Civil

IV/I

Question BanK

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing (*CE 705*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. a) What is purpose of preparing detail estimate before construction work? [2]
   b) Estimated cost is never equal to the actual cost of a project. Give your opinion. [3]

2. For a construction project of following quantities of works need to be executed with given cost. Prepare Abstract of Cost (AOC), Bill of quantities (BOQ), and Summary of cost including 5% contingency and 13% taxes. [6]

SN	Items Works	Quantity	Unit	Unit Rate
1	Earthwork in excavation	150	Cum	150
2	Earthwork for backfilling	100	Cum	200
3	PCC of work for foundation	5	Cum	9000
4	2nd classes Brickwork for foundation	2.5	Cum	12000
5	1st class Brickwork for superstructure	25	Cum	15000
6	(1:5) Plastering work	450	Sqm	200
7	PCC for RCC work	10	Cum	16000
8	Fe-415 reinforcement	1300	Kg	150

3. Prepare a preliminary estimate of a poly-technique building for student number 800 in order to assess the amount for building based on the following particulars. [6]

   Carpet area required per student = 1.2 sq.m.
   Area of corridors, Verandah etc. = 20% of plinth area
   Plinth area rate = Rs. 3500 per square meters.
   Area of Walls = 15% of plinth area.
   Cost of water supply work = 5% of building cost.
   Cost of sanitary = 7% of building cost.
   Cost of electrification = 12% of building cost.
   Cost of approach road and boundary walls = 3% of building cost.
   Contingencies and work charge establishments shall be 5% and 2.5% of the total cost respectively. [2]

4. a) i) What is lead and lift? [6]
      ii) Prepare the rate analysis for M20 PCC work in 10m × 10m × 1m raft foundation. [4]
   b) Write the method of deduction work for plastering work as per IS-1200. [2+2]
   c) Explain in detail how Nepal Government agencies take norms and rates for rate analysis.

5. Find out quantities of materials required for brick wall of size (10m×3m×0.23m) which has two windows of size (1.5m×1.5m). Take average size of brick (230mm×115mm×55mm), mortar thickness of 12 mm and mortar of (1:5) cement sand ratio. [5]

6. Prepare a detail estimate report for small sewerage project. [6]

7. Prepare detailed estimate for following item of works for RCC frame structured building (Fig. 2.) [3+4+3]

   i) Earthwork in excavation in foundation
   ii) Brickwork in 1:4 c/s mortar upto plinth level
   iii) 1:4 (c/s) mortar inside the room

8. Drawing of an Underground RCC water tank is given below (Fig.1). Prepare detailed estimate for following item of works. (Fig.1) [4+3+1]

   i) Brickwork (1:4)
   ii) PCC for M20 RCC work
   iii) Steel reinforcement for M20 RCC work (assuming 1% steel)

9. Calculate the quantity of the earthwork of a portion of a channel with the following data;- [8]

   Bed Width = 6m, Free Board = 50cm, Slope of cutting 1:1, side slope of banking 1.5:1, full supply depth is 2m, width of the banks is 1.5m. There is vertical drop of 0.5m at ground surface at chainage 0+090. The longitudinal slope of canal is 1 in 600

Chainage	Ground Level (m)	Bed Level (m)
0+000	225.3	224.00
0+030	225.2	
0+060	225.1	
	225.2	
0+090	224.7	
0+120	224.8	

10. Draw balanced canal section. Calculate the volume of earthwork of a portion of hill road from the given data: Top formation Width in cutting = 8m, Top formation Width in banking = 10m side slope in cutting and banking are 1.5:1 and 2:1 (H:V), respectively. [2+8]

Distance	Height of Filling	Depth of Cutting	Transverse Slope of Ground (H:V)
0 m	-	0.60	10:1
30 m	-	0.70	15:1
60 m	0.80	-	12:1
90 m	0.85	-	10:1

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1. Compare estimated cost and actual cost. Write down the unit of measurement and unit of payment for following item of works. [3+2]
   i) R.C. sunshade with specified width and height
   ii) Thickness specified shutter of doors and windows
   iii) Iron Grills
   iv) Asbestos cement sheet in roofs
2. What are the subheads of various items of work? When is an approximate estimate prepared? [4+2]
3. Prepare a preliminary estimate of a 4 storied office building having a total carpet area of 2000m^2 for obtaining the administrative approval of the ministry. Given the following data: [5]
   - 30% built up area will be taken up by corridors, verandah, toilets, staircase etc.
   - 10% of built-up area will be occupied by walls
   - Plinth area rate is Rs. 15000/m^2
   - Extra for special architecture treatment 1.5% of the building cost
   - Extra for electric installation 8% of the building cost
   - Extra for other services 5% of the building cost
   - Contingencies 5% of the total building cost
   - Supervision charge 5% of the total building cost
4. Explain the significance of analysis of rates in civil engineering projects. What are the requirements for analysis of rates? [3+3]
5. Calculate quantity of materials required for 5 m^3 of stone masonry in 1:6 cement sand mortar ratios. [5]
6. Prepare analysis of rates for providing, laying and consolidation of 10cm thick compacted gravel for sub grade per square meter. [5]
7. What is project? Explain its characteristics. Describe stages of estimating project. [8]
8. Calculate the quantities from the given building drawings: Fig. 1(a, b) [4×4]
   a) Earthwork in excavation
   b) Crushed rubble stone masonry
   c) 1st class brick work in supper structure
   d) 12 mm plastering work 1:4 for inner wall

   Following are the double room building estimation specifications:
   - In foundation cement concrete M25 is used.
   - CRS wall is used in the foundation for the base of the brick wall
   - Plinth beam size is 400 mm × 600mm in cement concrete M25
   - Damp-proof course 25mm thick is applied
   - In superstructure 1st class brickwork is in 1:4 cement mortar and thickness 300mm

- Doors D, size-1.2 m × 2.1m
- Windows W, size-1 m ×1.5m
- Shelves S-1 m × 1.5 m

9. Estimate for the construction of highway for one km length. Cut slope be 1.5:1and fill slope be 2:1, mid depth of cutting be 0.35m for two lane road and ground slope be 9:1. The pavement thickness be wearing coat, base course and sub-base over the subgrade 50mm, 250mm and 350mm respectively. [8]

10. From the drawing attached of the brick masonry pier, (Fig. 2) calculate the total quantity of brick work and also the pointing work. [6+2]

11. Work out quantity of well foundation of bridge foundation. The well is to be circular of 2m internal diameter with 300 mm thick masonry wall in 1:6 cement sand mortar. The well is founded in strata 14.00 m thick. Water table remains at 3.80 m depth. Well curb at bottom is RCC with M25 grade concrete mix and is 400 mm deep. The well rises 60 cm above ground level. Top of well is to sealed with 0.45m thick (1:4:8) cement concrete as well cover. Estimate quantities for the following works. [8]

a) Earthwork in excavation
b) Sinking of well
c) Brick masonry work in (1:6) cement sand mortar
d) PCC for RCC in curb

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180

1. What is estimating and costing? Explain the principle of units. [2+3]
2. What are the various methods of taking out quantities? What are the sub-heads of items of work for building project? [4+4]
3. Why and when are these estimates prepared/used? [2×2]
   a) Preliminary estimate
   b) Complete estimate
4. Prepare the analysis of rate for 12.5 mm plastering work in 1:3 cement sand mortar per 100 square meters all complete and as per the instruction of engineer. What modification is required in the given calculation if the plaster work is for ceiling work? Also, justify why lead and lift is important for the analysis of rate work. [6+1+1]
5. Prepare an analysis of rate for providing and fixing wash basin of size (800×400) per number. [8]
6. Describe different stages of project estimate. Explain the characteristic of technical report writing of a project. [4+4]
7. Prepare detailed estimate of the following items of works from the given building drawing attached fig 3. [3+2+4+3]
   a) Earth work in excavation in foundation
   b) Plain cement concrete (1:3:6) in foundation.
   c) Brickwork in 1:6 C.S. in super structure wall.
   d) Wood work for door and window frame.
8. Calculate the quantity of earthwork and area of permanent land required for the land acquisition purpose for a portion of a channel from following data: [12]

   Bed width = 4m
   Free board = 45 cm
   Side slope in cutting = 1:1
   Side slope in banking = 1.5:1
   Full supply depth = 1 m
   Top width of bank = 3 m left and 1.5 m right

Chainage	90	120	150	180	210	220
RL Ground	109.8	109.7	109.55	109.30	109.15	109.10
RL Bed	109.52	Bed slope 1:300 rising				

9. Prepare a detailed estimate of the following items from the septic tank with soak pit from the given fig 1. [4+2+2]

a) Earth work in excavation for soak pit
b) Cement concrete flooring for septic tank
c) Cement plaster (1:3) of 20 mm for septic tank floor

Dimensions of septic tank is: width = 750 mm, length = 1500 mm
Soak pit is of 1000 mm diameter

10. From the given fig 2 of RCC T-beam decking of one span of 6 m of which section in given, calculate the following items of works. [4+3]

a) PCC for RCC work
b) Reinforcement quantities for all RCC member

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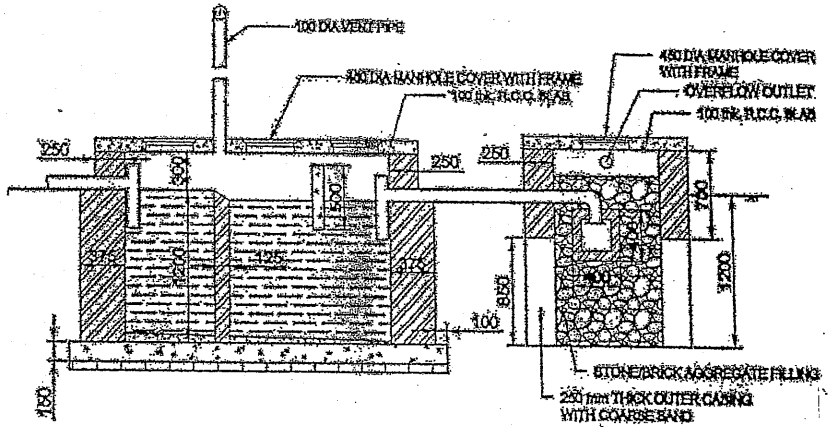


Fig 1

R. C. C. T-BEAM DECKING

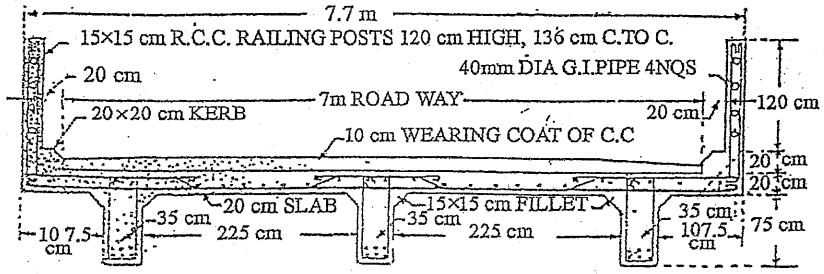
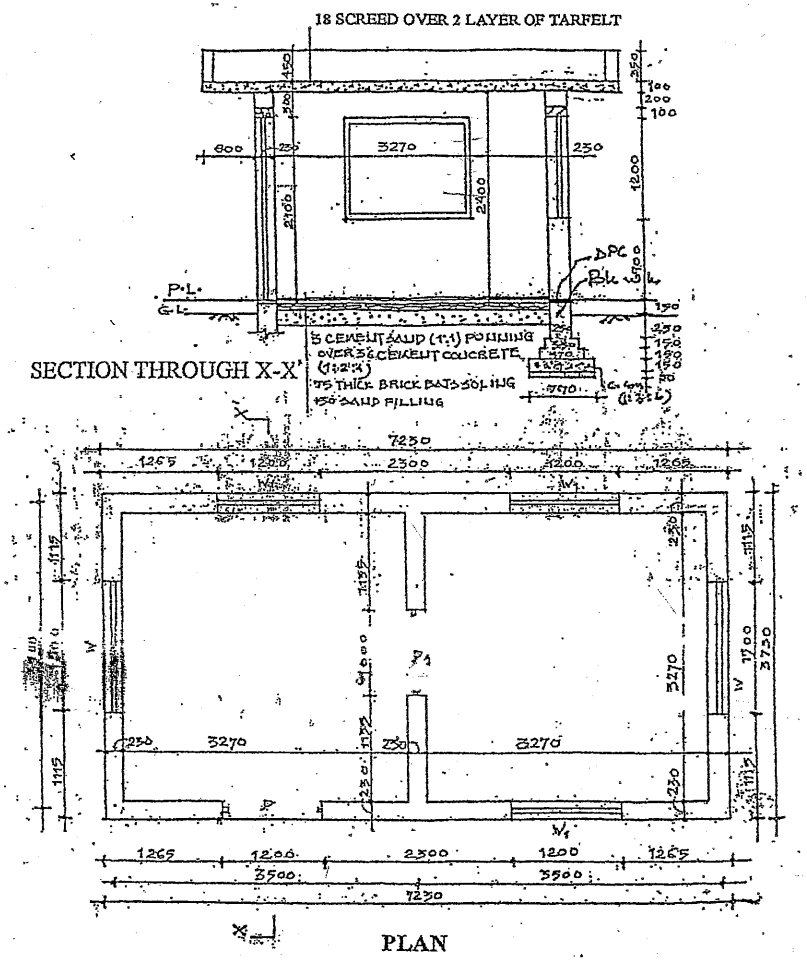


Fig 2



DOORS AND WINDOWS SCHEDOLE

All dimensions are in mm.

D = 1200×2100
D_1-1000×2100
W – 15400×1200
W_1-1200×1200

Fig 3

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1. You are working for a design project of a building. Your Team Leader instruct you to perform a work break down structure for the quantity calculation work. How are you planning to do so for the frame structure building project? [4]
2. What are the necessary points that needs to be considered while measuring earthwork. In what case do you need to prepare revise estimate? Explain with an example. [4+4]
3. Prepare a preliminary estimate of a building having a total carpet area of 2000 m^2 for obtaining the administrative approval of the ministry. Given the following data: [6]
   - 30% built up area will be taken up by circulation space
   - 10% built up area is occupied by walls
   - Plinth area rate is Rs 20000.00 /sqm
   - Interior design will taken 1% of the building cost
   - Other extra services will cost 5% of the building cost
   - Take supervision charge as 3%
4. Why analysis of rate is important for civil engineering work. Also, explain how rates are taken for analysis. Calculate the quantities of materials required for PCC (1:1.5:3) for RCC roof 0.10 m thick 20 m wide and 25 m long [Assuming rebar 0.8% to vol. of PCC] [2+2+4]
5. Prepare analysis of rates for providing, laying and consolidation of 30 cm thick compacted gravel for sub grade per square meter. [8]
6. What are the requisites for a project estimate? Explain in brief the factors you consider while preparing a building project estimate. [4+4]
7. Find following quantities for following item of works from attached building drawing. The building is a load bearing structure with 23 cm wall all around. a non-load bearing wall of thickness 11 cm divides the living room and the bathroom. The half brick thick wall is not connected to the foundation. [3+4+3]
   a) Earthwork in excavation in foundation
   b) First class brick work in cement sand mortar (1:4) in super structure.
   c) 12 mm thick cement plaster in 1:4 c/s mortar in inner (opening schedule door: 2 nos 1.2×2.1 m, window 3 nos 1×1.1 m)
8. Briefly explain the method of quantity estimate for road construction. Workout the quantities of earthwork in embankment and cutting based on the data provided below.

   Formation width of road: Dedicated four lane width based on NRS-1070. Side slope in embankment and excavation is 1:2 and 1:1.5 respectively. [2+10]

Chainage	0+000	0+030	0+060	0+090	0+120	0+150	0+180
RL of GL (m)	152.00	152.35	152.60	152.80	153.00	152.65	152.20
RL of FL (m)				151.80 152.45			153
Cross slope	Plain	Plain	1:12	1:10	1:11	1:11	1:13
Gradient of road	1:200 rising				1:300 rising		

9. The plan and section of the under-ground water tank which is fully constructed below the ground level. Find the quantities of [2+4+2]

a) Earthwork in excavation for construction.
b) Brickwork in 1:6 cement sand mortar.
c) Plastering work for inner part of tank.

10. Work out quantity of well foundation for bridge. The well is to be circular of 2 m internal diameter with 300 mm thick masonry wall in 1:6 cement sand mortar. The well is founded in strata 14.00 m thick. Water table remains at 3.80 m depth. Well curb at bottom is RCC with M25 grade concrete mix and is 400 mm deep. The well rises 60 cm above ground level. Top of well is to sealed with 0.45 m thick (1:4:8) cement concrete as well cover estimate quantities for the following works. [4×2]

a) Sinking of well.
b) Brick masonry work in (1:6) cement sand mortar.
c) Sand filling.
d) PCC for RCC in well cover.

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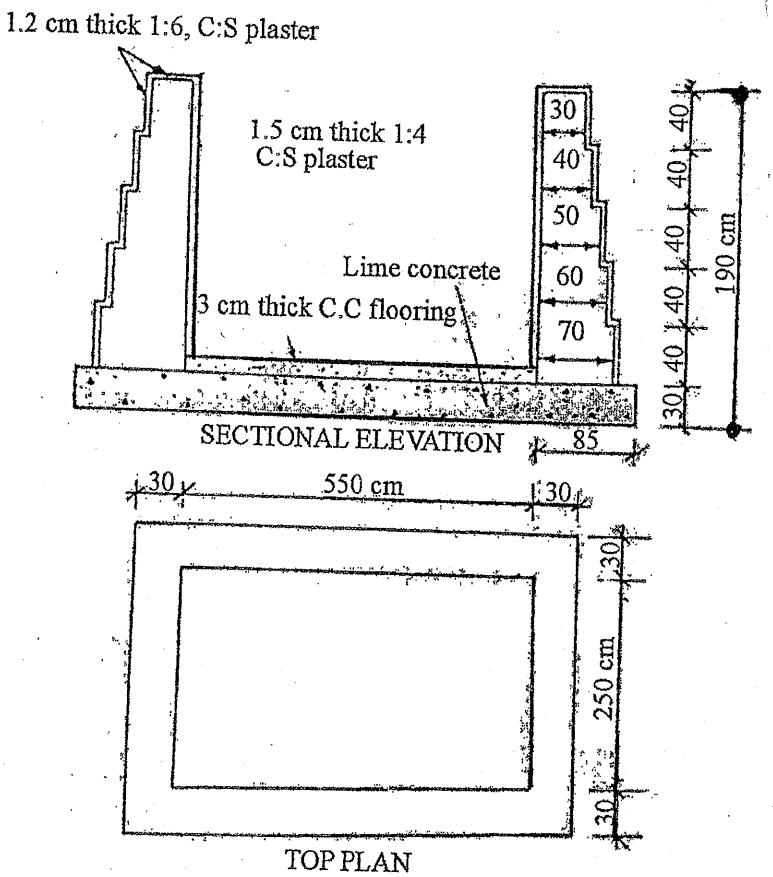

Fig: Underground Water tank

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1. Define estimate and explain the necessary things required for estimating. [1+4]
2. What is Bill of Quantities (BOQ)? How do you distingue it with Abstract of Cost (AoC)? List out the general rules to be followed during measurement of building and civil engineering works. [1+2+3]
3. What are different methods of preparing approximate estimate? In what case do you need to prepare supplementary and approximate estimate, explain with an example. [6]
4. Explain the purpose of rate analysis for a project. How the government prepare their rate analysis? [3+2]
5. Estimate the quantities of materials required for the 30 cm thick brick wall of length 10 m and height of 3 m. Local chimney bricks are laid using 1:4 cement sand mortar of joint thickness of 10 mm. [5]
6. Prepare analysis of rates for providing and laying of 20 mm thick premix asphalt concrete road per 275 sq.m area. [5]
7. Why project reporting is important? Give the major outlines of project report. Discuss estimate of water supply project. [2+2+4]
8. Calculate the following items of works from the attached drawing of building Figure 1. [5×4]
   a) E/W in excavation in foundation
   b) 1st class B/W in 1:4 cement sand mortar in super structure
   c) Wood work in door and window frame
   d) 1:2:4 RCC work excluding steel reinforcement work.
   e) Sal wood work in paneled door shutter
9. Calculate the quantity of E/W for the portion of the road of 500 m. The formation width is of 8.0 m having side slope of 1:1 and 2:1 for cutting and banking respectively. Road takes falling gradient of 1 in 75 from chainage 0 to 100 m remains level surface from 100 to 200 m and again attains rising gradient of 1 in 90 from 200 to 500 m. The surveying data provide the following records. [8]

Chaingae (m)	0.00	100.00	200.00	300.00	400.00	500.00
RL of ground (m)	655.50	654.25	652.00	653.70	655.00	658.20
RL of formation (m)			653.60			

10. Find following item of works from attached drawing of slab culvert (Figure 2). [4×3]
    a) Earthwork in excavation in foundation.
    b) First class brick work in cement sand mortar (1:4)
    c) Cement pointing works on exposed brickwork in cement sand mortar (1:3) from 15 below ground level.
    d) Reinforcement work in slab provided 16 mm bars as main reinforcement @ 100 mm c/c and 10 mm bars as distribution reinforcement @ 220 mm c/c.

