Note: Interest chart cannot be used in Exam