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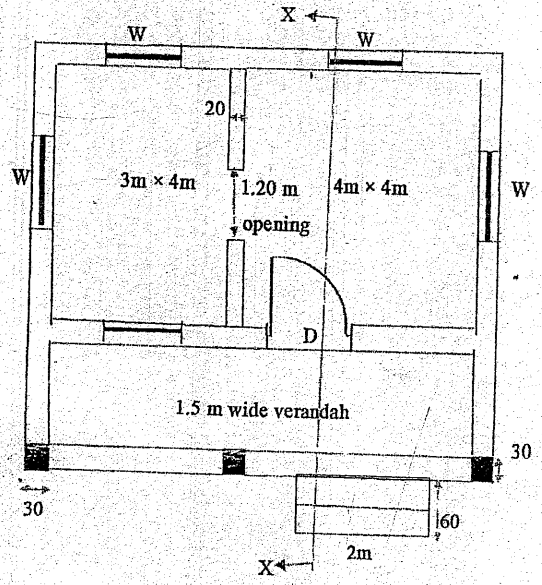
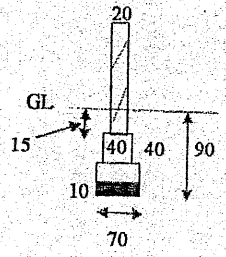
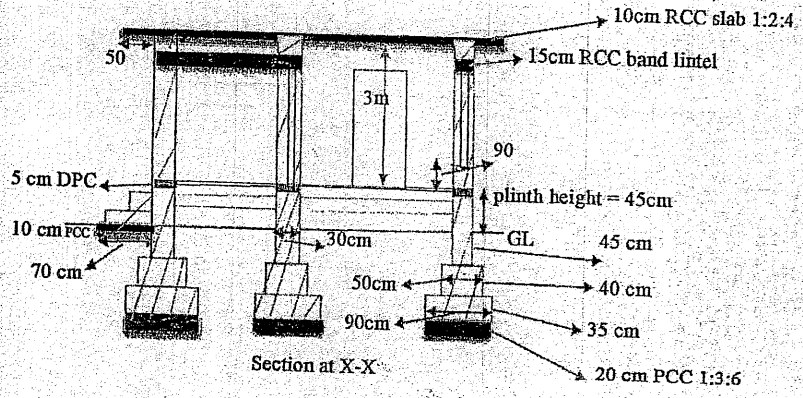


Plan



Section of partition

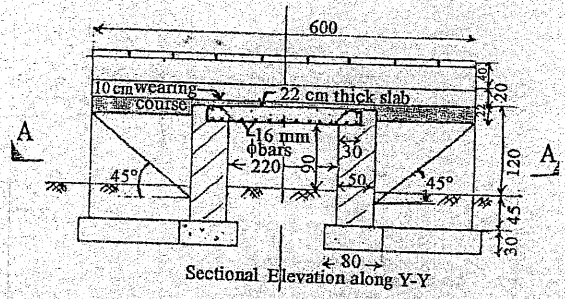


Section at X-X

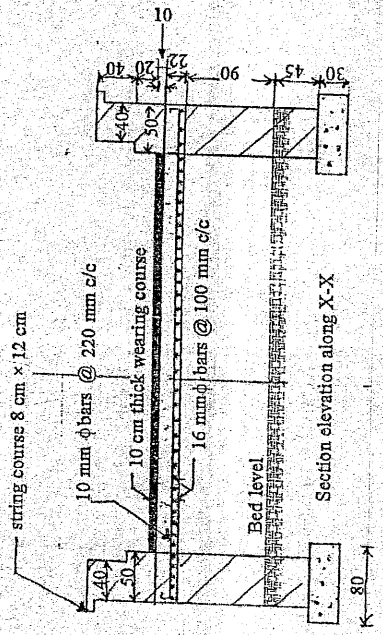
Size of door = 1.2 × 2.10m
Size of window = 1.5 × 1.5m

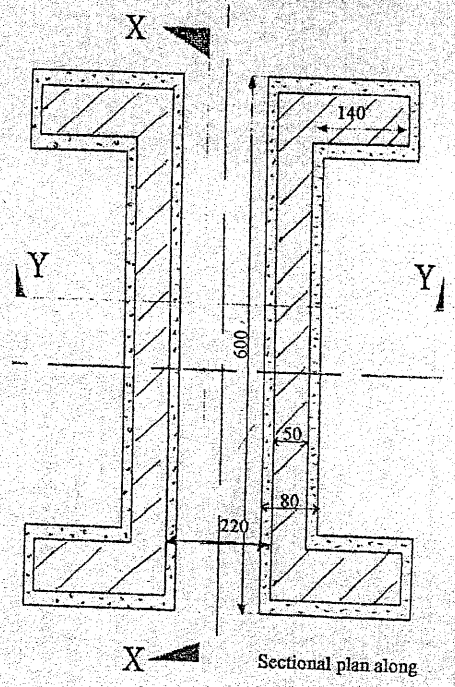
Figure 1

[Note:- All dimensions are in cm unless otherwise stated]



Sectional Elevation along Y-Y





Sectional plan along A-A

Figure 2

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1. Explain that estimated cost is never the actual cost. What are the data required for estimating? [3+2]
2. What are the various methods of taking out quantities of civil engineering? Explain briefly. State the different factors considered during detailed estimation. [4+2]
3. Prepare a preliminary estimate of the four storied office building having carpet area of 250m^2 per story. The height of each story is 3.5m and on the roof floor there is parapet wall of 0.90m height. The cube rate of the building in that locality is Rs. 250/cu.m. Take 10% built up area is covered by walls and 35% by circulation purposes. Assume other necessary suitable provisions. [5]
4. What are the requirements for rate analysis? Explain the factors affecting the rate analysis. [4+4]
5. Prepare an analysis of rate for sal wood doors and windows frame per m^3. [4]
6. Prepare the analysis of rates one metric ton of reinforcement. Labor norms per MT skilled 12 no/m^3/day, unskilled 12 no/m^3/day. Assume suitable rates. [6]
7. What are the tasks you need to consider in preparing estimate of a building project work? Explain in brief. Discuss estimation irrigation project. [4+4]
8. Prepare detailed estimate of the item of work form the building drawing (figure 1) attached herewith: [4×5]
   a) Earthwork in excavation in foundation
   b) PCC (1:3:6) in foundation
   c) Brick work in 1:6 cement sand mortar upto Plinth
   d) Plastering work 1:4 for the ceiling.
9. Calculate the quantity of earthwork and area of permanent land required for the land acquisition purpose for a portion of a channel form following data: [10]
   Bed width = 4m
   Free board = 45cm
   Side slope in cutting = 1:1
   Side slope in banking = 1.5:1
   Full Supply depth = 1m
   Top width of bank = 3m left and 1.5m right
   There is 50cm fall at chainage 800m

Chainage	800	850	900	950	1000	1050
RL ground	109.8	109.7	109.55	109.30	109.25	109.15
RL Bed	109.52	Bed slope 1:250				

10. From the attached drawing (figure 2) attached of RCC column, estimate the following items. [3+5]
    (i) RCC 1:2:4 in column
    (ii) Steel reinforcement work excluding formwork

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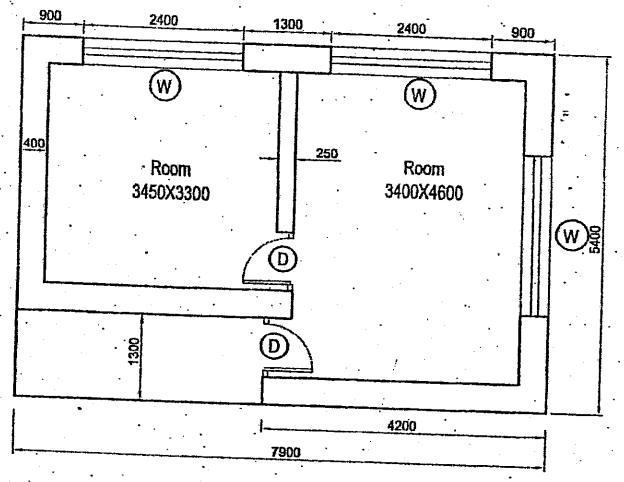
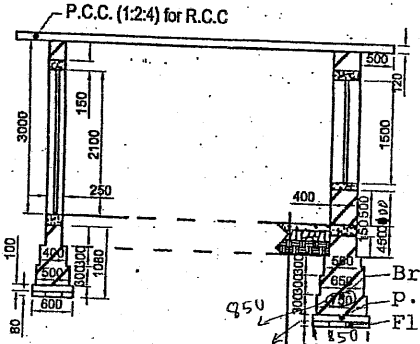
All dimensions are in mm



PLAN

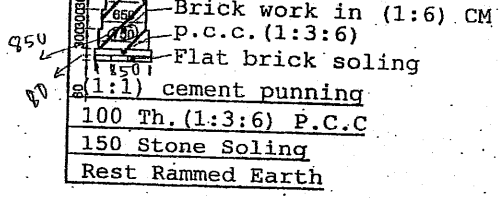


SECTION OF
0.25m, WALL

OPENINGS

D = 900X2100

W = 2400X1500



SECTION OF
0.40m, WALL

Fig-1

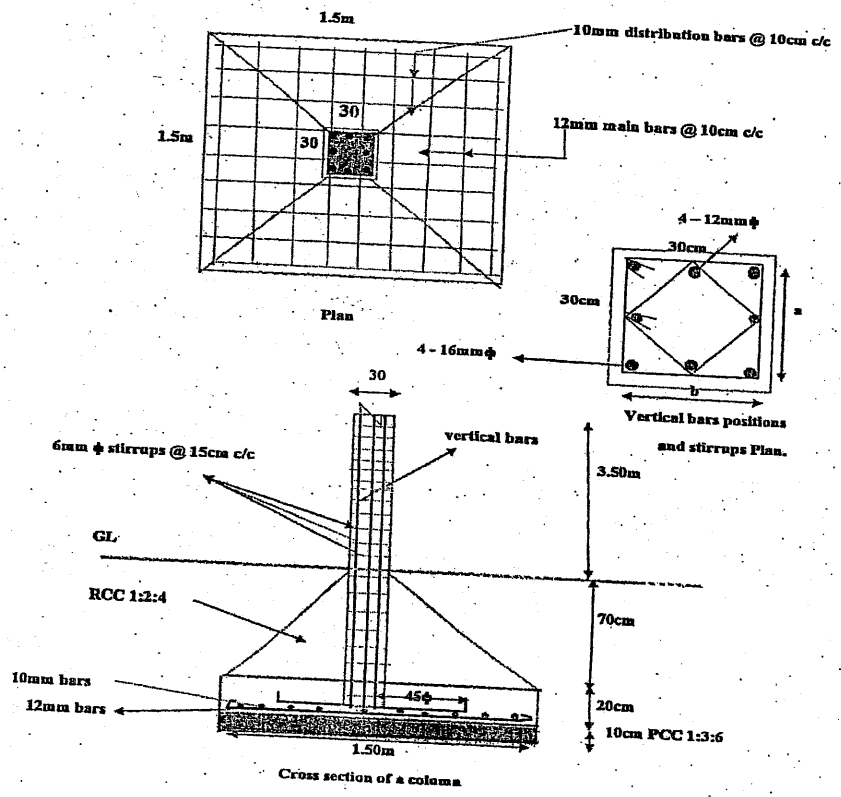


Figure 2

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Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE 705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. a) List out principle of units of measurement. Explain the data required for preparing detailed estimate. [3]
   b) Mention the various purposes of estimating and costing. [3]
2. Explain the following: [2×3]
   a) Multiplying factors adopted of Panelled door and Louver door.
   b) Rules for deductions from plastering for opening brick surfaces.
   c) Bill of quantities and abstract of cost.
3. a) What do you understand by approximate estimate? When do you need revised estimate? [4]
   b) Prepare a preliminary estimate of six storied framed structure office building having a total carpet area 3000.00 m^2
   (i) Area for circulation is 20% of plinth area.
   (ii) Area for wall and column is 10% of plinth area.
   (iii)Prevailing plinth area rate per m^2 is Rs. 25000.00
   (iv)Extra cost for other services 25% of the cost of building. [4]
4. a) What are the requirements of preparing rate analysis? Explain the factors that affect rate analysis. [4]
   b) Calculate the quantities of materials required for following items of work. [6]
   (i) 115m^2 of 75mm thick PCC (1:3:6) in floor.
   (ii) 110m^2 fo 12.5mm thick cement sand plaster (1:4) in wall.
   c) Prepare an analysis of rate for brick work in (1:6) cement mortar in upper floor per m^3. [6]

   Or,

   Prepare an analysis of rate for W.C. Commode with cistern per set.
5. What is Project? How is building project estimate. [6]
6. Estimate quantities of earthwork of a portion of road from the following data: [10]
   (i) Formation width of road is 10m.
   (ii) Side slope in cutting and filling (1:1) and (2:1) (H:V) respectively.

Distance	0	30	60	90	120	150	180
R.L. of ground	102.60	103.00	102.65	102.20	101.50	101.20	100.65
R.L. of formation	101				102.15		
Gradient	Rising Gradient 1 in 200				Falling Gradient 1 in 120		

7. Workout the quantity of a portion of channel fully in banking with the following data: [10]

Distance	R. L. of Ground level	Proposed bed level
500	1314.75	1316.00
1000	1314.90	
1500	1314.20	

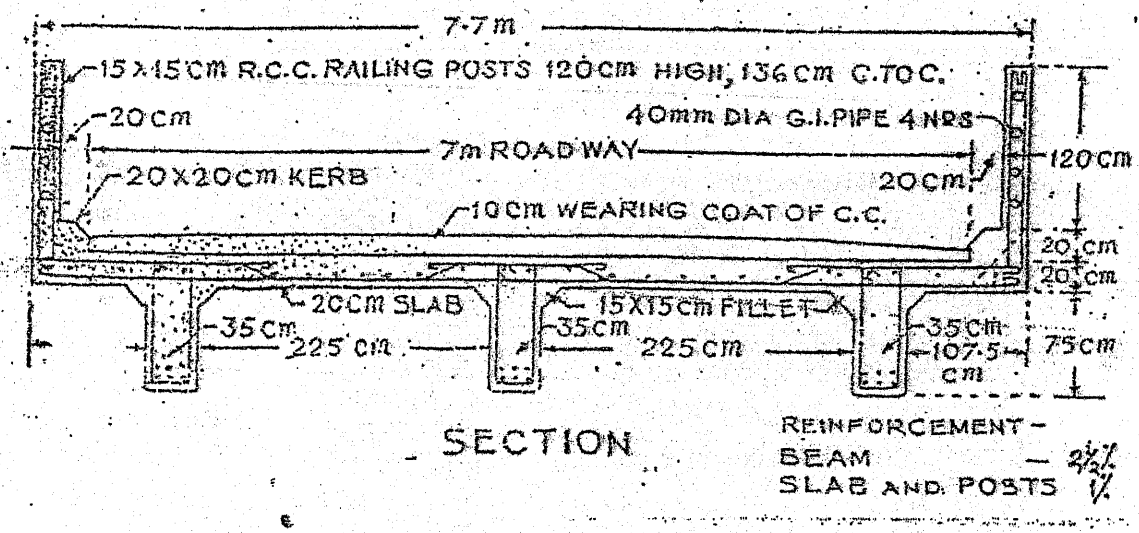
The bed width of channel is 4.50m. The bed slope is 1 in 5000. The full supply depth is 1.50m. and free board is 0.50m. The top width of both side banks are 2.50m in each bank. The side slope of banks is (1.5:1)

8. Estimate the quantities of the following items of work from the accompanying drawing (building):(Figure 1) [3+3+4]

(i) Earthwork excavation in foundation
(ii) wood work for doors and windows frame
(iii)Two coats enamel painting over one coat primer in doors and windows.

9. Estimate the quantities of a T-beam decking of single span bridge which has 6m clear span and bearing on either side is 45cm. from the accompanying bridge drawing. [8]

R. C. C. T-BEAM DECKING



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE 705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Necessary figures are attached herewith.*
- ✓ *Assume suitable data if necessary.*

1. What is an estimating? What are the purposes of estimating? Mention various data which are required for preparing detailed estimate. [1+3+2]

2. Explain the following: [2+2+2]
   a) Multiplying factors adopted in painting of Panelled door, flush door, Louver door and Glazed window.
   b) Rules for deductions from plastering for opening in brick surfaces
   c) Bill of quantities

3. a) When and where are the following estimates used: [6+5]
   (i) Detailed estimate (ii) Revised estimate (iii) Supplementary estimate
   b) Prepare a preliminary estimate of a five storied office building having total carpet area of 2500 m^2 for obtaining the administrative approval of the government, given the following data:
   (i) 30% of the built-up area will be taken up by corridors, verandah, staircase, lift etc and 10% of the built up area will be occupied by walls.
   (ii) Prevailing plinth area rate Rs. 25000.00 per m^2
   (iii)Provide 20% extra cost for water supply and sanitary fittings, electrical works, contingencies and other services.

4. a) What is an analysis of rate? Mention various factors on which the unit rates of particular item of work depends and also mention the various purposes of rate analysis. [5+6+6]
   b) Calculate the quantities of materials required for 100m long 23cm thick and 1.20m high wall in (1:6) cement mortar.(Assume size of brick is 235×110×57mm and thickness of mortar 10mm)
   c) Prepare an analysis of rate for 40mm thick PCC (1:2:4) in floor per m^2.

5. A road is to be constructed in hilly area with formation width of 10m, side slopes in banking and cutting (2:1) and (1:1). The height of banking or depth of cutting at the centre line of the road are given below. The cross slopes of ground are also given at different sections. Calculate the quantities of earthwork. [9]

Distance	Cutting	Filling	Cross slope of ground
0	0.50	--	12:1
50	0.60	--	10:1
100	--	0.40	15:1
150	--	0.60	12:1

6. Calculate the quantity of earthwork of an irrigation channel with the following data: [9]
   Bed width of channel = 5m
   Top width of both banks = 2m
   Longitudinal slope of bed = 1 in 3000
   Side slopes in cutting and filling = $1\frac{1}{2}$:1 (H:V)
   Fully supply depth = 1m
   Free board = 0.60m
   R.L. of bed at 0m = 1395.50m
   Ground level along the alignment are as given below:

R.L. of Ground	1397.50	1397.00	1396.50	1395.70
Distance	0	300	600	900

7. Estimate the quantities of the following items of work from the accompanying building drawings: [12]
   a) Earthwork in excavation in foundation
   b) Brick work in 2nd footing in foundation
   c) Wood work for doors and windows frame

8. Estimate the quantities of the following items of work from the accompanying RCC Slab Culvert drawings: [10]
   a) Earthwork in excavation in foundation
   b) PCC (1:3:6) in foundation
   c) PCC (1:2:4) for RCC slab

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE 705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. State, why estimated cost is necessary in construction work. Describe various data required to prepare an estimate. [3+3]
2. What do you mean by contingencies and work charged establishment. Enumerate the relationship and differences between the Bill of quantities and Abstract of Estimated cost. [2+4]
3. The plinth area of an apartment is 500 Sq.m. determine the total cost of building from the following data: [4]
   i) Rate of construction = Rs. 3450 per m^3
   ii) The height of apartment = 16.25m
   iii) Water supply, sanitary and electrical installations each at 6% of building cost
   iv) Architectural appearance @ 1% of building cost
   v) Unforeseen item @ 2% of building cost
   vi) P.S and contingencies @ 4% of building cost
4. Explain the significance of analysis of rates in civil engineering projects. What are the requirements for analysis of rates? [3+3]
5. Calculate the quantities of material required for 10 m^3 brick masonry in (1:3) cement sand mortar. (normal size of brick = 9 "× 4½" × 3") [5]
6. Prepare analysis of rate for 25mm thick 1:2:4 for cement concrete floor 100 m^2. (Assume suitable rate) [5]
7. Define project. Discuss estimate of irrigation project. [6]
8. Calculate the quantity of earthwork of an irrigation canal with the following data.
   Bedwidth = 5m, freeboard = 0.6 m, fully supply depth = 1m,
   Trap width of both the bank =2m, Side slope in cutting =1:1, side slope in banking=1 ½:1 [6]

Distance (m)	0	300	600 m
Ground level (m)	325.24	324.80	324.43
Proposed bed level (m)	324.00	1 in 3000 downward	

9. Prepare detailed estimate of the following items of work for a building from the attached Fig.1. [4×3]
   i) Earthwork in excavation in foundation
   ii) First class brick work in (1:4) cement mortar in foundation and plinth.
   iii) Wood work in door and window frame.

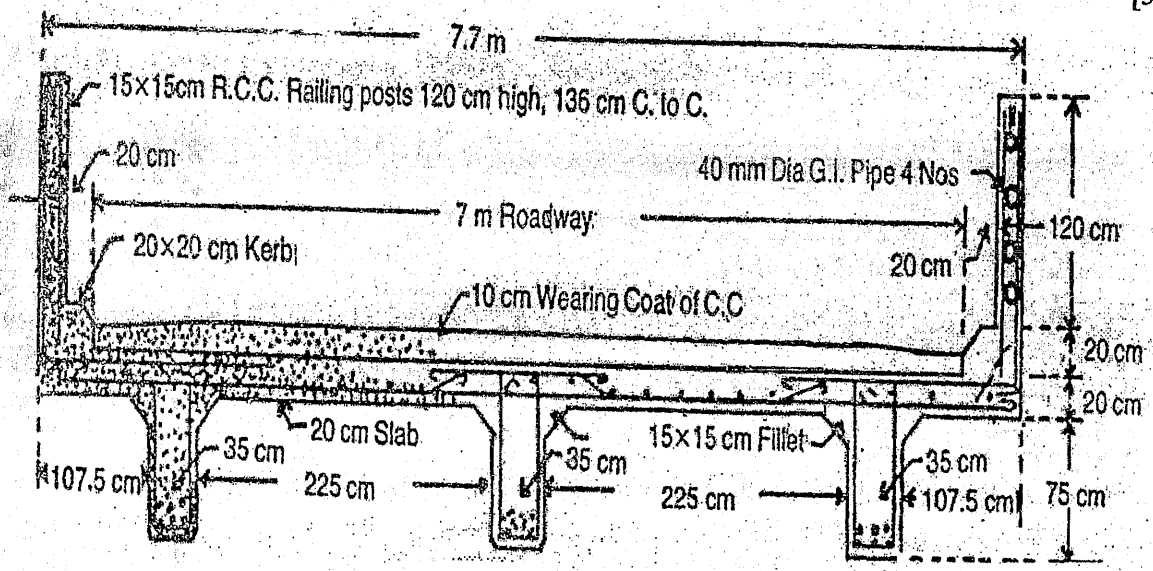
10. Estimate the quantity of earthwork of a hill road when the formation width in cutting is 4m and side slope is 2:1. The formation width in banking is 6m and side slope 3:1. The ground and formation level at the centre of road and also the transverse slopes of ground surface are as below: [10]

Chainage (m)	0	50	100	150	200	250
RL of GL(m)	1150.00	1150.60	1151.50	1150.80	1151.50	1152.00
RL of FL(m)	1149.20	1150.00	1150.80	1151.60	1151.50	1153.20
Cross slope (m)	1:10	1:1	1:14	1:12	0	1:10

11. Workout the quantity of well foundation of a bridge. The well is to be circular of 5m internal diameter with 800 mm wall in 1:6 cement and sand mortar. The well is to be founded on strata 15m below bed of river which is dry during winter. Bottom of the well is to be plugged with 1.5m thick cement concrete 1:4:8 and the top to be sealed with 1m thick cement concrete 1:2:4 and central portion is to be sand filled. [7]

12. Find out the quantities of the following items of work of a T-Beam decking of a bridge with 6m span and 45 cm bearing at ends.

    i) RCC work (1:2:4) excluding steel
    ii) Cement concrete (1:2:4) in wearing coat [5+2]



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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Enlist the purposes of preparing an estimate of quantities of work and its cost. [4]
2. What are various methods of taking quantities of works? [4]
3. What are the components of a complete estimate? Prepare a sample of abstract cost [4+4]
4. Briefly explain the various factors that affect the rate analysis. Why is rate analysis in civil engineering necessary? [4+4]
5. Prepare quantities of material required of 12 mm thick (1:6) cement plastering per $10m^2$ in brick wall. [4]
6. Prepare rate analysis of plain cement concrete (1:3:4). Assume suitable rates of material and labor. [6]
7. What do you mean by Project estimate? How do you prepare project estimate? State the reports on estimate. [1+2+3]
8. Find the quantity of the following from attached drawing. (fig. 1) [3x4]
   a) Brick work in cement mortar (1:6) up to plinth.
   b) 10 mm thick cement plastering in ceiling and underside of roof projection.
   c) P.C.C. in foundation (1:3:6)
9. Find the quantity of earth work of a hill road from the following data. Formation width is 10 m, side slope in filling and cutting 2:1 and 1½ :1 respectively. [12]

Chainage (m)	0	100	200	300	400	500	600
RL of Ground (m)	1115.20	1116.10	1116.85	1118.00	1118.25	1118.10	1117.75

Formation: RL at chainage 0 is 1116.5 m, upward gradient 1 in 200 up to chainage 300m. Downward gradient 1 in 400 from chainage 300m to onward.

10. Find the quantity of earth work of irrigation canal using prismoidal method from the following data: [6]

Distance (m)	0	50	100	150	200
RL of Ground (m)	100.00	101.00	101.00	99.00	100.00
RL of Formation(m)	99.50	99.00	89.50	89.00	88.50

Formation bottom width of canal is 6 meter and side slope 1:1.

11. Workout quantity of (i) earth work excavation and (ii) brick work of slab culvert. (fig. 2) [4+6]

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Write five units of measurement of each length, area and volume. [5]
2. Explain various methods of building estimate with suitable sketch. Explain the term contingencies and work charge establishment. [5+5]
3. Why revise estimate should be prepared? What is Rate analysis? Explain its important. [5]
4. Workout quantities of materials required in brickwork (consider brick size 230mm×110mm×55mm and mortar joint thickness as 10 mm) in cement mortar (1:6). Prepare rate analysis of plain cement concrete (1:2:4). Assume suitable rates of labor and materials. [14+6]
5. Define project. Discuss estimation of road project. [5]
6. Calculate the quantity of earthwork for a portion of hill road from following data: Formation width = 10 m in banking and 8 m in cutting, side slope in cutting = 1:1, side slope in filling = 2:1. [10]

Chainage	Cut depth	Fill height	Transverse slope
0+060	0.5	-	10:1
0+090	0.6	-	15:1
0+120	-	0.7	12:1

7. A drawing of a building is attached herewith. Calculate the quantities of:
   i) Brickwork in cement mortar (1:6) up to plinth [10]
   ii) 35 mm thick paneled door shutters. [5]
   iii) 10 mm thick cement plaster in ceilings and underside of roof projection. [5]
8. Workout quantity of brickwork of a septic tank. [5]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. a) Mention the various purposes of Estimating. [4]
   b) Write the units of measurement and payment for the following items of work: [4]
   (i) Surface excavation (ii) Brick work in well steining
   (iii)Lightening conductor (iv) Cornice
2. Describe how will you prepare a detailed estimate of a building. [6]
3. Under what circumstances the following types of estimates prepared? [6]
   a) Preliminary estimate b) Revised estimate c) Supplementary estimate
   d) Complete estimate
4. a) What are the factors on which the unit rates of particular item of work depends? [4×3]
   b) Calculate the quantities of materials required for the following items of work:
   (i) 75 m^3 of Brick work in (1:3) cement mortar
   (ii) 115 m^2 of 75 mm thick PCC (1:2:4) in floor
   c) Prepare an analysis of rate for WC Pan with low level Cistern.

   OR

   Prepare an analysis of rate for providing, laying and consolidation of 40mm thick Premix Asphalt carpeting per m^2.
5. a) A town planning authority has to acquire an area of 500000 m^2 for the development of new colony. After developing the area it is proposed to be sold at Rs 50.00 per m^2. Workout the maximum compensation which can be given to the owners whose land is to be acquired for the development of the colony, assuming: [8]
   (i) the authority is establishment charges 15% on the sale price
   (ii) 40% area is to be provided for roads, parks etc
   (iii)Colony improvement expenditure Rs 8.00 per m^2
   (iv)Engineers and architect's fee for surveying and planning the colony at 4% on the sale price
   b) Write short notes on: [6]
   (i) Scrap value (ii) Depreciation
   (iii)Sinking fund (iv) Capitalized value

6. Estimate the quantities of the following items of work from the accompanying RCC slab culvert drawings: [12]

   a) Earthwork in excavation in foundation
   b) PCC (1:3:6) in foundation
   c) Brick work in (1:4) cement mortar
   d) PCC (1:2:4) for RCC slab

7. Estimate the quantities of the following items of work from the accompanying Building drawings: [12]

   a) Earthwork in excavation in foundation
   b) Panelled door shutter
   c) Brick work in foundation and plinth

8. Calculate the quantities of earthwork of a hill road in side long ground from 0 m to 400 m partly in cutting and partly in filling with the following data: width of road = 10m, side slope in cutting and filling = (1:1) and (2:1). The road has a downward gradient of 1 in 200. The cross slope of ground = 1 in 5. Formation level at 0 m = 1203.50m. [10]

Ground level	1202.50	1201.97	1202.35	1199.66	1200.50
Distance	0	100	200	300	400

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Explain that estimated cost is never the actual cost. Also write principles of unit measurement. [4+2]
2. Explain in brief the various methods of taking out quantities of civil engineering works. Why is a revised estimate required? Explain its reasons. [4+4]
3. What are the types of estimates that are to be prepared for Administrative sanction? [5]
4. a) What are the importances of Analysis of Rates? Explain the factors that affect rate analysis. [2+2]

   b) Prepare Rate analysis of the following as per Norms of Nepal [4+4]

   (i) Ist class Brick in 1:6 C.S mortar in foundation for 1 cum.
   (ii) 20mm thick Bitumen Premix carpeting in a wearing coat of a road for 1 squ.
5. What is project? Discuss estimation of irrigation project. [5]
6. a) Estimate the quantities of following items of work from the accompanying building drawings. [16]

   (i) Earthwork in excavation in foundation.
   (ii) Lime concrete in foundation.
   (iii)First class brickwork in foundation and plinth in cement mortar (1:6)
   (iv) 1st class brickwork in superstructure.

   b) Prepare an estimate for a road portion from the following data.

   - Formation width in Banking = 10m
   - Formation with in cutting = 8m
   - Side slope in cutting = 1:1
   - Side slope in Banking = 2:1 (H:V)

Chainage	0	30	60	90	120	150
Depth of art	0.5	0.3	0.2	-	-	-
Ht.(Height) of Bank	-	-	-	0.3	0.5	0.7
Cross slope of ground	10:1	12:1	14:1	12:1	10:1	8:1

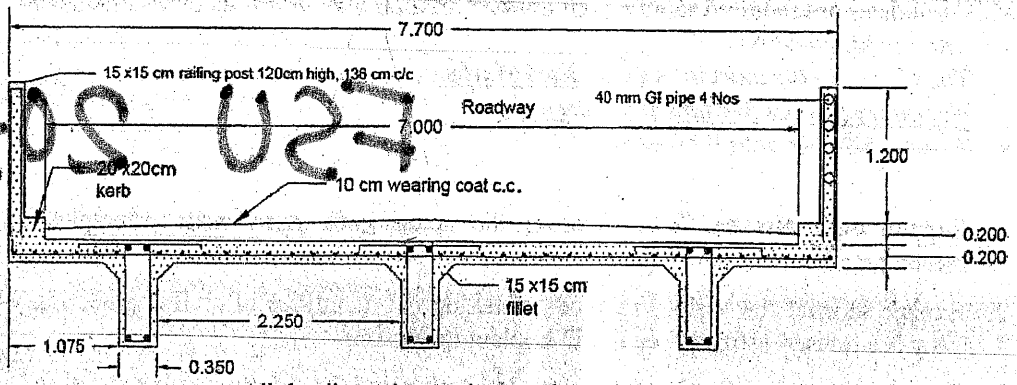
   c) Calculate the quantity of earthwork for portion of channel with following data: [8]

   Bed width = 3m
   Free board = 0.5m
   Side slope for digging = 1:1
   Side slope for banking = 1:1.5
   Full supply depth = 1m
   Top width of bank = 1.5m

Chainage (m)	0	30	60	90
RL of Ground (m)	224.8	224.43	224.12	224.5
Proposed Level (m)	223.94	223.88	223.82	223.76

d) Estimate quantity of following works in RCC T-beam for a bridge of one span of 6m section provided in figure below. Assume 45 cm bearing on either side of abutment. The mild steel section reinforcement are 2.5% in beam and 1% in slab and post. density of mild steel is 78.5 quintal per cu.m (7.85 gm/cm^2)

(i) RCC work (1:2:4) for ribs, fillets, deck slab, kerb and wearing coat.
(ii) Steel and GI pipe works [8]



All the dimension are in m. unless otherwise stated.

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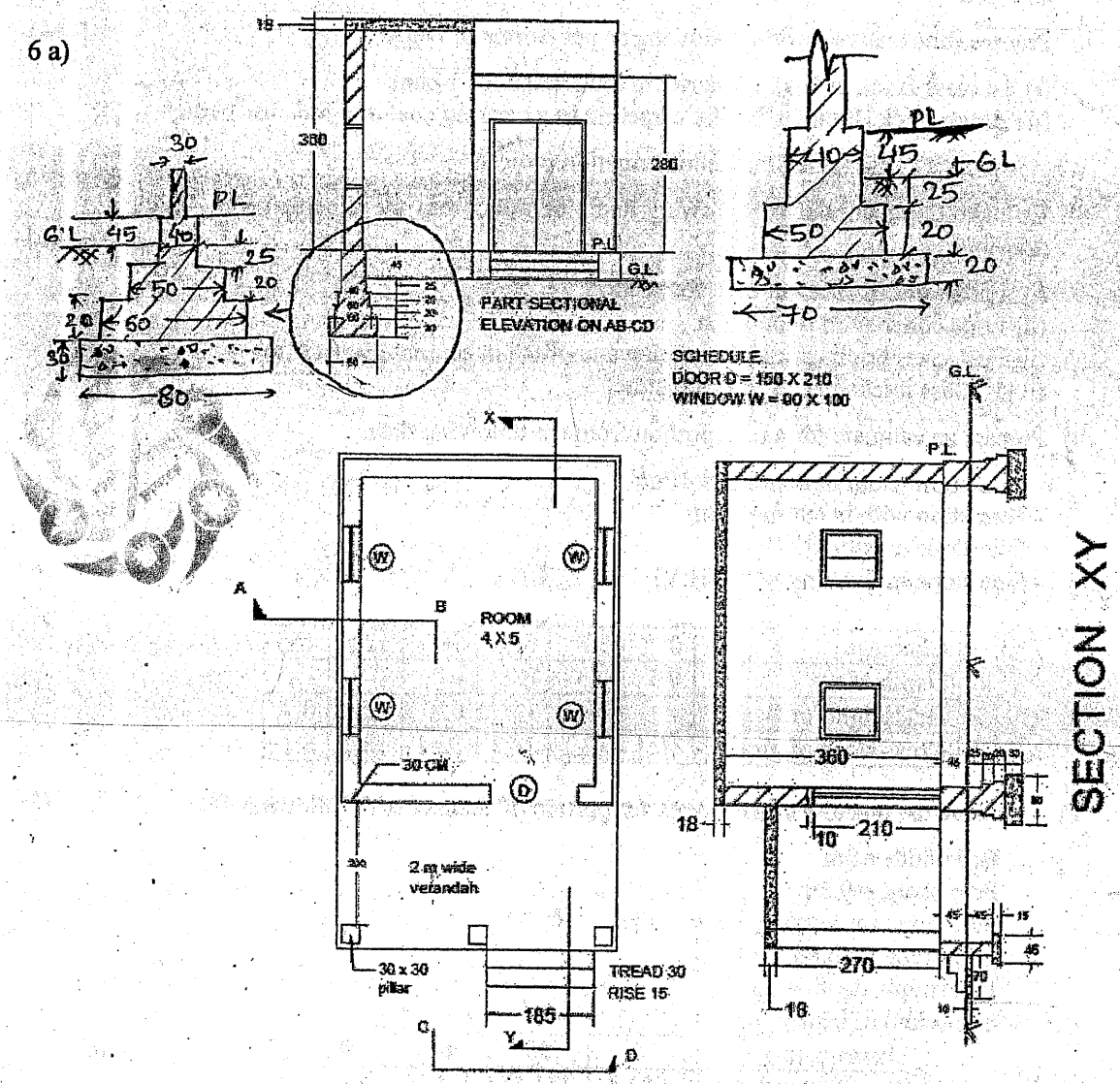
6 a)



All the dimension are in cm. unless otherwise stated.

06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. a) Describe the term estimate. State the necessity of estimated cost in construction work. Mention the various requirements for preparing detailed estimate. [2+2+2]

   b) (i) Describe briefly how will you prepare a detailed estimate of a building. [2×5]

   (ii) Prepare bill of quantities from the following data for the construction of RCC T-beam Decking bridge.

Quantity of work	Detail of work	Rate per unit of work
108 m^3	PCC (1:1:2) for RCC works	Rs 13,200.00
3240 m^2	Formwork for RCC works	Rs 750.00
21600 kg	Steel reinforcement for RCC works	Rs115.00
18 m^3	PCC (1:2:4) wearing coat	Rs 12090.00

2. a) What are the different methods of preparing approximate estimate? Write the suitability of each method. [6]

   b) Estimate the quantities of the following items of work from the accompanying BUILDING drawings. [10]
      i) Lime concrete in foundation
      ii) Brick work in second footing
      iii) DOOR shutters
      iv) 25 mm thick DPC

3. i) What are the purposes of analysis of rate? Which points are taken into consideration while preparing analysis of rate? [4×4]

   ii) Estimate the quantities of cement, sand and coarse aggregate required for 12 cm thick RCC slab of (1:1½:3) mix proportion. The outside dimensions of slab are 4.20m×3m.

   iii) Calculate the quantities of materials required for 115m3 of brick masonary in (1:3) cement mortar, (the size of brick is 240×115×60 mm and thickness of mortar is 12 mm)

   iv) Prepare an analysis of rate for 12 mm thick cement plaster (1:3) in ceiling per $10m^2$.

4. Calculate the following items of work from the attached building drawing. [16]
   i) Earthwork in excavation
   ii) Stone soling in foundation and sand filling in floor.
   iii) PCC for RCC upto plinth beam
   iv)Brick work upto plinth

5. Prepare an estimate of earthwork for a road portion from the following data: [16]
   Formation width =8 m in cutting and 10 m n banking
   Side slope in cutting = 1:1
   Side slope in Banking = 2:1 (H:V)

RD:	0	30	60	90	120
RLS of ground:	507.0	507.95	507.30	506.90	506.50
Formation level:	507.0 and upward gradient @ 1 is 150				
Cross slope of ground:	1:10	1:12	1:10	1:12	1:10

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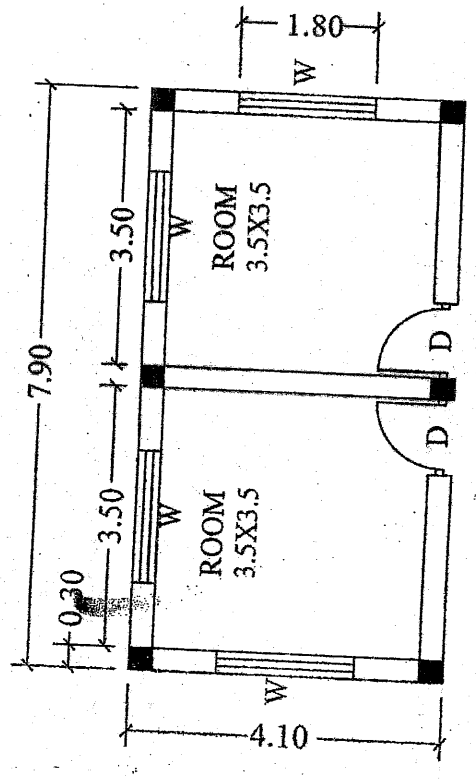
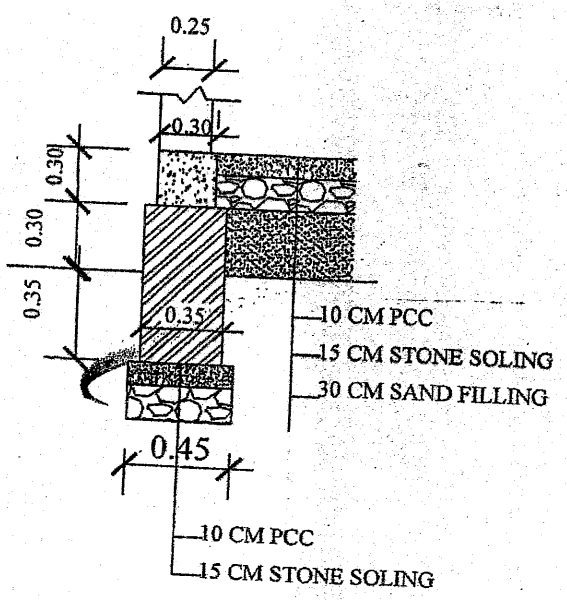
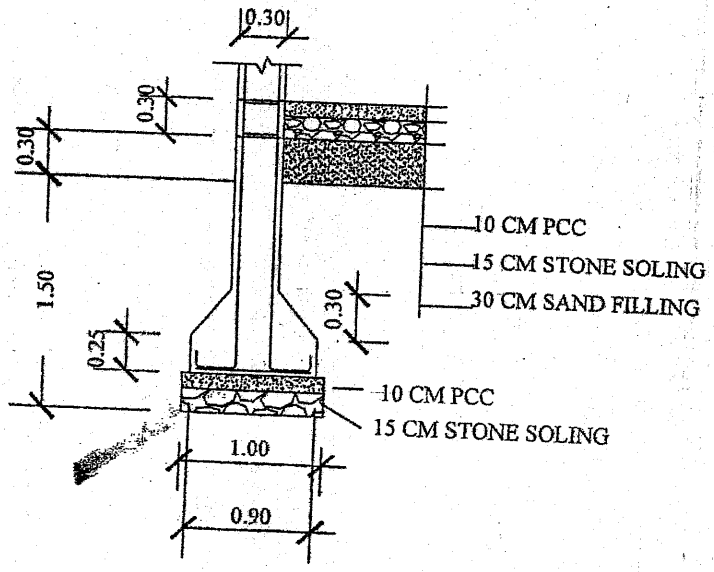
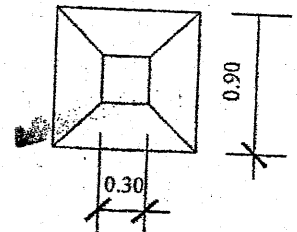


PLAN



WALL SECTION





COLUMN SECTION

NOTE
ALL DIMENSION ARE IN METRE
DRAWING IS NOT IN SCALE

OPENING SCHEDULE
DOOR D-1.0x2.1
WINDOW-1.8x1.5

SECTION
COLUMN: 0.30x0.30
FOOTING: 0.90x0.90
PLINTH BEAM:0.30x0.30

05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. a) Define Estimate, what are the purposes of preparing estimate? Explain various requirements for preparing detailed estimate. [2+3+3]

   b) What are various methods of taking out quantities of items of works? Explain the importance of abstract of bill of quantities. [4+4]

2. a) What are various types of estimate? Where and when do you require a revised estimate? Explain. [4+4]

   b) Why is Rate analysis necessary in civil engineering works? Prepare rate analysis for the following: [2+3+3]

      i) First class Brick work in 1:6 C.S mortar

      ii) Single coat wearing course surface dressing on top of WBM.

3. a) Mention the various factors included in road project, estimate. [6]

   b) A hill road is to be constructed in a side long ground in cutting. Calculate the quantities of earth work in a length of 200 m from the data given below: [10]

Formation width of road = 8 m, side slope = 2:1

Distance	Depth of cutting at center	Cross slope of ground
0	0.60 m	8:1
100	1.20 m	10:1
200	1.80 m	12:1

4. a) Work out the quantity of earthwork from 1000 m length of a channel with the following data: [8]

   i) Bed width = 4.0 m
   ii) Proposed bed level at 0 m = 1137.30
   iii) Side slope in cutting = 1:1
   iv) Side slope in banking = 1 ½ :1
   v) Top width of both bank = 1.50 m
   vi) Full supply depth = 60 cm
   vii) Free board = 45 cm
   viii) Bed slope = 1 in 5000

Ground levels as given below:

Distance	0	500	1000
Ground level	1137.90	1137.80	1137.60
Proposed bed level	1137.30		

   b) Work out the quantities of the following items of work from the accompanying SEPTIK TANK drawing: [8]

      i) Earthwork in Excavation
      ii) PCC (1:3:6)
      iii) Brickwork in (1:4) cement mortor

5. Calculate the quantity of Earthwork and area of permanent land required for the land acquisition purpose for a portion of a channel from the following data: [12+4]

Bed width= 4 M, Free Board= 45 Cm , Side slope in cutting 1:1, Side slope in Banking= 1 ½ :1
Full supply depth = 1m, Top width of bank= 3 m (Left) 1.5 m Right
There is a 50 cm fall at 60 m distance

Distance	0	30	60	90	120	150
Rt of GL	109.80	109.7	109.35	109.30	109.15	109.10
RL of Bed	109.52	Bed slope 1 in 3000				

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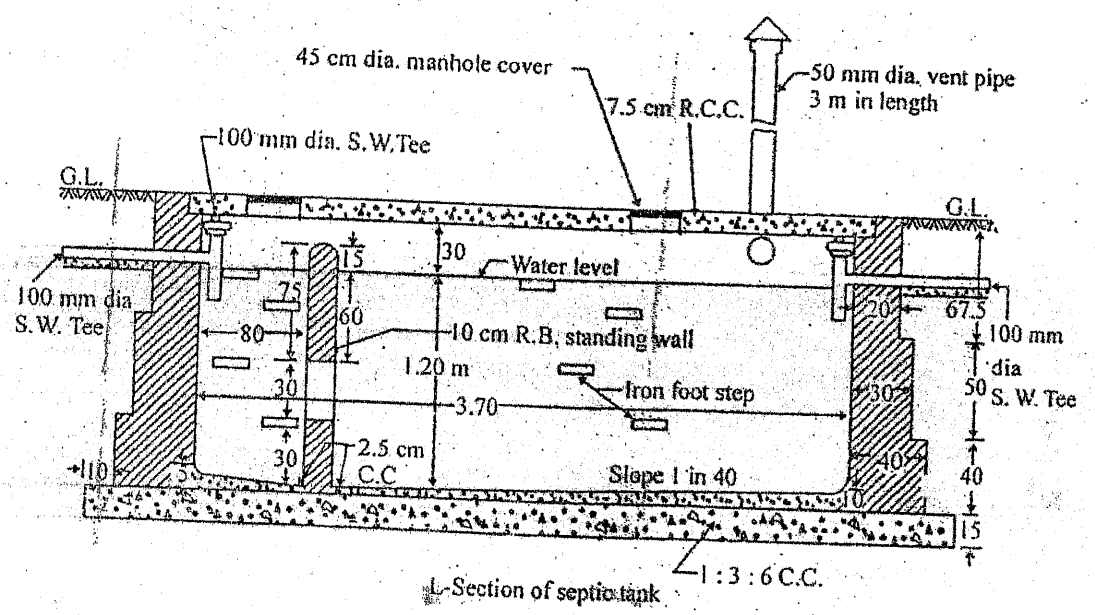
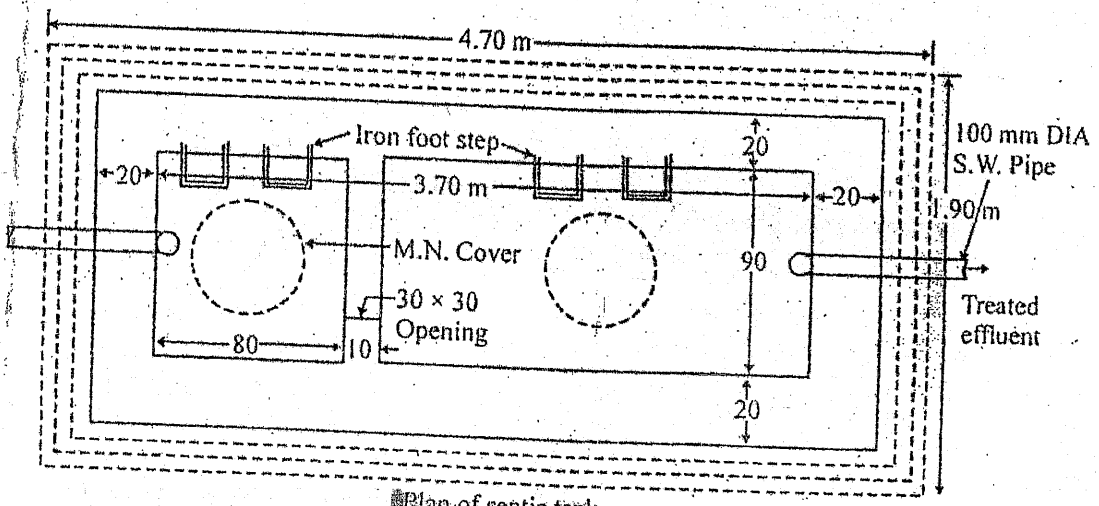
For Question No.3(b)



Section of septic tank



Plan of septic tank

(All dimensions in cm except otherwise mentioned)

05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. a) What are the purposes of preparing an estimate of quantities of work and its cost? Explain the data required for preparing an estimate. [4+4]
   b) What are various methods of taking quantities of works? Explain their uses. What do you understand by Bill of Quantities? [4+2]
2. a) What are the components of a complete estimate? When and where are approximate estimate and revised estimate used? [3+3]
   b) What do you mean by Project estimate? How do you write a Project report for a building project? [2+4]
3. a) What is Rate analysis? Write importance of Rate analysis. [3+3]
   b) Prepare Rate analysis for the following items of work: [6+6]
      i) Brick work in (1:6) cement mortar in ground floor level.
      ii) 20 mm thick premix carpeting wearing course

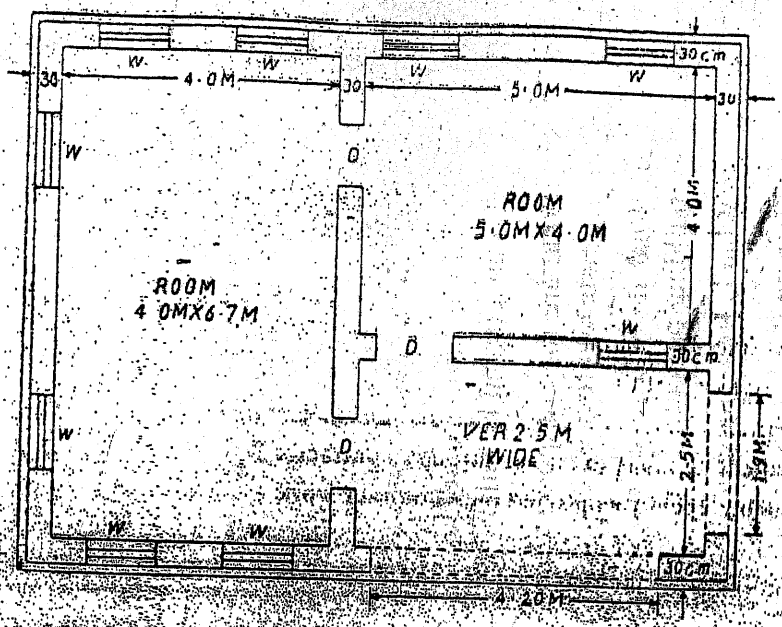
      OR

      500 long WC. Pan with low level cistern per-no.
4. Prepare detailed estimate of the following items of work for a building from the attached drawing: [12]
      i) Earthwork in excavation in foundation
      ii) Lime concrete in foundation
      iii) Brick work in 1:6 cement sand mortar in formation up to plinth
5. Calculate earthwork for a portion of hill road from the following data: [12]

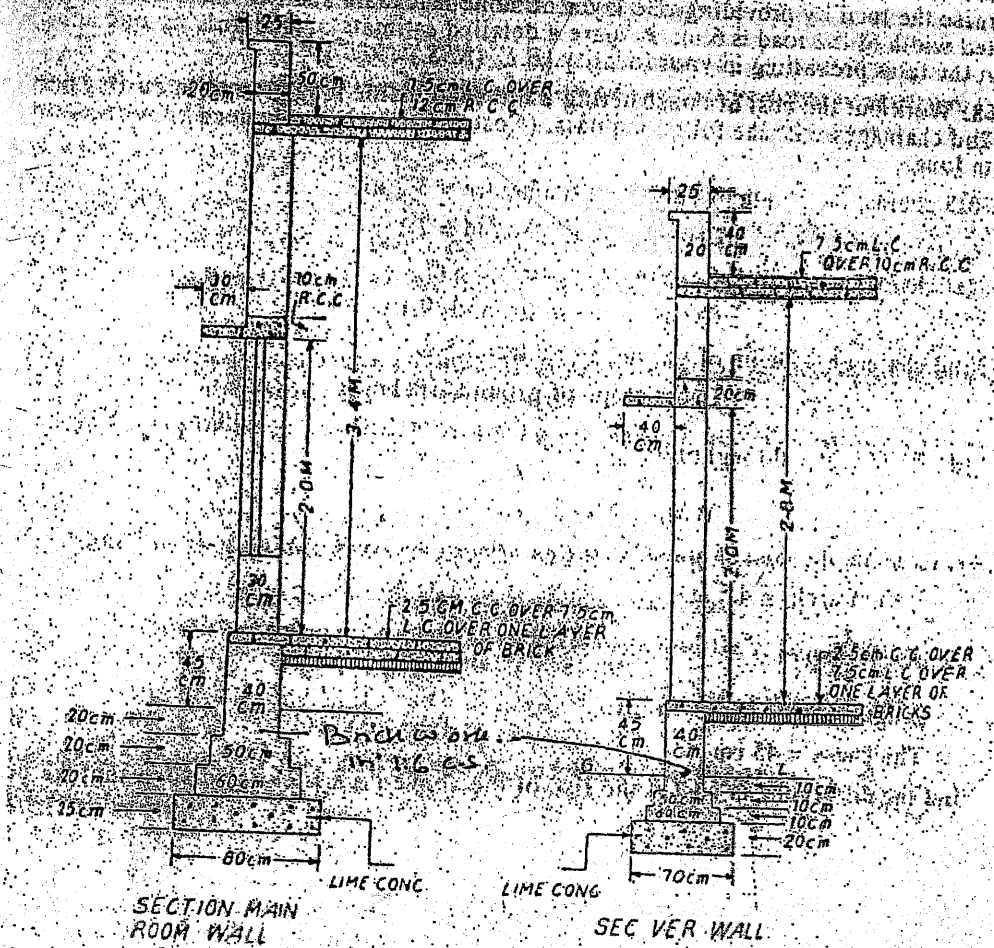
Chainage	0 m	30 m	60 m	90 m
RL of GL	104.0 m	105.0 m	106.0 m	107.0 m
Formation level	105.0 m	105.5 m	106.0 m	106.5 m
Transverse / cross slope of ground	20:1	15:1	12:1	10:1

   Formation width = 10 m, side slope in cutting = 1:1
   Side slope in banking = (2:1) (H:V)
6. Prepare detailed estimate for the following items of work from the given drawing of septic tank and soak pit. [4+4+4]
      i) Earthwork in excavation in septic tank and soak pit
      ii) Plain cement concrete (1:3:6) in foundation
      iii) Brick work in (1:6) cement mortar in septic tank and soak pit

***



PLAN DOORS 1·0X2·0M WINDOW 5·1·0X1·5M



PLAN
All Dimensions in Centimetre unless otherwise Specified.

04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Explain with example process of preparation of a preliminary estimate of a office building. [5]
2. a) Explain with neat sketches to workout quantity of semi-circular arch (span, thickness and rise of arch given). [4]
   b) Prepare tables of quantity sheet and abstract cost for a residential building. [3]
   c) What is Bill of quantities? State its importance. [3]
3. List most common units of measurement and payment for civil works and sanitary works (at least five from each). [5]
4. a) Prepare materials required for an items of brickwork in cement mortar (1:4). Size of brick is 230mm×110mm×55mm, with mortar joint 10mm. [6]
   b) Prepare rate analysis for 20mm thick cement sand plaster (1:4) in wall per $100m^2$. [6]
   c) Explain various factors which affects the rate analysis. [6]
5. Define project. Discuss estimate of irrigation project. [5]
6. a) Estimate detailed quantities for the following items form attached building drawing:
      i) Earth work in excavation in foundation [4]
      ii) Brick work in cement sand (1:6) mortar up to plinth [4]
      iii) 40 mm thick sal work wood paneled door shutter [4]
      iv) 12 mm thick inside cement plaster (1:6) [4]
   b) Calculate the quantities of earthwork of a portion of hill road from the following data: [12]

      Formulation width = 8m, side slope in cutting and filling = (1:1) and (2:1)

Distance	Depth of cut	Depth of fill	Cross slope of ground
0 m	0.30	-	10:1
30 m	0.20	-	15:1
60 m	-	0.50	12:1
90 m	-	0.70	8:1

   c) Workout the quantity of well foundation of a bridge. The well is to be circular of 4.5 meter internal diameter with 800 mm wall in 1:6 cement and sand mortar. The well to be founded on strata 15 meter below bed of river which is dry during the hot weather. Bottom of the well to be plugged with 1.0 meter thick cement concrete 1:4:8 and the top to be sealed with 0.75 meter thick cement concrete 1:4:8 and central portion is to be sand filled. [9]

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SINGLE ROOM BUILDING WITH FRONT VERANDAH

Fig.

05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Necessary figures are attached herewith.*
- ✓ *Assume suitable data if necessary.*

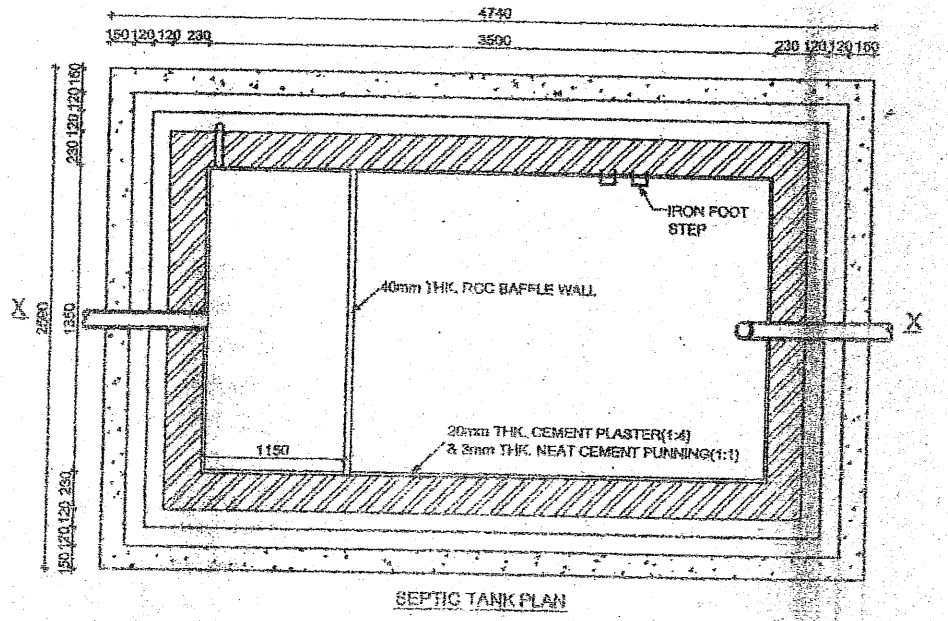
1. a) Define estimate and write its purpose. [5]
   b) What are the various methods of taking out qualities? Explain with figure. [6]
   c) What are the units of measurements and payments of the following items? [5]
      i) Earth work in excavation
      ii) Woodwork in door and window shutters
      iii) W.C pan
      iv) Reinforcement work
      v) White washing
2. a) What is analysis of rates? Write the requirements of rate analysis. [5]
   b) Prepare the analysis of rates for 12 mm thick 1:4 cement plastering on ceiling per 10 m^2. [5]
   c) Find the quality of materials required for first class B/W in 1: 4 cement sand mortar per 150m^3. (Assume size of brick = 230×110×57 mm and thickness of motor is 12mm) [6]
3. a) What are the different types of estimate and in which conditions they are used? [7]
   b) Calculate the volume of earthwork in the hill road having formation width of road is 10 m from the following data: [9]

Distance (m)	Depth of cut(m)	Ht.of fill(m)	Cross Slope	Remarks
0	0.90	-	10:1	Side slope: Cutting = 1:1 Filling = 2:1
100	-	1.20	6:1	
200	-	0.50	5:1	

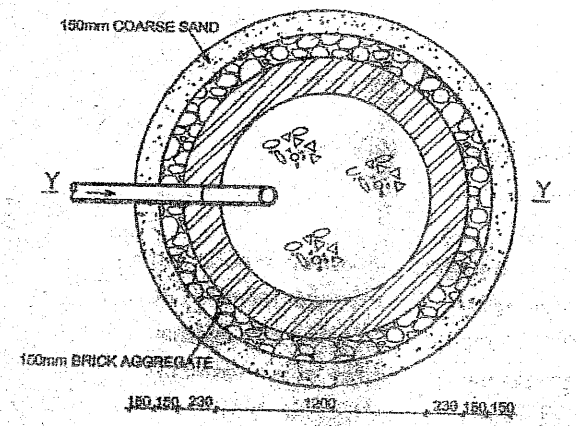
4. a) What are the things that should be considered for preparing project estimate report of an irrigation project? [8]
   b) What are the difference between (i) contingencies and overhead costs. (ii) Bill of quantities and Abstract of cost. [8]
5. Estimate the following items of work from the attached drawing provided behind this page: [4×4]
   i) Earth work in excavation in septic tank and soak pit
   ii) Brick work in 1:6 cement sand mortar
   iii) Dry brick work
   iv) Brick aggregate filling

***

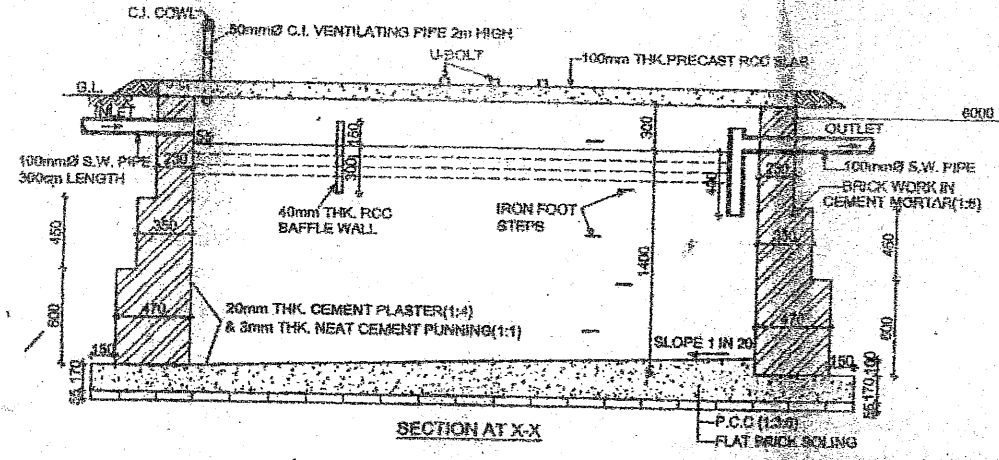
QUESTION NO 5



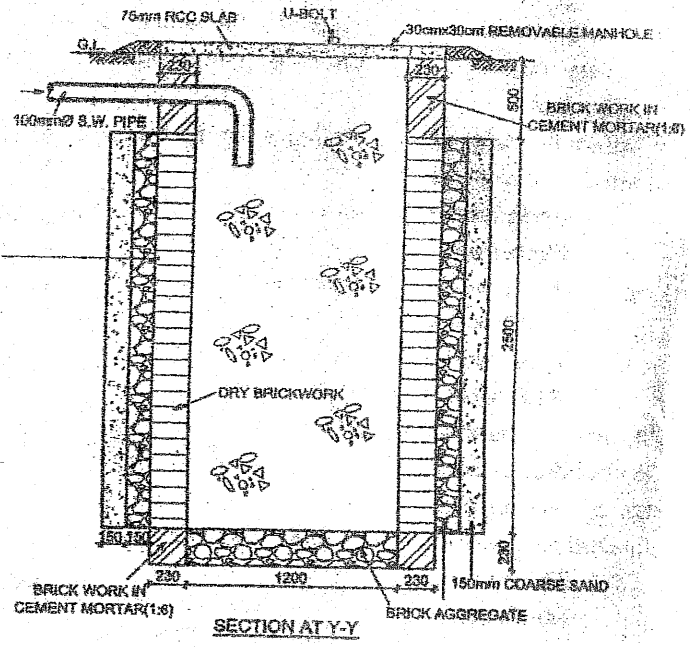
SEPTIC TANK PLAN



SOAK PIT PLAN



SECTION AT X-X



SECTION AT Y-Y

05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Estimating and Costing *(CE705)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. a) What are the purposes of Estimating and Costing? Explain the data required for Estimating. [3+5]
   b) Explain in short the various methods of taking quantities in building works. [4]
2. a) What do you understand by approximate estimate? When do you need revised estimate? And Why? Explain. [4+4]
   b) What are the purposes of Rate Analysis? Prepare Rate analysis of the following: [4+4+4]
      i) 1st class brick work is 1:6 C.S mortar per m^3
      ii) 25 mm thick premix carpeting per m^2 W.C commode low level cistern per no.
3. a) What are the works that an estimator has to take account in project estimate? Explain. [6]
   b) Find out the quantities of the following items of work of a T-beam seeking of a bridge with 6 m span and 45 cm bearing at ends. [5+3]
      i) RCC work (1:2:4) excluding steel
      ii) Cement concrete (1:2:4) in wearing coat
4. Prepared a detailed estimate of the following items of work of a building (drawing attached here with) [5+4+5]
   i) Earth work in excavation
   ii) PCC (1:3:6) in foundation
   iii) Brick work is 1:6 c.s mortar in foundation and phith
5. Estimate the quatities of earthwork for a portion of a hilly road from following data: [10]

   Formation width = 10 m
   Side slopes in cutting = 1:1 and in Banking = 2:1 (H.V) length of chain = 30 m

Chainage:	12	13	14	15
Depth of cut:	0.4	0.2	-	-
Ht.of Banking:	-	-	0.3	0.5
Transverse slope of ground:	1:10	1:12	1:10	1:8

6. Calculate the quantity of earth work for a portion of channel with the following data: [10]
   - Bed width = 3 m
   - Free Board = 0.44 m
   - Side slope for digging = 1:1
   - Side slope for Banking = 1: 1½ (V:H)
   - Fully supply depth = 1 m
   - Top width of bank =1.5 m

Chainage:	0	30	60	90	120	150
RL of GL:	225.24	224.8	224.43	224.12	224.5	224.98
Proposed level:	224.00	223.94	223.88	223.82	223.76	223.7

   Also draw a typical X-section.

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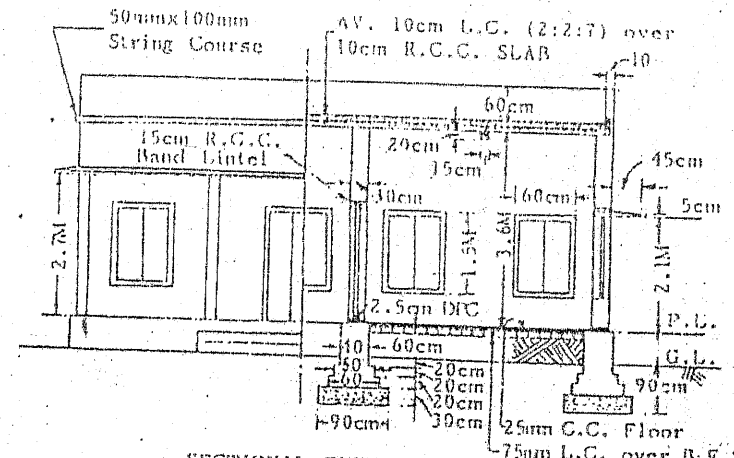


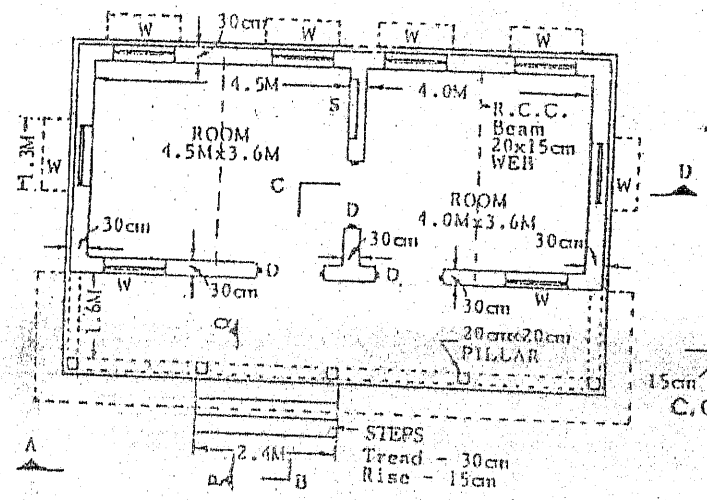
SECTIONAL ELEVATION ON ABCD

Schedule

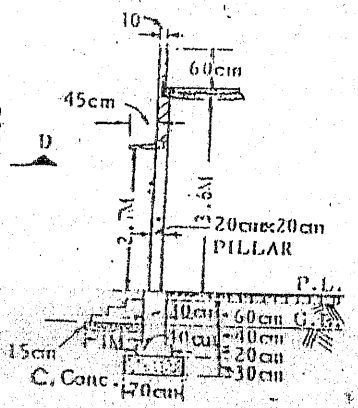
DOOR :
D = 1.2M x 2.1M
FRAME
= 10cm x 8.0cm

WINDOW :
W = 1.1M x 1.5M
FRAME
= 10cm x 8.0cm

SHELF
S = 1.1M x 1.5M
20cm Deep

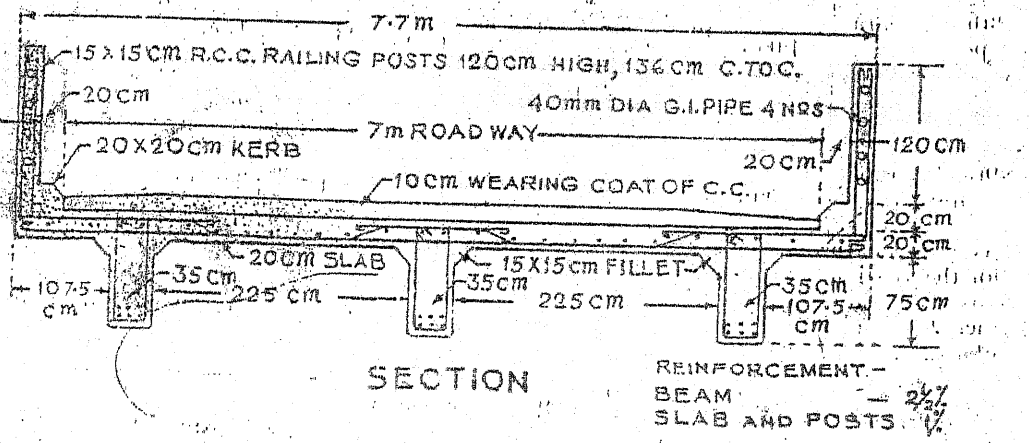


PLAN



SECTION ON PQ

R. C. C. T-BEAM DECKING



SECTION

REINFORCEMENT.—
BEAM — 2½%
SLAB AND POSTS — ½%

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering (*CE 704*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Briefly discuss the institutional set up in hydroelectricity development in Nepal with flow chart. [4]
2. Mention different phases of hydropower development cycle. What factors do you consider in pre-feasibility and feasibility study of hydropower projects? [2+2+2]
3. The water turbine at a hydel storage plant produces the 1000 HP when working under a net head of 30 m and with an overall efficiency of 80%. The inflow in the reservoir during a year is given below. [4+4]

Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Q (Mm^3)	90	80	73	80	70	98	120	80	96	105	100	75

   Find, i) Minimum capacity required ii) Total quantity of the water wasted

   (Assume the reservoir is full in the beginning of the year).
4. How do you optimize the plant capacity of a RoR Project? Discuss. [4]
5. Define elementary profile of a gravity dam. How do you proportionate the dimensions of an elementary profile if the reservoir is full? [1+5]
6. Determine the seepage line for a homogeneous earthen dam of height 22 m and top width 6 m retaining 20 m depth of water in the reservoir. The slope of the upstream and downstream faces of the dam is 45°. Also determine the seepage discharge, if the length of the dam is 3 km and the value of the coefficient of permeability of the dam material is 3×10^{-3} mm/s. [10]
7. Define spillway. Explain siphon and shaft spillway with neat sketch. [1+3+3]
8. Draw a neat sketch showing the typical arrangement of components of a headworks of a RoR hydropower project. Write down the importance of its intake. How do you decide the location of an intake in a river? [2+2+2]
9. Design a settling basin for a design discharge of 6 cumec. The basin is designed to be removed particle size of 0.25 mm. If the depth of basin is 3 m and settling velocity 2.5 cm/sec, find the dimensions of the basin considering turbulence. [7]
10. Briefly discuss on the hydraulic design consideration of the surge tank and pressurised hydraulic tunnel. [3+3]
11. Design a forebay with following data: [6]
    Design discharge = 20 m^3/s, penstock length = 300 m
    Detention line = 3 minutes, diameter of penstock = 2.2 m.
12. a) What are the functional requirements to fix the approximate dimension of the power house? [4]

    b) Design of a pelton turbine for a hydropower plant having net head 312.5 m and discharge 5 cumec. Take efficiency of turbine 85% frequency 50Hz and velocity coefficient 0.98. [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering (*CE 704*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

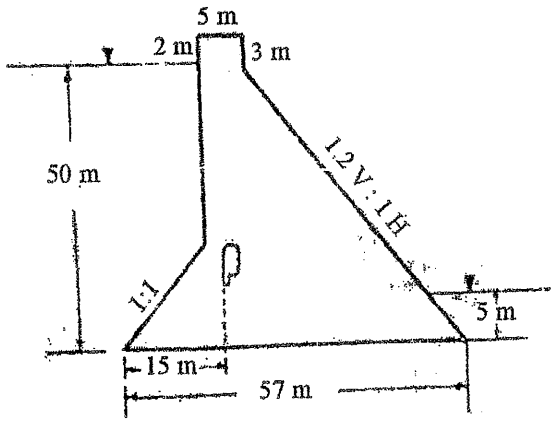
1. a) Table below shows the inflow for one reservoir.

   i) By assuming the mean inflow as the draft, develop mass-curve of the reservoir.
   ii) Determine storage capacity and length of critical period.
   iii) Determine storage capacity if the draft is only 80% of the mean inflow and compare with storage capacity of (ii). [12]

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Inflow m^3/s	38	32	27	26	15	10	8	7	6	4	3	3

   b) Explain briefly the procedure for obtaining Licenses for Hydropower development of 5 MW RoR hydropower project as per the provision of hydropower development policy 2001. [4]

2. a) Calculate the forces and the principle stress and the shear stress at the toe and heel of the gravity dam section shown below. Check the dam against sliding, crushing, overturning and tension. Do not consider the forces other than self-weight, hydrostatic pressure and uplift pressure. Assume allowable compressive stress for the material of the foundation is 50 kg/cm^2, allowable crushing stress for the material of the dam body is 10.5 kg/cm^2, friction coefficient is 0.70 and uplift coefficient is 0.45. [12]



   b) What do you mean by intake? Sketch a generalized intake structure for a RoR diversion project. [4]

3. a) A hydropower electrical project has a concrete lined tunnel of 5.0 m diameter operating under a gross head of 200 m. Discharge through tunnel is 28 cumec and having surge tank of 300 m^2 at the end of tunnel. Head loss due to friction under a steady state condition is 2.5% of gross head. Assume friction factor of tunnel to be 0.015. Find [6]

   - Total length of tunnel
   - Maximum upsurge and downsurge in the tank
   - Calculate factor of safety of surge tank

b) Check whether hydraulic jump type stilling basin is required or not for a hydropower project. Given that discharge is 100 cumec flowing through 10 m long overflow spillway. The height of spillway crest is 30 m from downstream bed with a slope of river as 1 in 500, Manning's roughness coefficient is 0.018 and coefficient of discharge is 0.75. [6]

c) Describe the design procedure of forebay with neat sketch. [4]

4. a) Discuss hydropower development cycle with flow chart. Explain the type of studies done in detailed engineering design stage of hydropower project. [2+4]

b) Describe sediment deposition mechanism with neat sketch in a storage type hydropower plant. Briefly discuss sediment management techniques. [3+3]

c) Draw a general layout of the powerhouse using a vertical axis Francis turbine. [4]

5. a) Design specific speed, turbine diameter and setting of Francis turbine of a hydropower project having net head of 150 m and design discharge of 25 cumec. Take turbine efficiency as 82% [6]

b) Design a settling basin for particle size = 6 mm, sp. gravity = 2.65, absolute viscosity = 1.34 gm/cm-s, temperature of water = 20°C, discharge = 12 m^3/s. Calculate depth of sediment assuming concentration is 5000 ppm. Assume 15% flushing discharge and performance coefficient of Hazen = 0.16. Draw neat sketch of plan and section. [8+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering (*CE 704*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. How do you estimate the gross and net hydropower potential between two sections of the river? [4]
2. Explain different phases of hydropower development cycle. Draw the layout plan and section of RoR type hydropower project with headrace canal. [4+4]
3. A RoR hydropower plant is proposed in a river. Using marginal cost and benefit method optimize the installed capacity with following data.

   Interest rate = 12%; Energy price =$ 0.08/Kwh; Fixed cost = $60 × 10^6; Variable cost (Electro-mechanical) = $ 650 /KW; Annual O/M = 3% of variable cost; Project life = 35 years. [8]

% Time	8.33	16.67	25.0	33.33	41.67	50.0	58.33	66.67	75.0	83.33	91.67	100
Power(KW)	805	604	564	407	300	167	130	115	96	89	74	65

4. A concrete gravity dam has the following data: [10]
   Maximum water level = 550.00
   Bed level = 470.00
   RL Top of Dam = 554.00
   The d/s slope of 0.67:1 and stats at RL of 545.00
   US face is vertical
   Centre line of drainage gallery – 8.0 m from the u/s face
   Consider only weight, water pressure and uplift
   Calculate the maximum vertical stresses at the toe and heel of the dam. Also calculate factor of safety against sliding and over turning. Assuming 100% uplift pressure at heel, 50% at drainage gallery and zero at the toe. Take $\mu = 0.75$
5. How do you draw a phreatic line in a homogeneous earthen dam with a horizontal filter at toe? Discuss with neat sketch and mathematical expression. [6]
6. What are the purposes of spillway? Explain with sketch different types of spillway gates. [2+4]
7. How do you evaluate losses in intakes? [6]
8. Find out the dimension of a settling basin with turbulence flow for a high head hydropower plant, which utilizes a discharge of 50 m^3/sec. The sediment particles coarser than 0.2 mm (w = 1.5 cm/sec) have to be trapped in the basin. Draw plan and section showing major components and flushing arrangement. [6+2]
9. Why lining is important in hydropower tunnels? Explain different types of linings. [2+4]
10. In a hydropower project the headrace tunnel of 4.0 m diameter and 4000 m length carries 20 m^3/s discharges to the surge tank of 10 m diameter. The penstock from surge tank to power house has 3.2 m diameter and 700 m length. Considering the case of instantaneous closure, find the maximum height of surge tank required and time period of oscillation of wave. Assume friction factor = 0.018. [8]
11. Determine number of turbines and diameter of runner for a power plant having 23 cumecs inflow, 20 m head, turbine efficiency 85% and speed 170 rpm, specific speed 230 rpm and speed ratio 0.76. [6]
12. Describe components of a power house in hydropower plant based on their functional use. [4]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering (*CE 704*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Outline the challenges for hydropower development in Nepal. Discuss hydropotential in Nepal. [2+2]
2. Discuss hydropower development cycle with flow chart. Draw the layout plan and section of a storage hydel plant with to power house. [4+4]
3. In a Nepali river the mean monthly flow in a year 2021 is given below.

Month	Discharge (m^3/s)	Month	Discharge (m^3/s)
Jan	50	July	125
Feb	40	Aug	150
March	30	Sept	120
April	25	Oct	100
May	10	Nov	75
June	75	Dec	70

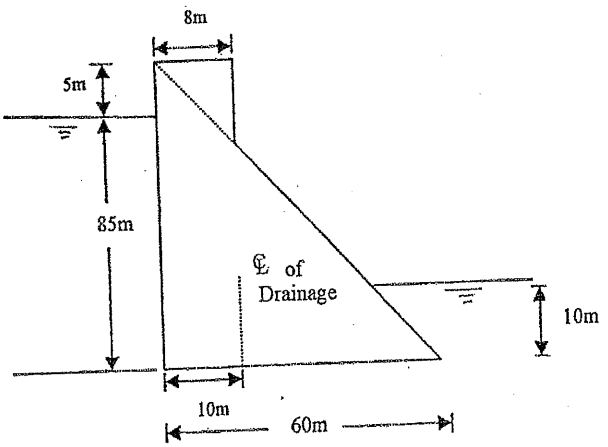
   a) Draw the flow duration curve.

   b) The power available at mean flow of water if available head is 100 m at the site and overall efficiency of the plant is 85%. [4+4]

4. Section of the gravity dam is shown below.

   i) Calculate maximum vertical stresses at the heel and toe of the dam.
   ii) The major principle stress at the toe of the dam.
   iii) Calculate factor of safety against overturning and sliding.

   Take $\gamma_c = 24\ kN/m^3$ and $\sigma_a = 2500\ kN/m^2$. [10]



5. Discuss design criteria of an earthen embankment dam. [6]
6. Why is the spillway provided in a dam? Mention with neat sketches the condition of providing a chute and shaft spillways. In which conditions a ski-jump type energy dissipater is provided below a spillway. [1+4+1]

7. Why is a vortex formed in intake? Discuss the hydraulic conditions for no vortex formation. [2+4]

8. Design a continuous type settling basin with neat sketches for a hydropower plant using following data: [8]

   Settling velocity = 5 cm/sec
   Turbine discharge = 10 m^3/sec
   Particle size to be removed = 0.15 mm
   Assume other necessary data if necessary.

9. What is the economical diameter of penstock? How do you determine economic diameter by graphical method? [1+5]

10. A RoR hydel plant has a circular surge tank of 13 m diameter at the end of 1.8 km long headrace pressure tunnel with 3.95 m diameter. The penstock system consists of 4 numbers, 400 m long, 1.30 m diameter each. Calculate maximum up-surge, down-surge and time of oscillations if frictional factor for tunnel and penstock are 0.016 and 0.025 respectively. [8]

11. A proposed hydropower development having a net head of 90 m, design discharge of 40 m^3/s uses Francis's turbine. Taking turbine efficiency 0.86. Calculate specific speed, turbine diameter and setting of the turbine. [6]

12. Mention the types of powerhouse. Draw the plan of typical powerhouse having three units. [1+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE 704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) A hydropower plant is planned to be designed in Nepalese river, where mean monthly flows for a typical year are as follows.

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
m^3/s	4.4	3.9	3.4	4.2	4.2	16.5	78.1	108.9	52.8	22.0	9.9	6.4

Other data pertaining to the plant are as follows:
Design discharge = 18 m^3/s
Full supply level = 2250 masl
Turbine centerline = 1650 masl
Dia of 4 km long tunnel = 3 m, f = 0.014
Dia of 1 km long penstock = 2.2 m, f = 0.012
Hydraulic efficiency = 95%, Turbine efficiency = 93%, Generator efficiency = 99%, Transformer efficiency = 99%

Considering only the frictional loss,

(i) Compute installed capacity, primary and secondary energy to be produced from the power plant assuming that 10% of minimum monthly flow to be released downstream. What is the plant factor? [2+2+2+2]

(ii) The developer is interested to develop a daily peaking reservoir for 4 hours. What will be the capacity of the reservoir to satisfy daily peaking requirement? [4]

b) Discuss about the objective and the strategies of the hydropower development policy-2001. List out the various hydropower development institutions in Nepal. [3+1]

2. a) A homogeneous earthen dam has the following data: Dam crest level = 300.00 masl; Deepest river bed level = 278.00 masl; HFL in the reservoir = 297.50 masl; Dam crest width = 4.50 m; Dam u/s slope = 3:1; Dam d/s slope = 2:1 and coefficient of permeability of the dam material = 5×10^{-4} cm/s. Determine the phreatic line of the dam section and the discharge passing through the dam. [4+4]

b) What measures are applied for treatment of foundation before construction of a gravity dam? Discuss briefly. [4]

c) Find the minimum safe width for an elementary profile of a gravity dam of 18 m height. The specific gravity of the dam material is 2.25. Consider both no and full uplift condition. [4]

3. a) Design a fore bay structure with turbine discharge of 14.5 m^3/s with two penstocks 1.8 m diameter each. Take retention time 3 minutes and limiting velocity 0.22 m/s. Draw neat sketch of plan and section. [6]

   b) Determine the discharge through a chute spillway of 250.00 m long ogee crest, if the height of the spillway crest above the u/s approach channel s 10.50 m, the width of the approach channel is 2500 m, and the head over the crest is 4.50 m. Take $C_d = 0.85$. [4]

   c) What are the most commonly used intakes in Run-of-River projects in Nepal? What factors do you consider while selecting the site for intake location? [3+3]

4. a) If you have to develop a small hydropower project of capacity 10 MW in a cost effective manner in a remote area of Nepal. What are the stages of study that have to be undertaken before the construction start? [8]

   b) A Pelton wheel develops 70 kW under a head of 100 m of water, it rotates at 400 rev/min. The diameter of penstock is 200 mm. The ratio of bucket speed to jet velocity is 0.46 and overall efficiency of the installation is 85%. Calculate

   (i) Volumetric flow rate
   (ii) Wheel diameter [2+2]

   c) Specify with neat sketch the location of a spiral casing and draft tube used in hydroelectric power generation. Mention their importance. [2+2]

5. a) Find out the dimension of a settling basin with turbulence flow for a high head hydropower plant, which utilizes a discharge of 25 m^3/sec. The sediment particles coarser than 0.2 mm (w = 1.5 cm/sec) have to be trapped in the basin. Draw plan and section showing major component and flushing arrangement. [6+2]

   b) The design discharge through the tunnel of a hydropower project is 25 m^3/sec is conveyed by two number of penstock to the turbine. The length and diameter of tunnel is 4 km and 8m respectively, friction factor of tunnel is 0.016 and length of each penstock is 500 m, diameter and friction factor of penstock is 2m and 0.04 respectively and velocity of wave in penstock = 1600 m/sec. If the surge tank of 15 m diameter has been provided at the end of the tunnel, find the following for full load rejection. [8]

   (i) Maximum up-surge
   (ii) Maximum down-surge
   (iii) Water hammer pressure
   (iv) Time of oscillation of wave

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE 704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. a) Answer the followings:

   (i) What are the top three hydropower producing country in the world till 2020?
   (ii) What are the three existing largest power plant in Nepal (with capacity)?
   (iii) What are the first three hydropower plant (capacity and year) from the history of Nepal? [4]

   b) A peaking ROR project in western Nepal with net head of 250m has following river flow data: [12]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
River flow (m^3/s)	100	80	80	105	200	500	1100	1200	800	350	200	120

   The storage capacity avaliable for this project is 1100 million m^3. This storage capacity is utilized for dry months (Nov-May) during which the plant is used as peak load plant operating 4 hours a day. Considering design flow as Q_{25}, calculate maximum power generation (in MW) and ratio of wet season energy to dry season energy.

2. a) The discharge of water over a spillway 12m wide is $300m^3/s$ into stilling basin of the same width. The lake level behind the spillway has an elevation of 50m and river water surface elevation downstream of stilling basin is 25m. Assume a 10% energy loss in flow down the spillway, find invert level elevation of the flow of the stilling basin so that hydraulic jump forms in the basin. Select an appropriate USBR stilling basin and list all the dimensions. [10]

   b) What is economic diameter of penstock? A steel penstock with an internal diameter of 1.25m, supplies water at a head equivalent to $18kg/cm^2$. There is a possibility of a 20% increase in pressure due to transient conditions. The design stress and efficiency of the joint may be assumed to be $1025kg/cm^2$ and 85% respectively. Compute the thickness of the penstock required. [2+4]

3. a) Design and draw section of a side intake for a project in which river bed level is 3315.0 masl. Weir crest level is fixed to 3317.5 masl. The highest flood level in 100 years returned period is 3319.55 masl. The canal water level is fixed as 3317.3 masl. The turbine discharge of a period is $1.45m^3/s$. Assume other suitable data. Take cylindrical trashrack bar with 10mm thick and 100mm spacing. [6]

   b) Determine the basewidth of a 20m high trapezoidal concrete dam having a vertical upstream face and top width of 5m. Design water depth is 18m. There is no tail water Ignore earthquake, silt and ice loads. Take e=B/6, $\sigma_{concrete}$=30MPa, $\sigma_{foundation}$ = 80MPa, τ_s = 6MPa. Specific weights of water and concrete are $10kN/m^3$ and $24kN/m^3$ respectively. Assume suitable data, if necessary. [6]

c) For embankment dam on pervious foundation, soil seepage underneath the dam poses a serious problem. Briefly discuss the consequences of this problem and how it is reduced? [4]

4. a) Draw a layout (plan and section) of ROR hydro project for following cases: [6]

(i) Alignment with pressure tunnel
(ii) with free surface flow

Name salient features also (draw with representative contours).

b) Design a settling basin (i) with intermittant flushing (ii) continuous flushing for a hydroelectric plant by using the simple settling theory. The design discharge of the plant is $5m^3/s$ and depth of the basin is 3.20. Take w=2.5cm/s and λ=1.5. Compare and justify the result. Assume 15% flushing discharge and efficiency = 90%. [10]

5. a) Consider the design of a multi-jet pelton wheel with parameters and operating conditions as given below: [8]

Head = 200m
Flow rate = $4m^3/s$
Nozzle velocity coefficient = 0.98
Wheel dia. = 1.47m
Mechanical efficiency = 86%
Blade speed to jet speed ratio = 0.47
Jet dia. to wheel dia. ratio = 0.113

(i) Calculate the wheel rotational speed (rev/min).
(ii) Calculate the power output (MW).
(iii)Determine no. of nozzle required.
(iv)Calculate specific sp eed of machine.

b) Explain the general arrangement for a power house. How would you fix the appropriate dimensions of a power house? [2+2]

c) Discuss different types of intakes used in storage hydel plants. [2+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE 704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. a) The monthly flows of a stream over the period of the driest year on record are as shown below: [7+3+2]

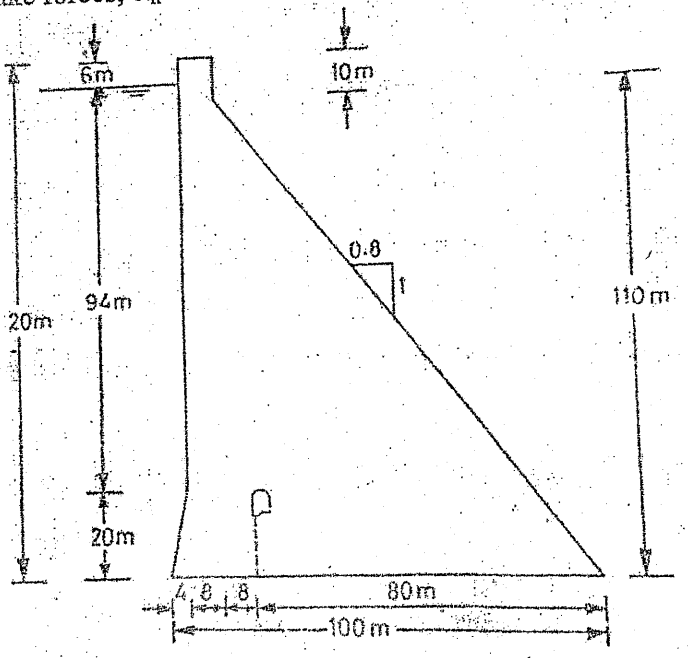
Month	J	F	M	A	M	J	J	A	S	O	N	D
Flow ($\times 10^6 m^3$)	4.0	2.25	5.0	1.25	0.5	0.75	0.5	0.75	1.25	1.25	5.0	6.25

(i) Estimate the maximum possible uniform draw-off from this stream and determine the reservoir capacity to achieve the uniform draw-off and the minimum initial storage to maintain the demand.

(ii) If the reservoir has only a total capacity of $8\times10^6 m^3$ with an initial storage of $4\times10^6 m^3$, determine (a) the maximum possible uniform draw-off and (b) the spillage.

b) Describe various types of hydroelectric scheme based on hydraulic characteristics. [4]

2. a) Determine the principal stresses at the toe and heel of the dam shown in figure for the reservoir full conditions. Consider the following forces: [10]
(i) Self weight (w_c=25kN/m^3)
(ii) Water pressure (w=10kN/m^3)
(iii)Uplift pressure
(iv)Silt pressure the depth of silt as 20m
(v) Earthquake forces, α_h=0.1



b) Determine the maximum and minimum vertical stresses to which the foundation of the dam will be subjected from the following data:
Total overturning moment about toe(ΣM_o)=1.2×10^6 kN-m
Total resisting moment about toe (ΣM_R) = 2.5×10^6 kN-m
Total vertical force above the base (ΣV) = 6×10^4 kN
Base width of dam = 55m.
Slope of d/s face = 0.8:1
Also calculate the maximum principal stress at the toe. Neglect tail water depth. [2+2+2]

3. a) What are the main parts of non-pressurized and pressurized ROR intake? Present the general arrangement of such intakes in a neat proportionate sketches. [2+6]

b) Find out the dimension of a setting basin with turbulence flow for a high hydropower plant, which utilizes a discharges of 60 m^3/sec. The sediment particles coarser than 0.2mm (fall velocity w=1.5 cm/sec) have to be trapped in the basin. Draw plan and section showing major components and flushing arrangement, neat and proportionately. [4+4]

4. In a pumped – storage hydropower project, water is delivered from the upper impounding reservoir through a low-pressure tunnel and four high-pressure penstocks to the four pump-turbine units. The elevation of the impounding reservoir water level is 500m, and the elevation of the downstream reservoir water level is 200m. The maximum reservoir storage which can be utilized continuously for a period of 48h is $15\times10^6 m^3$. [6+3+3+2+2]

The low pressure tunnel is constructed as follows: length = 4km; diameter=8m; friction factor, f=0.028.

The high pressure penstocks (4 nos) are constructed as follows:
length of each penstock = 500m;
diameter = 2m,
friction factor, f = 0.016;
turbine efficiency when generating = 90%;
generator efficiency (16 poles, 50Hz) = 90%;
turbine efficiency when pumping = 80%;
barometric pressure = 10.3m of water;
Thoma's cavitation coefficient, $\sigma = 0.043\ (N_s/100)^2$.

a) Determine the maximum power output from the installation
b) Estimate the specific speed and specify the type of turbine
c) Determine the safe turbine setting relative to the downstream reservoir water level.
d) If a simple surge chamber 6m in diameter is provided at the end of the low-pressure tunnel, estimate:
(i) the maximum upsurge and downsurge in the surge chamber for sudden rejection of one unit and
(ii) the maximum downsurge for a sudden demand of one unit.

5. a) Write down advantages and suitability of chute type spillway, shaft spillway, ogee type spillway and roller gate. [2+2+2+2]

b) Why is vertical shaft arrangement preferred while laying turbine and generator in a powerhouse? Explain briefly. [4]

c) State the objectives of the current Hydropower Development Policy of Nepal. Discuss the necessary amendment required to improve the existing scenario of the Hydropower Development Sector. [2+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE 704)*

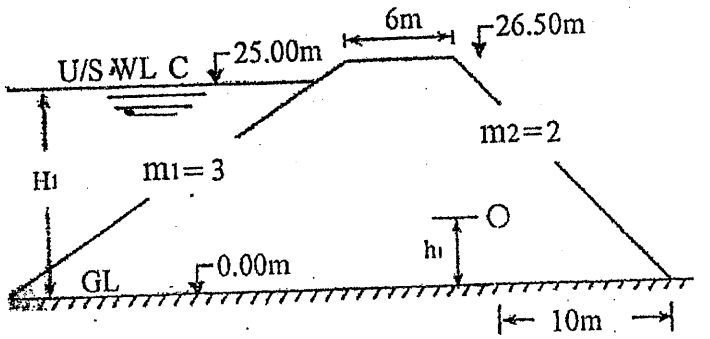
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. a) During a low water week a river has an average daily flow of 40 m^3/s with a fluctuation during the day required a pondage capacity of approximately 30% of the daily discharge. A hydroelectric plant is to be located on the river which will operate 6 days a week, 24 hours a day, but will supply power at a varying rate such that the daily load factor is 50%, corresponding to which the pondage required is equal to 0.2 times the mean flow to the turbine. On Saturday all the flow is ponded for use on the rest of the days. If the effective head on the turbines when the pond is full is to be 25 m and the maximum allowable of fluctuation in pond level is 1m, find

   (i) the surface area of the pond to satisfy all the operating conditions
   (ii) the weekly output at the switch board in kwh. Assume turbine efficiency 80% and generator efficiency 90% [5+5]

   b) Explain the working principle of RoR, PRoR and ST plants with the help of figures. Also comment on the suitability of those plants in the context of Nepal. [6]

2. a) An earthen dam of homogeneous materials with a drain pipe is shown in figure. Determine the co-ordinate of phreatic line and specific discharge passing through the body of dam. coefficient of permeability = 15×10^{-4} m/s. [6]



   b) Explain the necessity of grouting and drainage galleries in concrete gravity dam. Draw an elevation view of a concrete gravity dam showing the alignment of drainage galleries and series of grout holes.
   Drawing a section of concrete gravity dam show arrangement of vertical formed drain, trap drain and drainage hole. [2+4+4]

3. a) Design a settling basin for a high head project in a river which utilizes 60 m^3/s discharge and gross head of 300 m. The sediment particles larger than 0.15 mm (fall

velocity = 1.5 cm/s) need to be trap in the basin. Consider effect of turbulence as well. Also draw plan and section of the basin showing major components. [8+4]

b) Explain various remedial measures that help to control the deposition of sediments in RoR project. [4]

4. a) A penstock carries 8 m^3/s of water at head of 25m. The cost of pipe line in place is given by US\$250hd^2 per meter length, where h = head and d = diameter of the pipe. Annual fixed charges are 8% of the pipe line cost. The estimated head loss in friction is $\frac{0.025Q^2}{12.1d^5}$ per m length of the pipe. Efficiency of the turbine is 80% and selling price of the power is US\$500 per kW per annum. Calculate the most economic diameter of the penstock. [8]

b) It is proposed to form a hydraulic jump in a stilling basin to dissipate the energy below spillway. Depth of flow changes from 1.5m to 4m. Calculate the discharge over the spillway if the length of the crest is 120m. [3]

c) Mention the four different types of spillway and describe each of them in short. Also write down the functions of the spillway. [4+1]

5. a) What are the opportunities and challenges for Hydropower development in Nepal? Write your comments on the Hydropower Development Policy – 2001 of Nepal. [4+2]

b) A Francis turbine works under a head of 25m and produces 11760 kW while running at 120 rpm. The turbine has been installed at a station where atmospheric pressure is 10 m of water and vapour pressure is 0.20 m of water. Calculate the maximum height of the straight draft tube for the turbine. [6]

c) Draw a section of vertical axis Francis turbine in a powerhouse showing different parts of powerhouse. [4]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

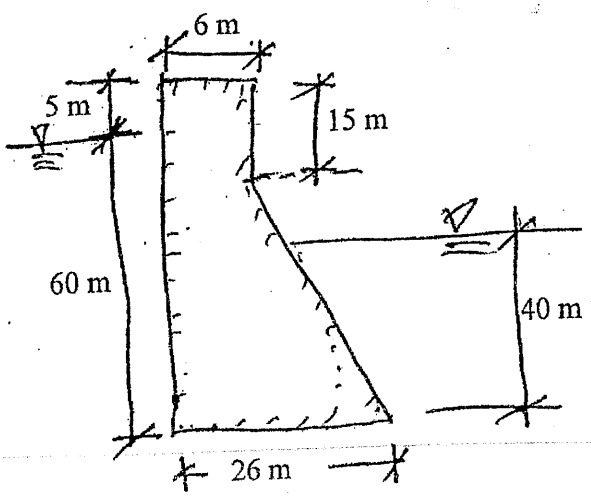
1. What are the opportunities and challenges for Hydropower development in Nepal? Write your comments on the Hydropower Development Policy-2001 of Nepal. [4+2]
2. Sketch and explain layouts of the run of river plant. Also explain the importance of storage hydropower plants over run of river plant. [3+3]
3. a) A RoR plant has a minimum flow of 30 m^3/s and net head of 70 m. The overall efficiency of plant is 85%. Calculate the installed capacity of the plant (i) Without pondage (designed for pure RoR plant) and (ii) If the plant is designed for a peaking plant with 6 hours peaking. The plant has two set of unit such that one unit full capacity if operating during off peak hour. Total evaporation and other losses is 5% of the stored water. [6]

   b) Monthly flow volumes feeding a reservoir are given in the table. Determine the storage capacity required to supply the mean annual flow. [4]

Month	1	2	3	4	5	6	7	8	9	10	11	12
Volume ($10^6 m^3$)	296	386	504	714	810	1154	746	1158	348	150	223	182

4. a) Write about the "Middle third rule" in the design of concrete gravity dam? Describe with necessary derivation. [6]

   b) A concrete gravity dam of given profile is purposed by a designer for implementation. The unit shear resistance and angle of resistance is 500 KN/m^2 and 35° respectively. $\gamma_{con} = 24\,KN/m^3$, check the stability of dam against flotation, overturning and sliding. [8]



5. a) Design a settling basin for a high head project in a river which utilizes 60 m^3/s discharge and gross head of 300 m. The sediment particle larger than 0.15 mm (fall velocity = 1.5 cm/s) need to be trap in the basin. Consider effect of turbulence as well. [7]

   b) Design a hydraulic jump stilling basin for the flood discharge 28 $m^3/s/m$ flowing from an ogee spillway with the spillway crest 55 m above the downstream gravel river bed with a slope 1:1000 and Manning's roughness coefficient 0.028. Assume coefficients of discharge, depth and length are 0.75, 1.2 and 4.5 respectively. Also assume sp.gr of sediment as 2.65. [10]

6. Describe with governing equations the procedure to obtain the specific discharge through the body of earthen dam with horizontal drain. [6]

7. a) Find out the dimension of a forebay which accommodates a storage for 3 minutes of operation for a hydropower plant having following data: [3]

   Design discharge = 20 m^3/s

   Length of penstock = 300 m

   Diameter of penstock = 2.20 m

   b) Discuss the various factors which govern the determination of economic diameter of a penstock. Find the wall thickness of penstock pipe if the internal diameter is 3.0 m which supplies water from a head of 220 m with a possibility of increase in pressure upto 40% due to transit condition. Take σ_{st} = 1400 kg/cm^2 and efficiency of joint = 0.95. [2+3]

8. Determine the diameter of Francis turbine for a site where the net head is 110 m and discharge 140 m^3/sec having efficiency of 90%. Determine also the elevation of turbine with reference to the water surface in tailrace. Assume the turbine will have to drive a 50 cycle generator. [8]

9. Explain the different types of power house use in hydropower project. [5]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What are the major provisions in hydropower development policy in 2001? List out the major institutions involved in hydropower development sector. [3+3]
2. What is a daily peaking power plant? With a neat sketch show the general arrangement of such plant daily peaking power plant. [3+3]
3. Find the specific discharge through homogeneous earthen embankment dam with 2 m thick central impervious core, [7]

   Height of the dam = 50m

   Upstream water level = 48.00m

   Downstream water level = 3.0m

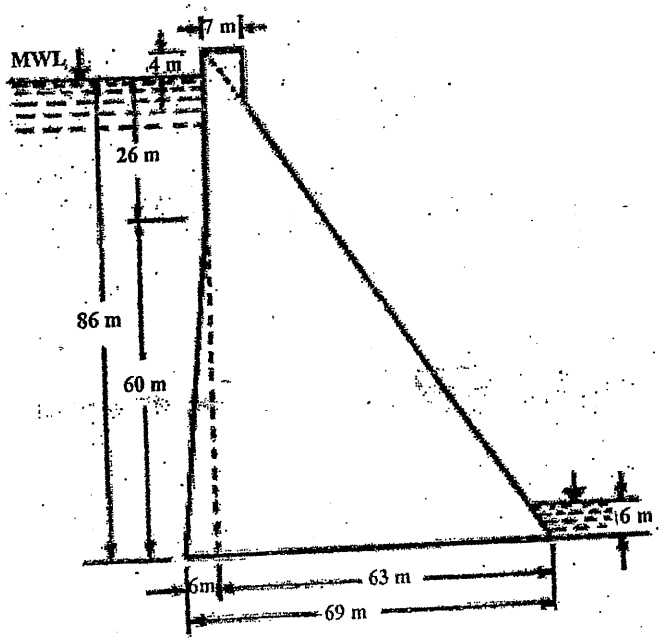
   Width of the dam at the top = 10.00m

   Upstream and downstream slope of the dam = 1:3 (V:H)

   Coefficient of permeability of the soil =3 cm/hr

   Coefficient of permeability of impervious core = 1.0×10^{-8} m/s

4. a) Examine the stability of the gravity dam shown in figure below considering seismic effects. Also indicate the values of various kinds of stresses that are developed at heel and toe. Uplift may taken same as hydrostatic pressure at base of corresponding faces and is considered to act over 60% of the base area. Seismic coefficients (α) are 0.1 and 0.05 for horizontal and vertical directions respectively. Take, $\gamma_c = 24$ KN/m^3 and $\gamma_w = 10$ KN/m^3. [10]



   b) Derive an equation for determining the length of discharge face for an earthen dam without filter. The downstream slope lies between 30° and 60°. [6]

5. a) Describe design principle of a settling basin of a hydropower plant based on particle size and concentration approach. [7]

   b) Design a hydraulic jump stilling basin for the flood discharge 25 $m^3/s/m$ flowing from an overfall spillway with the spillway crest 60 m above the downstream gravel river bed with a slope 0.001 and manning's roughness coefficient 0.028. Assume, $C_d = 0.75$, $\sigma = 1.2$, $k = 4.5$ and sp.gr = 2.65. [10]

6. How does a siphon spillway function ?What are the ways in which a siphon spillway can be primed? What are the limitations of siphon spillway? [2+2+2]

7. a) Describe geometrical shapes of tunnel with neat sketches and write down the suitability of those shapes for various rock conditions. [4]

   b) Differentiate between forebay and surge tank. Design a forebay which accumulated water for 3 minutes for operation of a hydropower plant having data as given below. Also check the length of fore bay and limiting velocity. [2+6]

   Design discharge = 20 m^3/s
   Number of penstock = 1
   Diameter of penstock = 2.2 m
   Limiting velocity = 0.2 m/s

8. A hydropower plant having net head of 150 m and design discharge of 25 m^3/s is going to use Franci's turbine. Take efficiency = 81%. Find the specific speed, turbine diameter and elevation of turbine with respect to the water surface in tailrace. [6]

9. Sketch a typical type of layout of powerhouse project and briefly explain of each. [4]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

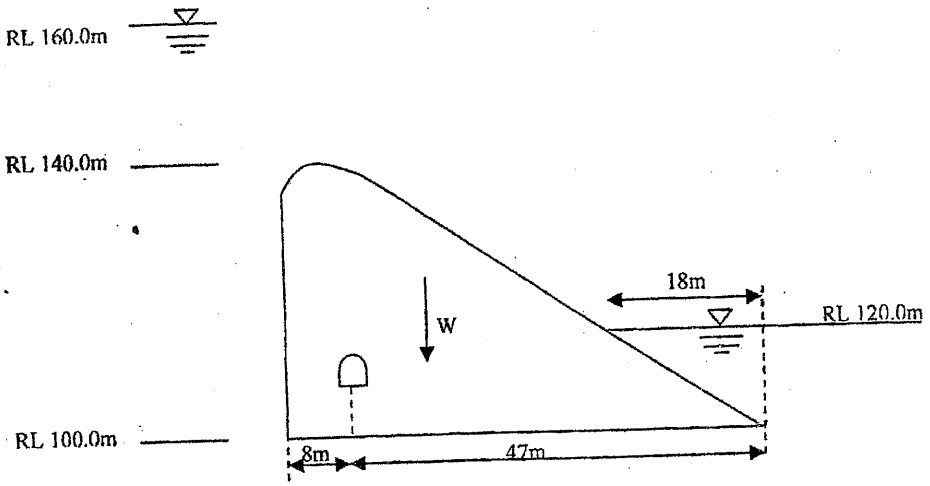
1. Discuss about the Hydropower Development Policy 2058 of Nepal. [6]
2. What are the various stages of hydropower planning? If you have been appointed as a water resources engineer in Water Resources Ministry and you are assigned to undertake various investigations related to water resources field. Discuss field investigations you carry out at various stages of the Hydropower project. [2+6]
3. The hydrograph of a typical river of Nepal follows the equation as:

   $Q_t = 5.589t^2 - 51.275t + 139.94$; where Q_t is mean monthly discharge in m^3/s and 't' is time in months counted as October as the 1st month and so on. A hydropower plant has to develop in this river with net head of 150m and overall efficiency as 85% and the environmental flow is not considered. [3+3+4]

   a) Calculate the installed capacity and firm energy for RoR Project that will be developed for design discharge as Q_{40}.

   b) If the project has to design as a Peaking Run of the river (PRoR) Project for 6 hrs daily peaking (3hrs in morning and 3hrs in evening) and with design discharge as Q_{40}. What is the installed capacity of the PRoR Project? Assume that the project is designed such a way that 50% of available flow is used during the off peak hours and remaining 50% of available flow is stored for peak hour generation. Neglect all the losses.

4. a) Check the stability of the overflow section of the gravity dam shown in figure. Assume the weight of concrete, gates, piers and weight of water over crest, W_{total} = 3.0×10^4kN. Moment of weight of concrete, gates, piers and water above crest etc. about toe $M_{toe} = 10^6$ kN-m. Neglect all forces other than weight, uplift pressure and water pressure. Also check for tension. Take $\mu = 0.75$ and $q = 1400$ kN/m^2. [10]



b) Design a hydraulic jump stilling basin for the maximum discharge of $25m^3s^{-1}m^{-1}$ flowing from an overall spillway, with the spillway crest 50m above the downstream gravel river bed with a slope $S_0 = 0.001$ and $n = 0.028$. [6]

c) What are the purposes of spillway? What are the advantages of ogee shape spillway? Explain. [2+2]

5. a) With considering turbulent effect, design a settling basin to remove the sediment size greater than 0.3 mm diameter. Assume design discharge of the basin is $8m^3/s$ and trap efficiency as 90%. [8]

b) Differentiate between pressurized and non-pressurized intakes. [4]

6. a) A hydropower plant has planned to use a steel penstock pipe of length 600m having a diameter of 0.8m to carry a discharge of $5m^3/s$. The static head available is 80m. The wave velocity, design stress and joint efficiency for the penstock pipe are 1200m/s, $1326kg/cm^2$ and 85% respectively. What thickness of the penstock pipe would you recommend for the power plant if the gate closure time is 30 seconds? [8]

b) Discuss various shape of tunnel with their advantages. [4]

7. a) A hydropower plant has design discharge of 60 m^3/s and net head of 90m. Design Francis turbine for this power plant (number of turbine, specific speed, diameter and setting of turbine). Take turbine efficiency 94%. [6]

b) What are the functions of draft tube? [2]

8. Write about the structure and dimensioning of the power house? [2+2]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What are the objectives of the Hydropower Development Policy, 2058? List out various hydropower development institutions in Nepal. [4+2]

2. a) Draw a general layout (plan and section) of the diversion type hydropower project. Comment on the suitability of the Run of River (RoR), Peaking Run off River (PRoR) and Storage projects in Nepal. [3+3]

   b) Briefly describe the hydropower development cycle. [2]

3. The hydrograph of a typical river of Nepal follows the equation as:

   $Q_t = 5.589t^2 - 51.275t + 139.94$; where Q_t is mean monthly discharge in m^3/s and 't' is time in months counted as October as the 1st month and so on. A hydropower plant has to develop in this river with net head of 150m and overall efficiency as 85% and the environmental flow is not considered. [3+3+4]

   a) Calculate the installed capacity and firm energy for RoR Project that will be developed for design discharge as Q_{40}.

   b) If the project has to design as a Peaking Run of the river (PRoR) Project for 6 hrs daily peaking (3hrs in morning and 3hrs in evening) and with design discharge as Q_{40}. What is the installed capacity of the PRoR Project? Assume that the project is designed such a way that 50% of available flow is used during the off peak hours and remaining 50% of available flow is stored for peak hour generation. Neglect all the losses.

4. a) A concrete gravity dam (trapezoidal in section) has height 20 m, top width 1.2 m and bottom width 10 m is proposed to block the water of height 18 m. The u/s face of the dam is vertical and the d/s face has slope 1:2 (H:V). Considering the forces: self weight, hydrostatic force and uplift pressure, check the stability of the dam. (Assume unit weight of concrete = 24 KN/m^3, permissible shear stress of joint as 1400 KN/m^2, coefficient of friction as 0.75, and uplift factor k as 0.8). Neglect the tail water effect to the dam. [8]

   b) Discuss the construction procedure of phreatic line in embankment dam. [4]

   c) Write about the cavitations in spillways and its preventive measures. [4]

   d) Explain the different types of gates use in hydropower head works. [4]

5. a) Design a settling basin to remove the sediments of size greater than 0.3mm having a design discharge of 25 cumecs. The sediment has specific gravity of 2.65 and fall velocity of 50 mm/sec. [7]

   b) What are the general requirements of a functional RoR headworks? [5]

6. a) What is tunnel support? What are the parameters for evaluation of tunnel support? [1+3]

   b) A power station is fed by a 2030m long concrete lined tunnel of 4.22m diameter and 380m long pressure shaft of 3.41m diameter operating under a gross head of 250m. It has a surge tank of 15.85m diameter at end of tunnel. If the design discharge of the plant is $60m^3/s$ and friction factors in tunnel and pressure shaft are 0.014 and 0.012 respectively. Compute the maximum, minimum and normal water level at surge tank if the water level at reservoir is 457.00m. Draw neat sketches showing the calculated values. [8]

7. In a hydropower project, it is planned to use a Francis turbine. The project has a head of 185m and discharge of 100 cumecs. Determine the size and the elevation of the turbine if the overall efficiency is taken as 85%. [8]

8. Draw plan and sections of a powerhouse showing various components. Assume a Francis Turbine is used in this powerhouse to generate the electricity of 10 MW. [4]

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Describe briefly the provision for licencing of Hydropower according to Hydropower Development Policy Nepal, 2058. [6]
2. Lists out the minimum Checklist for Reconnaissance, prefeasibility and feasibility studies for hydropower development. [7]
3. The power supplied by the state electricity authority throughout the year by steam power plant are as shown in table below. [5+5]

Month	Power Supplied (MW)
jestha	550
asar	500
shrawan	450
bhadra	380
asoj	330
kartik	280
mangsir	250
poush	220
Magh	200
falgun	150
chaitra	145
baisakh	100

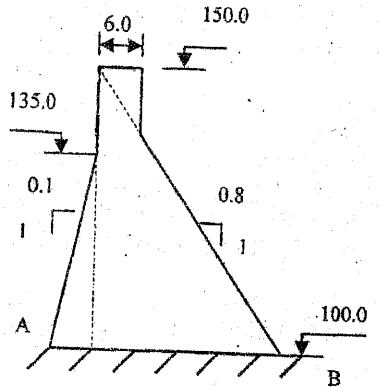
But the current demand forced them to have loadshedding. To minimize the loadshedding by providing at least power equivalent to Magh month throughout the year, Authority has decided to import power from neighbouring country for only 3 months i.e. Falgun, Chaitra and Baisakh as 50 MW, 55 MW and 100 MW respectively.

a) Despite importing power, authority felt that they can not provide uniform power of Magh throughout. So they decide to have a diesel plant for deficit. Estimate the minimum capacity of diesel plant. (Use load duration curve for analysis)

b) If instead of above system (Steam plant +import+diesel plant), Authority has planned to provide the power in near future by constructing ROR hydropower plant by its own to substitute the current model. Derive the Flow duration curve for such new hydro project to supply the power demand given in table. Assume power demand is constant in future.

4. a) Check the stability of dam against overturning, sliding and material failure (stresses) with respect to worst location assuming that in addition to self weight, 25% of mass of dam will act as horizontal component (from upstream side), whereas 15% as upward vertical component as seismic load and will act at the CG of the section.

Assume unit weight of the concrete as 24 kN/m^3, Assume unit weight of the concrete as 24 kN/m^3, allowable compressive stress in foundation and concrete as 2,500 kN/m^2 and 3,000 kN m^2, angle of friction between concrete and foundation as 36° and unit shear resistance between foundation and dam as 700 kN/m^2. [4+4+2]



b) Write with neat sketch, expressions for computing seepage and phreatic surface in Earthen dams for two cases; homogeneous and without drain and dam with toe drain. [2+3]

c) Draw a neat sketch of side intake with all components. How do you calculate hydraulic loss at trash rack? [3+2]

5. a) What do you mean by sediment flushing in settling basin? Briefly explain the different type of flushing system used in hydropower in Nepal. [2+4]

b) With considering turbulent effect, design a settling basin to remove the sediment size greater than 0.3 mm diameter. Assume design discharge of the basin is 8 m^3/s and trap efficiency as 90%. [6]

6. a) Derive an expression for minimum upsurge without damping effect in the surge chamber using continuity and momentum equations. [3+7]

In a storage hydropower plant, water is delivered from upper impounding reservoir through low pressure headrace tunnel and three high pressure penstocks to three francis turbine units.The elevation of reservoir and tailwater level are 320 m and 200 m above datum respectively. It is decided to design a simple surge tank between headrace tunnel and penstocks for sudden rejection or demand of two units. If the maximum and minimum water level elevation in the surge tank is limited to 330 m and 310 m above datum respectively due to topography and construction difficulty, determine the minimum area of surge tank and permissible length of low pressure headrace tunnel to fulfill the design objective.
Given data:
Discharge in tunnel: 100 m^3/s
Head race tunnel: diameter-7 m and head loss in tunnel= 10 % of gross head of system.
Penstocks: each length 500 m, diameter 2.5 m, f= 0.016

b) Write procedure to compute the dimensions of the forebay and write the equations used for such purpose. [3]

7. Drawing efficiency curves, discuss the performance characteristics of Pelton and Francis Turbines. What is the advantage of pelton turbine over Francis? Write down the principle behind setting of Francis turbine relative to the tail water level. [2+2+2+2]

8. Draw plan and sections of a powerhouse showing various components. Assume a Francis Trubine is used in this powerhouse to generate the electricity of 10 MW. [4]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

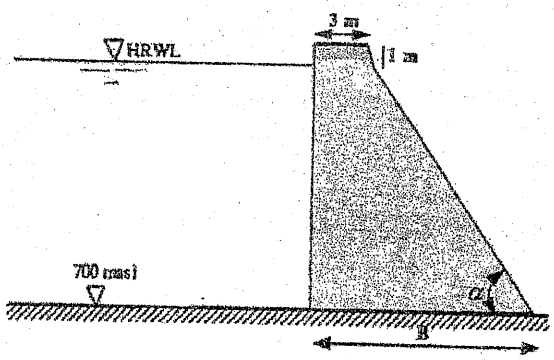
1. Discuss about the objectives and strategies of *the Hydropower Development Policy-2001* (2058 BS) of Nepal. [6]
2. Highlight the major studies and investigations carried out during reconnaissance, prefeasibility and feasibility studies. [8]
3. A hydropower plant is to be planned in a Nepalese river, where the mean monthly flows for a typical year are as follows:

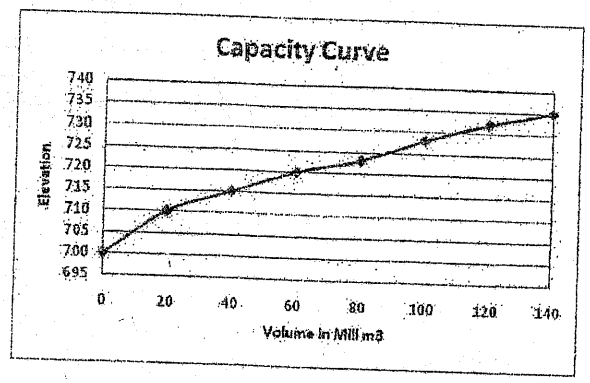
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q(m^3/s)	4.4	3.9	3.4	4.2	5.6	16.5	78.1	108.9	52.8	22.0	9.9	6.4

Other data pertaining to the plant are as follows:
- Design Discharge = 18 m^3/s
- Full Supply Level = 2250 masl
- Turbine Center line = 1650 masl
- Dia of 4.0 km long tunnel = 3.0 m, f=0.014
- Dia of 1.0 km long penstock = 2.2 m, f=0.012
- Hydraulic Efficiency, 95%; turbine efficiency, 93%; Generator Efficiency; Transformer efficiency, 99%

Considering only Frictional loss,
a) Compute installed capacity, primary and secondary energy to be produced from the power plant assuming that 10% minimum flow to be released downstream. What is plant factor ? [5+2]
b) The developer is interested to develop a daily peaking reservoir for 4 hours. What will be the capacity of the reservoir to satisfy daily peaking requirement? [3]

4. a) A concrete gravity dam shown in figure below was constructed for development of hydropower project. The dam has a vertical upstream and inclined downstream face. The highest regulated water level (HRWL) of the dam is fixed at 1 m below the top crest level. At HRWL, the storage capacity of reservoir created by the dam is 60 mill m^3. The reservoir capacity curve of the dam is shown in figure below. In a flood situation the 80 m long dam creat can serve as a spillway to discharge the flood. Assume density of concrete γ_c = 24 KN/m^3 and the friction angle between the dam and foundation $\phi = 43°$. [3+5+3+5]





a) Find all main forces acting on the dam when the water level in the reservoir is at HRWL. Give your answer in terms of base width "B".

b) Find the bottom width "B" and downstream inclined angle α, if dam is at state of moment equilibrium with respect to downstream dam toe. Use a factor of safety against overturning as 1.4.

c) Is the dam free from tensile stress? Find the required unit shear resistance (cohesion) if the shear safety factor of the dam is F_{SF}=2.5.

d) In a flood event the dam shown on figure overtopped but didn't fail. The outflow discharge over the dam crest was estimated to 320 m3/s. During this time, the reservoir water level was raised to 722.5 masl(m above sea level). Find the discharge coefficient and give your comments of the value.

b) Drawing a neat sketch of Hydropower Intake, show major components. How do you minimize headloss in intake? [3+1]

5. Draw a neat sketch of ROR plant Headworks showing each component clearly in plan and section. Describe briefly the general requirements of such headworks for optimum functions for sediment loaded rivers. [6+6]

6. a) Discuss various tunnelling methods used in Hydropower projects. Why do you provide tunnel supports? How are they realized? [4+2+2]

b) Explain with mathematical expression the optimization of penstock. [4]

7) A Francis turbine works under a head of 40 m and discharge Q = 10 m^3/s. The speed of the runner is 300 rpm. At the inlet tip of the runner vane, the speed ratio is K_u=0.85 and flow ratio K_f=0.3. If the overall efficiency and hydraulic efficiency of turbine are 80% and 90% respectively. Assume discharge at the outlet is radial and velocity of flow is constant.

Determine: [2+2+1+2+1+4]

a) power developed in KW.
b) Diameter and width of runner at inlet.
c) guide vane angle at inlet.
d) specific speed of turbine.
e) diameter of runner at outlet.

Dimension suitably the powerhouse (length, breadth and height) with sketch, if three such turbines were used in a power plant. Assume suitably any requirements for calculations.

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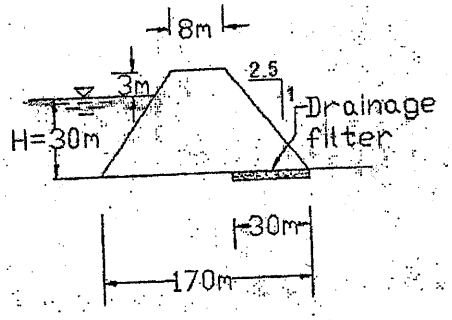
03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Discuss about the advantages and disadvantages of hydropower projects comparing to other sources of energies. [6]
2. What are the different stages of hydropower development? Explain the working principle of peaking run off river plant and show general arrangements of components with neat sketches. [2+3+3]
3. a) What do you mean by sediment yield and life of a reservoir? Explain various remedial measures that help to reduce the reservoir sedimentation. [1+3]
   b) A hydropower plant receives design discharge of 25 m^3/s from 150 m height. The annual output of the plant is 220 GWh. If he peak load demand is 30 MW, determine (i) annual load factor (ii) Capacity factor and (iii) Utilization factor. Assume overall efficiency of the plant equals to 85% and neglect head loss in the penstock. [2+2+2]
4. a) Following Figure shows the cross-section of an earthen dam having coefficient of permeability 1×10^{-6} m/s. Calculate the seepage discharge through the body of the dam with the help of phreatic line. [8]



   b) Write the purpose of use of filter material in earthen dam. Explain its design principle. [4]
   c) What are the factors to be considered in the dam site evaluation? Describe the different failure modes of a gravity dam? [4+4]
5. a) Find the dimensions of a settling basin for a high head project of Himalayan River which utilizes a discharge of 60 m^3/s and a gross head of 100m. The sediment size to be removed is up to 0.15 mm. Consider the turbulence effect also. Draw the plan and section. [5+2]
   b) What are the requirements of good intake? Explain different types of intake used in hydropower projects in Nepal with neat sketches. [2+3]

6. a) Describe advantages and disadvantages of different tunnel shapes based on geometry with neat sketches. [4]

   b) In a hydropower project, the headrace tunnel of 4.5 m diameter and 2,500 m length carries 25 m^3/s discharges to the surge tank of 10 m diameter. The penstock from surge tank to power house has 3.5 m diameter and 1000 m length. Considering the case of instantaneous closure, find the maximum height of surge tank required and time period of oscillation of wave. Assume friction factor = 0.02. [8]

7. a) Determine the size and setting height of the Francis turbine for a site having net head of 150 m, discharge is 160 m^3/s and efficiency of 85%. [4]

   b) Water is being supplied to a pelton wheel under a head of 300 m through a 100 mm diameter pipes. If the quantity of water supplied to the wheel is 1.50 m^3/s, find the number of jets in the wheel. Assume coefficient of velocity is 0.96. [4]

8. What are the different types of power houses used in hydropower? Explain their relative suitability considering the field conditions. [4]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Discuss the advantages and disadvantages of hydropower over other sources of energy. [3+3]
2. Differentiate between pre-feasibility and feasibility studies of a hydropower project with explaining the site specific hydrological and topographical investigations. [8]
3. a) A hydropower project is planned to develop in a Nepalese River having net head of 150 m, turbine efficiency of 90% and generator efficiency of 95% with the monthly hydrograph as shown below: [3+2+3]

Months	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Q (m^3/sec)	100	80	60	50	40	30	40	50	70	110	150	120

As an environmental flow, a minimum flow of 10% of each month is mandatory.

If the storage project is designed with full regulation of annual hydrograph find out: the capacity of the reservoir; installed capacity of the power plant, and annual energy generation.

4. a) Design an elementary profile of a gravity dam made of stone masonry using following data: [8]
   R.L of base of dam = 198 m
   HFL = 228 m
   Sp. gravity of masonry = 2.4
   Safe compressive stress in masonry = 1200 KN/m^2
   $\tan \phi = 0.70$
   Seepage coefficient = 1

   b) Show with neat sketch, various seepage control measures in embankment dam. [6]

   c) Discuss with sketch the arrangement and suitability of 3 different types of spillways used in a headworks. [2×3]

5. a) Differentiate between pressurized and non-pressurized intakes in RoR system. [3]

   b) Design the settling basin from the particle size and concentration approach and calculate the trap efficiency from the following data. (Refer figure 3 &4) [8]

   Design discharge = 80 m^3/s
   Number of basin = 2
   Installed capacity of the plant = 110 MW
   Water temperature = 12°C
   Particle size to be removed = 0.2 mm
   Manning's constant (n) = 0.01
   Flushing discharge = 1 m^3/s
   (If flushing system is continuous)

   Assume other necessary data if needed. If the flushing system is changed to intermittent with single basin what are the changes, describe with suitable reason.

   c) What are minimum performance standards of the sound headworks. [3]

6. a) Design a forebay using following data sets: [4]
   $Q = 15\ m^3/s$
   Storage requirements = 4 minutes
   Length of penstock = 500 m
   Diameter of penstock = 2 m

   b) Discuss various tunneling methods used in Hydropower projects. What is the purpose of shotcreting? Discuss the procedure. [4+2+2]

7. Design a pelton wheel turbine for a hydropower plant having net head of 310 m and discharge of $5m^3/s$. Take the efficiency of the turbine as 90%. What will be the specific speed of such turbine? [7+1]

8. Describe with sketch different types of power house and their general arrangement. [4]

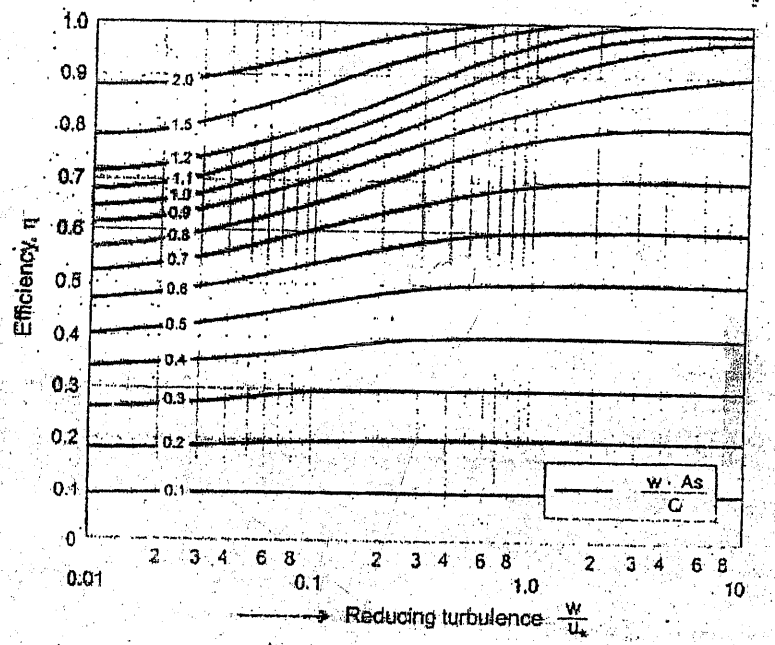

Figure 3: Camps Diagram

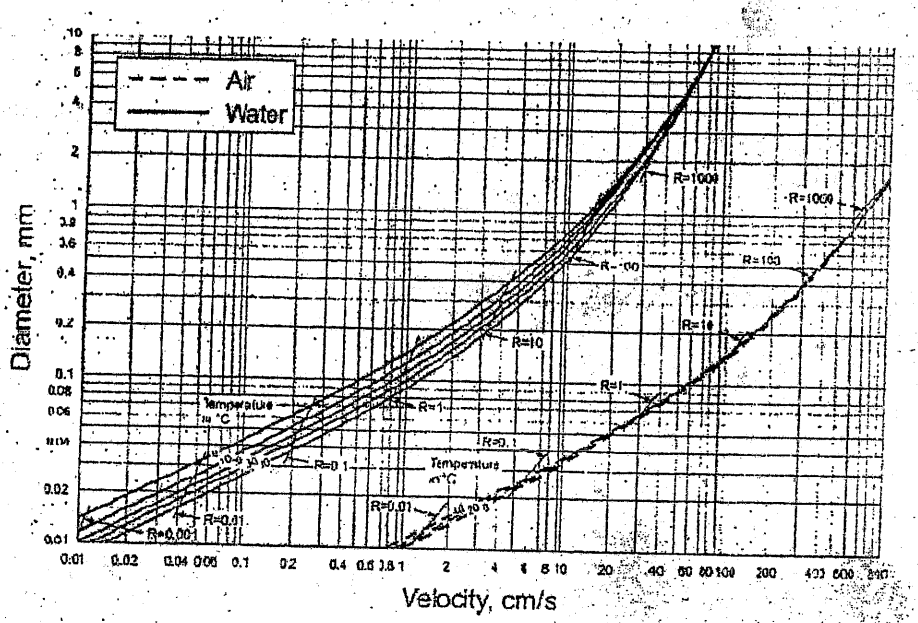

Figure 4: Fall velocity of quartz spheres in water and air after Rouse

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. a) Briefly discuss the historical development of Hydropower in Nepal. [3]
   b) Do you think daily peaking RoR projects are advantageous over RoR projects in Nepal? Justify your answer with daily load curve. [2]
   c) If you are developing 10 MW RoR hydropower project in Nepal, write different studies carried out during the feasibility level study. [5]
2. a) The average monthly flow of river in a typical dry year are as follows: [5+2+2]

month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Q m^3/s	65	53	51	115	187	270	580	974	1179	355	176	123

And other relevant data are follows i) prevailing interest rate =12% ii) Energy selling price for primary energy=Rs 5000/ Mwh and 3000/Mwh for secondary energy iii) installation (Electro-mech) cost = RS 80000/kW iv) project life time = 40 yrs v) overall efficiency of the plant = 87% vi) Effective head = 100m vii) O&M cost = 2% of electro mechanical cost viii) fixed cost = Rs $30*10^9$

a) Determine the installed capacity of such plant

b) Calculate the firm power of the plant, considering 95% probability of exceedance of flow

c) If the deficit in the firm power in the power system is 200 MW what is the storage capacity of reservoir to satisfy the demand.

   b) In a minigrid the average load variation is recorded as: [3]

Time	10 PM to 6 AM	6 AM to 9 AM	9 AM to 6 PM	6 PM to 10 PM
Load (KW)	400	540	450	820

Power is supplied by the plant capacity of 950 KW Micro-hydro. Find out load factor, plant capacity factor and utilization factor.

3. a) Discuss the selection criteria of different types of dam in hydropower projects. What type of dam do you select in different foundation condition? [3+2]
   b) Design and draw section of a side intake with coarse trash racks for a project in which river bed level is 3315.0 m amsl. Weir crest level is fixed to 3317.5 m amsl. The highest flood level in 100 years return period is 3320.83 m amsl and flood level in 20 years return period is 3319.55 m amsl. The canal water level is fixed at 3317.5 m amsl. The design discharge is 1.45 m^3/se. Assume other suitable data. [6]

c) Determine the specific discharge of the flow through earthen embankment dam having 2.5 m thick centre impervious core. The upstream and downstream slopes of an earthen embankment dam are 1:1 and 2:1 respectively. The water depth at upstream is 25 m. The dam has a crest width of 4 m and free board of 2 m. The coefficient of permeability of dam body material and center impervious core are 2.5 cm/hr and 0.15 cm/hr respectively. Also draw the phreatic lines. [6+4]

d) Why drainage gallery is provided in concrete dam? Mention the suitable location of a gallery in dam section with its effect in uplift pressure. [1+2]

4. a) What do you mean by mass curve? Write step wise procedure of calculation of reservoir capacity using the mass curve. [1+3]

b) What are the design considerations of headworks in high sediment laden rivers of Nepal to minimize the entry of sediments from the intake? Explain the favorable conditions to construct the bottom rack (drop) intake. [3+2]

c) Classify settling basin based on flushing system. Also explain its operation mechanism during flushing. [1+2]

5. a) In a hydropower project the following data are given: [1.5×4]

Design discharge (Q) = 60 m^3/s
No.of penstock = 3
Dia. of penstock = 2.0 m
Length of tunnel = 6.5 km
Dia. of tunnel = 9.0 m
Velocity of wave in penstock = 1750 m/s
Frictional factor for tunnel = 0.016

If the simple cylindrical surge tank of 25 m dia has been provided at the end of the tunnel, find (i) Max. up surge in the tank (ii) Max down surge in the tank (iii) water hammer pressure and (iv) Time of oscillation.

b) A penstock of discharge capacity 5m^3/s is functioning for a hydropower with dynamic head of 50 m over the turbine. Determine its economic diameter. [2]

c) Discuss methods of tunneling practiced in hydropower project. [4]

6. a) A pelton wheel has to be designed for the following data; [6]

Power to be developed = 6 M

Net rated head =300m

Ratio of the jet diameter to the wheel diameter =0.1

Overall efficiency =90%

Assume coefficient of velocity (Cv) = 0.98 and ratio of peripheral velocity of wheel to jet velocity = 0.46

b) Draw a plan and section of powerhouse having two unit of vertical axis Francis turbine showing from penstock to tailrace outlet. [4]

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. a) "Most of the political parties of Nepal are determined to avoid Load Sheding during 5 years in their menufesto" Do you agree with their commitment during this period? What approach need to be taken for hydropower development in Nepal to meet the demand rate up to 2020. [2+3]

   b) Explain site specific hydrological, geological and topographical investigations to be carried out during the pre feasibility study level of a hydropower project. [5]

2. Hydropower project is planned to develop in a river having net head of 100 m and overall efficiency of 85% with the monthly hydropgraph as shown below.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Discharge	100	120	140	300	320	1800	2000	2500	2100	900	500	300

   i) Calculate installed capacity, annual spill energy and firm energy if RoR project is designed based on the 40% probability of exceedence flow. [2+2+2]

   ii) If the storage project is developed with full regulation of annual hydrograph (design discharge is equal to average monthly flow), Calculate the storage requirements. [2]

   iii) Calculate the installed capacity and annual energy generation from the storage project as mentioned in above case. [2+2]

3. a) Show that the resultant force in a concrete gravity dam should pass within the middle third of the base width in order to avoid tension in the heel. [6]

   b) Design a hydraulic jump stilling basin at the toe of the spillway with the following data; [9]

   Discharge = 80 m^3/s
   Width of the spillway = 8m
   Spillway crest level = 96.00m
   River bed level = 65.00m
   Tril water level = 71.00 m
   Coefficient of discharge = 0.7
   Downstream bed slope (i) = 1:500 and Manning's roughness coefficient = 0.016 and ratio of length of stilling basin and sequent depth = 5.1

   c) Explain very briefly three types of gates and its working mechanism with sketches widely practiced in hydropower projects in Nepal. [1+3]

   d) Determine the seepage discharge for the earthen dam having 33 m total height with 3m width impervious central core. Take top width of the dam is 7m and freeboard 3m. The coefficient of permeability of dam material is 4×10^{-6} m/sec and that of impervious core is 4×10^{-8} m/sec. The upstream and downstream slope of the dam is 3:1 and 2.5:1 respectively. [5]

4. a) Find out the dimension of a continuous flushing settling basin for a high head project in Himalayan River which utilizes a discharge of 60 m^3/s and head of 300 m the sediment particles larger than 0.15 mm have to be trapped efficiency 95% in the basin. Consider the effect of the turbulence and check the length of basin using Valikanov's relation of the density of the silty water of 1.105 ton/m^3. Draw plan and section of the basin showing major components. [6+3]

   b) Explain the general requirements of a functional ROR headworks. [3]

5. a) What do you mean by hydraulic design of tunnel? Explain the selection criteria of tunnel alignment. [2+2]

   b) What are the design considerations of Forebay? Design a Forebay with turbine discharge $12m^3/sec$, water is conveyed from Forebay to powerhouse by two number of penstock of 2 m diameter each. Take retention time 3 minute and limiting velocity 0.2 m/sec. [2+4]

   c) Why restricted origice type is more efficient than simple cylindrical type. [2]

6. a) Design specific speed, turbine diameter and setting of the Francis turbine in a hydropower project having net head of 150 m and design discharge of 25 m^3/sec. Take turbine efficiency 81%. [2+2+2]

   b) What are the conditions Francis turbines are preferable than Pelton turbine? [4]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. List out the major features of Hydropower Development policy 2001. Is the policy able to attract private sector? Write your comments. [6]

2. a) Drawing neat sketch (plan and section with all components), discuss the principal characteristics of diversion type storage hydropower plant. [4]

   b) Highlight the major studies and investigations carried out during reconnaissance, prefeasibility and feasibility studies. [4]

3. The mean monthly flow of a typical Nepalese river is as follows: [2+4+2]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q (m^3/s)	80	74	83	100	130	222	600	800	590	240	120	100

   i) Calculate the installed capacity of a plant based on minimum flow of the river without pondage (if the plant is designed for pure run of river plant) with net head of 200 m and overall efficiency of a plant is 85%.

   ii) The plant has three sets of units (turbine and generator) such that one unit with full capacity is operated during off peak hour. If the plant is designed for a peaking plant with 4 hour peaking (morning 2 hour and evening 2 hour), what will be the installed capacity of a plant?

   iii) What will be the increase in benefit from peaking if peak hour energy rate is Rs 12/kWh and off peak energy rate is Rs 6/kWh during minimum flow month?

4. a) A concrete gravity dam on the rocky foundation is acted by the upstream horizontal hydrostatic force of 4.50 million KN and by the downstream the same of 0.50 million KN. Determine the volume of concrete works (r_{con} = 24 KN/m^3), neglecting bond stress and up lift force and taking a factor of safety on the horizontal thrust of 2.5 and a friction coefficient between the concrete and rock of 0.65. [8]

   b) Write with necessary sketch and their hydraulics, any three types of spillways used in a head works of a hydropower plant. [6]

   c) Explain causes of failure of earthen dam. What criteria do you adopt for safe design of earthen dam? [2+4]

5. a) Discuss the requirements of a functional RoR headworks. Drawing a typical plan of such headworks, discuss how these requirements are fulfilled. [2+3]

   b) Find out the dimension of a settling basin with turbulent flow for a high-head hydropower plant, which utilizes a discharge of 40 m^3/s. The sediment particles coarser than 0.15 mm (ω = 1.5 cm/s) have to be trapped in the basin. Draw plan and sections (cross and longitudinal) showing major components and flushing arrangement. [3+3]

   c) If you have allocated about 10% volume for sediment storage and overall trapping efficiency of settling basin is 40%, find out the frequency of flushing of settling basin, when the sediment concentration is 2000 ppm. [3]

6. a) The design discharge through the tunnel of a hydropower project is 60 m^3/s is conveyed by three number of penstock to the turbine of 2 m diameter each. Take the length of tunnel is 7 km, diameter of tunnel is 10 m, friction factor of tunnel is 0.016, friction factor of penstock = 0.04 and velocity of wave in penstock = 1800 m/sec. If the surge tank of 30 m diameter has been provided at the end of the tunnel, find the following: (i) maximum up-surge and down-surge in the tank (ii) water hammers pressure (iii) Time of oscillation of wave. [4+2+2]

   b) Discuss with sketch, types of tunnel supports and their necessity? [3+1]

7. What do you mean by setting of turbine? The pipe line 1200 meter supplies water to 3 single jet pelton wheels. The need above the nozzle is 360 m. The velocity coefficient for the nozzle is 0.98 and the coefficient of the friction for the pipe line is 0.02. The turbine efficiency is 0.85. The specific speed of turbine is 15.3 rpm and loss head is 18 meter in pipeline due to friction. If the operating speed of each turbine is 560 rpm, determine (i) Total power developed (ii) Discharge (iii) Diameter of each jet and diameter of pipe line. [2+6]

8. Drawing a section of vertical axis Francis turbine in a powerhouse, show the different parts of powerhouse structure. [4]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Hydropower Engineering *(CE704)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What are the objectives of Hydropower Development Policy 2001? Explain five main features provisioned in Hydropower Development Policy 2001 for the development of hydropower in Nepal. [3+3]

2. a) Prepare a three alternative layouts plan and sectional drawings of the ROR Hydropower plants. [6]
   b) What are the stages of hydropower development cycle? [2]

3. The stream flow record for a hydropower development site is given below. Draw a flow duration curve and determine firm and secondary energy if the available head is 60 m design discharge capacity is $45m^3/s$ and overall efficiency is 82%. [8]

Months	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
$Q(m^3/s)$	30	38	28	22	16	32	56	72	54	46	38	36

4. a) Draw uplift pressure diagram (i) for dam holding 50 m water depth at upstream vertical face with top and bottom width 10 m and 30 m respectively. Uplift may be considered to be acting an 60% of the area of section. Tail water depth is 5 m. (ii) for the same dam there is a drainage gallery at 6 m from face. [3+2]
   b) The u/s and d/s slope of a homogeneous earthen dam with 12m toe drain are 2:1 and 3:1 (H:V) respectively. The water depth at u/s of dam is 50m. The dam has a crest width of 20m and free board is of 5m. The coefficient of permeability of dam material is 2.5 cm/hr calculate (i) Specific discharge through the body of dam (ii) co-ordinate of phreatic line. [10]
   c) With appropriate drawings illustrate the general arrangement of intake for storage plants. [5]

5. a) How are the control of bed load and floating debris in ROR intake done? Explain with appropriate plan and sectional drawings of the system. [6]
   b) Compute the dimension of periodic type settling basin considering and without considering the turbulence effect for a hydropower plant through settling theory. [8]
   Take,
   Settling velocity = 6 cm/sec
   Discharge = $5m^3/sec$
   Particle size to be removed = 0.2 mm
   Depth of basin = 2.4 m

6. a) A power station is fed by a 4000m long concrete lined tunnel of 5.0 m dia and 600 m long pressure shaft of 4.0 m dia operating under a gross head of 250 m. If the design discharge of the plant is 60 m^3/sec and the friction factors in tunnel and pressure shaft are 0.014 and 0.012 respectively,
      i) Compute the sectional area required for mass oscillation in a surge tank [3]
      ii) Maximum upsurge and downsurge levels [3]
      iii) If the headwater level is 1048 m, find out the invert level of the headrace tunnel at surge tank [3]
   b) Explain the importance of tunnel lining. [3]

7. Discuss the various types of reaction and impulse turbines used in a hydropower plant. Discuss their suitability and major performance characteristics. [8]

8. Discuss the arrangement in a typical surface powerhouse. How do you compute the basic dimensions of such building? [2+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure (*CE 702*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Use of IS 456 and IS 13920 are allowed. IS 456 SP-16 is allowed to design column only.***
- ✓ *Assume suitable data if necessary.*

1. a) Discuss different types of flexural sections according to amount of reinforcement in tension zone. Describe different types of failure modes in above mentioned sections. [8]

   b) Determine area of steel required and the moment of resistance for a RC beam 250 mm x 450 mm. Consider M15 grade concrete and mild steel. Use working stress method. [8]

2. a) Describe anchorage and flexural bond stress. Derive equation for development length and bond stress. [6]

   b) Design a rectangular RC beam having cross sectional dimension 200 mm x 400 mm subjected to design bending moment 100 kN-m, design shear force 80 kN (at critical section) and design torsional moment 15 kN-m. Consider M25 grade concrete and Fe415 grade steel. [10]

3. a) Define interaction diagram with its features and neat sketches. Discuss on the modes of failure for compression members in eccentric compression within the interaction diagram. [4]

   b) Design a braced rectangular RC column having clear height of 4.0 m, with cross sectional dimension of 450 mm x 350 mm subjected to design axial load of 700 kN, design bending moments of 100 kN-m about major axis and 80 kN-m about minor axis. The column is held effectively at both ends and restrained against rotation at one end. Consider M25 concrete and Fe415 steel. [12]

4. a) Explain the ductility requirement for the reinforced concrete beam with a neat sketche. [2]

   b) Design a two-way slab simply supported on all four edges for a room 6 m x 4 m clear in size supported on 230 mm thick walls. The superimposed working load is 4 kN/m^2 and corners are not held down. Use M25 mix and Fe 415 grade steel. [14]

5. a) Discuss special confining reinforcement for ductile detailing of column with neat sketches. [2]

   b) Design an isolated footing supporting a square column 400 mm x 400 mm with 8-20 ϕ longitudinal reinforcement. The Column is subjected to axial service load of 1000 kN. Consider base of footing is 1 m below the ground level. Take allowable bearing capacity of soil 100 kN/m^2, M15 concrete and Fe 415 steel. Also check for load transfer from column to footing. [14]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure (*CE 702*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Use of IS456 and IS13920 are allowed. SP16 is allowed to design column only.***
- ✓ *Assume suitable data if necessary.*

1. a) Describe under-reinforced, over-reinforced and balanced reinforced concrete sections. [7]
   b) A rectangular beam of size 300 mm x 550 mm effective depth is reinforced with 4-16 mm diameter tension bars. Determine the stress induced in the top compression fibre of the concrete and tension steel when it is subjected to a moment of 50 kN-m. Take M20 concrete and Fe 415 grade steel with the permissible stress in concrete and steel not exceeding 5 MPa and 140 MPa respectively. [9]
   c) Define design strength and design load for limit state design method. [4]
2. a) Design a beam 425 mm x 550 mm subjected to factored bending moment of 100 kN-m, twisting moment of 28kN-m and shear force at critical section of 100 kN. The beam is under mild exposure condition. Use M20 grade concrete and Fe415 grade steel. [10]
   b) Describe the design steps of flanged beam sections.. [4]
   c) Determine the limiting moment of resistance and limiting area of steel for a reinforced concrete T-beam having effective width of flange 1500 mm, effective depth of 590 mm, depth of flange 150 mm and width of web 240 mm. Use M20 grade concrete and Fe415 grade steel. [6]
3. a) Design a RC slab (interior panel) resting on RCC beams on all sides for a room having clear dimensions of 4 m x 5 m. The slab is subjected to superimposed live load of 3 kN/m^2 and floor finish load of 2 kN/m^2. Use M20 grade concrete and Fe415 grade steel. Perform necessary checks and provide structural drawings. [15]
   b) Describe importance of ductile detailing in RC structures with neat sketches of ductile detailing for beams and columns. [5]
4. a) Design longitudinal and transverse reinforcement in a rectangular RC column of size 350 mm x 550 mm subjected to a factored axial load of 900 kN and moment equal to 200 kN-m with respect to the major axis. Take unsupported length of 3 m and effective length of 3.6 m. Use M25 grade concrete and Fe415 grade steel. [10]
   b) Design a footing for supporting a square column of 400 mm x 400 mm. The column carries a service load of 1500 kN. The safe bearing capacity of soil is 150 kN/m^2. Use M20 grade concrete and Fe415 grade steel. [10]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure (*CE 702*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What are balanced, under-reinforced and over-reinforced sections? Explain with neat sketches of the stress distributions and expressions for moment resistance of each section. [6]

   b) An RC beam 230 mm wide and 400 mm deep (effective depth of 380 nm with area of steel 580 mm^2 has permissible stress in concrete and steel 5 N/mm^2 and 140 N/mm^2 respectively. Find the moment of resistance of the section and actual stresses in concrete and steel. [8]

   c) Explain about design steps of doubly reinforced section with neat sketches. [6]

2. a) An RC beam with effective depth of 550 mm and breadth of 400 mm contains 5#25 mm diameter bars, out of which two bars are to be bent-up at 45°near the end of the support. The beam carrying a uniformly distributed factored load of 100 kN/m over a 6 m clear span. Calculate the shear resistance of the bent-up bars and design the additional stirrups if needed. Use M20 grade concrete and Fe415 grade steel. [10]

   b) Design column 400 mm × 500 mm having unsupported length of 4.0 m with both ends effectively held and restrained against rotation at one end with the following data: [10]
   Factored axial load = 1600 kN
   Factored moments = 150 kN-m and 50 kN-m
   Use M25 concrete grade and Fe500 steel grade.

3. a) Design a reinforced concrete rectangular slab of size 4.0 m × 5.0 m to support an imposed load of 4 kN/m^2 and floor finish of 1 kN/m^2. The slab has two adjacent edges discontinuous with the slab resting on 275 mm wide beam. Check the safety of slab against shear and deflection. Use M20 grade concrete and Fe415 grade steel. (Design of torsional reinforcements is not required) [12]

   b) What is the philosophy of design of structures in earthquake prone region? Explain about design for strength and ductility. [4+4]

4. a) Design an isolated footing for a 450 mm × 500 mm sized column, with 6#20 mm diameter bars. Carrying factored axial load of 1100 kN and factored uniaxial moment of 120 kN-m at the column base. Take the depth of footing 1.5 m and safe bearing capacity of soil 100 kN/m^2. Use M20 grade concrete and Fe500 grade steel. [12]

   b) Explain about ductile detailing in beams and columns. Why ductile detailing is needed in joints? [4+4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure (*CE 702*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Describe the difference between working stress and limit stress design. Explain characteristic strength and load. [2+2]

   b) Derive equations for bending moment carrying capacity of double reinforced rectangular section using assumptions for working stress method given by IS 456:2000. [6]

   c) A simply supported RCC beam of effective span 4 meter and overall dimensions 250 mm × 475 mm is subjected to superimposed load of 45 kN/m excluding its self-weight with point load 75 kN at midspan. Design the beam for limit state of collapse in flexure. Also, check whether the beam is safe in deflection or not. Consider effective cover to ne 45 mm, Take M 25 concrete and TMT bars. All the loads are in service level. [10]

2. a) A simply supported RCC beam 300 mm wide and 400 mm deep (effective) is reinforced with a 4-20 mm diameter bars. Design the shear reinforcement if M 25 grade of concrete and TOR steel bars is used and beam is subjected to a shear force of 130 kN and torsional moment 45 kN-m at service state. [10]

   b) A rectangular slab panel 5m × 4 m (clear span) is continuous over three edges and discontinuous over one short edge. The slab is to rest on 250 mm wide beam. The slab is subjected to live load of 4 kN/m^2 and floor finish of 1.5 kN/m^2. Design the slab and check whether the provided section satisfies the deflection criteria. Also, sketch the arrangement of reinforcement bars at the support and at the midspan with torsional bars. [10]

3. a) Define development length and lap splice. Derive the expression $L_d \leq 1.3\frac{M_1}{V_u} + L_0$ at simply supported end, where symbols have their usual meaning. [2+4]

   b) Design an unbraced rectangular RC column having clear height 6.0 m, with x-sectional dimension 400 mm × 350 mm subjected to design axial load of 600 kN, design bending moments 100 kNm about major axis and 50 kNm about minor axis. Consider M20 concrete and Fe 415 steel. [14]

4. a) Discuss about requirements for good detailing. Also describe bar bending schedule. [3+3]

   b) Design a footing for a rectangular column of size 30 cm × 35 cm reinforced with 8-20 mm dia. bars. The column is subjected to a factored axial load and moment of 1000 kN and 80 kN-m, respectively. The allowable bearing capacity of soil is 140 kN/m^2. At a depth of 1.6 m. Use M25 concrete and TMT bars for column and footing both. Sketch all of the reinforcement required. [14]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Use of IS 456, IS 1343, IS 13920 are allowed. IS 456 SP-16 is allowed to design column only.***
- ✓ *Assume suitable data if necessary.*

1. a) Explain with suitable diagrams balanced under-reinforced and over-reinforced sectors in RCC design. [6]

   b) Discuss about under re-inforced and over re-inforced RC sections with their significance during design with suitable sketches. [4]

   c) A simply supported beam has clear span 4.5 m, support width 200 mm is subjected to imposed load of 35 kN/m. Beam is also subjected to torsional moment 18 kNm, consider M20 concrete and Fe415 steel. Design for bending and shear. [10]

2. a) Discuss shear carrying mechanism of reinforced concrete structure with neat sketches. [4]

   b) Design an interior pannel of a slab for a room having clear floor finish dimension of 3.5 × 4.5 m. The slab rests on 250 mm wide beam. Assume liveload of 4 kN/m^2 and of 0.6 kN/m^2. Use M20 mix and Fe415 grade of steel. Check for shear and deflection is also required. Draw reinforcement detailing in plan and sections. [16]

3. a) Determine the reinforcement in short column has 4 m length fixed in both sides with bi-axially loaded having a following parameters: [10]

   Size of column = 400 mm × 600 mm; Factored load, Pu = 1000 kN;
   Factored moment Mux = 125 kNm; Factored moment Muy = 200 kNm;
   M25 concrete and Fe500 steel

   b) Determine the moment of resistance of a RC rectangular beam of overall dimension 250 mm × 475 mm reinforced with 3-16 mm dia. bars in tension side. Use M20 concrete Fe415 steel in working stress method. Also, discuss about the actual and theoretical point of curtailment of re-bar. [6+4]

4. a) Design a RC footing for a column having x-sectional dimension 400 mm × 300 mm, with 8-16 ϕ longitudinal reinforcement, column is subjected to axial compressive load of 1000 kN and reversible bending moment 100 kNm. Consider M20 concrete for footing, M25 concrete for column and Fe415 steel for both. Take safe bearing capacity of soil is 200 kN/m^2 at a depth of 1.5 m. [12]

   b) Explain the empirical method of controlling deflection as per IS 456. [4]

   c) Discuss how ductility of RC structure can be increased. [4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Concrete Structures *(CE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Use of IS 456, IS 1343, IS 13920 are allowed. IS 456 SP-16 is allowed to design column only.***
- ✓ *Assume suitable data if necessary.*

1. a) Define characteristics loads and characteristic strength. Discuss stress strain relation for steel and concrete in Limit State Method (LSM) and Working Stress Method (WSM). [1+1+2+2]

   b) An R.C.C beam 25 cm wide and 60 cm deep has 4 bars of 20 mm dia. as tension reinforcement. The centre of bars being 5 cm above the bottom of the beam. Determine the uniformly distributed load the beam can carry over a simply supported effective span of 6.10m. The permissible stresses in concrete and steel are taken as 7 MPa and 230 MPa respectively. Use modular ratio. [8]

   c) What are the factors affecting the ductility. Explain the ductility requirements of R.C.C. beam as per IS 13920. [6]

2. a) Explain about behaviour of concrete under shear with sketches. Explain the different conditions. [4]

   b) Design a two adjacent sides (edges) discontinuous reinforced concrete slab for room having clear dimensions of 3.5m × 4.5m. The slab rest on 250mm wide beam. Consider 25mm thick PCC floor finish and live load an slab as 4.0KN/m^2 and partition wall load on slab as 1.0kN/m^2. Use M20 concrete and Fe415 steel. Check also the slab safe in shear deflection or not. Show the reinforcement and arrangement in plan and section (along short span only). (Design of Torsional reinforcements in slab not required). [16]

3. a) Determine the longitudinal and transverse reinforcements to be provided in a biaxially loaded short square shaped RCC column with following data:
   Size of column = 400×400mm.
   Ultimate factored axial load = 800kN
   Inclusive of live load at an eccentricity of 80mm in both X and Y direction.
   Use concrete grade of M20 and steel grade of Fe415. [10]

   b) Explain about bond and development length with formula derivation. [5]

   c) Explain the design steps of flange beams. [5]

4. a) Design an isolated square footing foundation of uniform thicknesss for a 400mm×400mm column subjected to an axial load of 650kN at service state. Consider safe bearing capacity of soil as 170 kN/m^2 and concrete of M20 and steel grade of Fe500. Show the reinforcements in plan and in section of footing. [12]

   b) A simply supported normal T beam of 6m clear span with service load of 40kN/m. It is reinforced with 4 numbers of 20mm diameter bars at support. Design the shear reinforcement near the support considering the shear contribution of 2 numbers of 20mm dia bars near support. The beam has cross section of 300mm×600mm overall. Use M20 concrete and Fe 415 steel. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Use design codes IS456, IS1893, IS13920 are allowed.***
- ✓ ***SP16 is allowed for column design only.***
- ✓ *Assume suitable data if necessary.*

1. a) Describe about the requirement of steel as reinforcement in RCC structure. Explain about moment of resistance of doubly reinforced section. Derive the formula. [2+2+4]

   b) Calculate the tensile reinforcement required for a rectangular RC beam of size 230mm×425mm (overall) if it has to carry a moment of 64KNm at service condition. Use M20 grade concrete mix and Fe500 grade steel in working stress method. [8]

2. a) Describe the method of controlling deflection and cracking in RCC structure. [2+2]

   b) Determine the longitudinal and transverse reinforcement of RC column subjected to a factored axial load of 1440KN and factored moment Mux about major axis of 195 KNm and Muy about minor axis 180KNm. The size of column is 350mm × 350mm and unsupported length of 3.60m.Adopt M20 concrete and Fe500 grade (TMT) steel. Also do the ductile detailing of transversal reinforcement. [12]

3. a) Define development length and ductility. Describe the ductility requirements in different joints of RCC structure. [1+1+4]

   b) A RC beam has an effective depth of 550mm and a breadth of 300mm. It contains 4 no. of 20mm dia bars out of which two bars are to be bent up at 45° near end of the support. Calculate the shear resistance of bent up bars and the additional stirrups needed if the factored shear force due to uniformly distributed load is 425KN at the support. The span of the beam is 6m. Use M20 grade concrete mix and Fe415 grade (TOR) steel. [10]

4. a) Define balanced, under-reinforced and over-reinforced sections. [3]

   b) Design a RCC footing to carry a column load of 1250KN from 400×400mm square column having 20mm diameter bar as longitudinal steel. The bearing capacity of soil is 140KN/m^2. Consider the depth of foundation as 1.8m. Take unit weight of earth as 18KN/m^3. Use M20 grade concrete mix and Fe415 grade steel. Also sketch the reinforcements in plan and section. [13]

5. a) What is splicing and why it is required in RCC structures. [2]

   b) Design a RC slab over a room 5m×6m. The slab is supported on masonry walls all round with adequate restraint and corners are held down. The live load on slab is 3KN/m^2 and floor finish 1.5KN/m^2. The thickness of supporting wall is 230mm. Use M20 concrete mix and Fe415 grade steel. Also draw the tp and bottom reinforcement detailing with their section and plan. Check for deflection and development length is necessary. [14]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Use design codes IS 456, IS 1893, IS 13920 are allowed and SP16 is allowed to column design only.***
- ✓ *Assume suitable data if necessary.*

1. a) Explain with the help of sketches, under-reinforced, over-reinforced and balanced sections. [4]

   b) What are the serviceability requirements in the limit state design of RC structures? Explain them briefly. [4]

   c) A rectangular RC beam of overall dimensions 250mm × 450mm is reinforced with 4-16 mm dia. bars in tension at an effective cover of 40mm. Calculate the moment of resistance of the beam using working stress method. Adopt M20 concrete and Fe415 grade steel. [8]

2. a) A reinforced concrete rectangular beam has an overall depth of 500mm and breadth of 300 mm. It consists of 5-25 mm dia bars in tension and 3-16 mm dia. bars in compression. Calculate the shear reinforcement needed for a factored shear force of 370 kN. Take M20 grade concrete and Fe415 grade (TOR) steel. Also check the spacing for minimum shear reinforcement. [8]

   b) A rectangular RC beam of overall dimensions 650 mm by 300 mm is subjected to a factored bending moment of 85 kN-m, factored shear force of 110 kN and factored twisting moment of 25 kN-m. Design the beam for longitudinal and transverse reinforcements. Use M25 grade concrete and Fe415 grade steel. [8]

3. a) Design a short rectangular column of size 350mm × 500mm and unsupported length of 3.30m subjected to an axial factored load of 1500 kN and factored moments 130 kN-m and 80 kN-m about major and minor axes respectively. Adopt M30 grade concrete and Fe500 grade steel. Sketch the reinforcement details. [14]

   b) Define development length and lap splice. [2]

4. Design a RCC slab for a room of clear dimensions 6m × 4m whose one short edge is discontinuous and corners are restrained at supports. The live load on the slab is 4 kN/m^2 and superimposed load of 1.20 kN/m^2. Adopt M20 grade concrete and Fe415 grade steel. Check the slab for deflection, and development length. Give the detail sketches, sectional view along short span with reinforcement details along with torsional reinforcements. [16]

5. a) Design a R.C.C isolated footing to carry an axial load of 1500 kN. The column is 350mm ×350mm in size with 20mm diameter, 8 Nos longitudinal bars. The bearing capacity of soil is 175 kN/m^2. Use M20 grade concrete and Fe415 grade steel. Assume missing datas. [10]

   b) Explain with the help of sketches the ductile detailing of RC beams. [6]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS 456, IS 13920 are allowed. IS 456 SP-16 is allowed to design column only.*
- ✓ *Assume suitable data if necessary.*

1. a) A rectangular R.C beam of size 230×350 mm overall is reinforced with 4-16 mm dia bars at tension zone in bottom, determine the moment of resistance of that beam section if the permissible stresses in concrete and steel does not to exceed 7.0 Mpa and 140 Mpa respectively. Take Nominal cover to re-bar as 25 mm and m =13.33. [7]

   b) Define anchorage bond and flexural bond stress. Prove that flexure bond stress is the function of shear force (V) and $L_d \leq 1.3\frac{M_1}{V_u} + L_0$ at supply support end, where symbol have their usual meaning. [7]

   c) With the help of neat sketch, describe the requirement for confining reinforcements in RC columns for earthquake resistant design. [6]

2. a) A Reinforced concrete beam has an effective depth of 600 mm and a breadth of 400 mm. It contains 5 no of 25 mm dia bars out of which two bars are to be bent up at 45° near end of the support. Calculate shear resistance of bent up bars and additional stirrups needed if the factored shear force diagram is 250 kN at support and 0 kN at mid span of 6 m span beam. Use M20 grade steel and Fe 415 steel. [14]

   b) Describe the step-by-step procedure used for the design of RC bean subjected to shear moment and torsion. [6]

3. a) A rectangular slab panel 5 m × 4 m (clear span) is continuous over three edges and discontinuous over one short edge. The slab carries a floor finish of 1.20 KN/m^2 and live load of 4.0 KN/m^2. Design the slab panel with detailing the top and bottom reinforcements. Sketches the re-bar details clearly. The width of slab supported beam as 225 mm. Take M20 concrete and Fe 415 steel. [14]

   b) Explain different category of limit state design with necessary details. [6]

4. a) Determine the longitudinal and transverse reinforcement in bi-axialy loaded column having a following parameters: [15]

   Unsupported length of column = 3.10 m

   Size of column = 500 mm×600 mm

   Factored moment, Mux = 125 kN.m;

   Factored load, p_u = 1300 KN

   Factored moment, M_{uy} = 200 KN.m

   Use M25 concrete and Fe 500 steel. Take reinforcement in four side. Sketch the details.

   b) Describe the design procedure for mat foundation. [5]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS 456, IS 13920 are allowed. IS 456 SP-16 is allowed to design column only.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain how would you design shear reinforcements for flanged beam sections. [5]

   b) A beam of rectangular section is 300mm wide and 500mm deep to the centre of tensile reinforcement. It has to carry a dead load of 45 kN/m excluding its self weight. Find the steel reinforcement required for the mid span section. The beam has a span of 7m. Use M20 concrete and Fe 415 steel. Effective cover to compression steel = 40 mm. Use limit state method. [15]

2. a) Explain briefly ductile detailing requirements for beam and column with neat sketches. [6]

   b) Design a short RC column with following datas: [14]

   Unsupported length = 3.0 m

   Factored load, p_u = 1550 kN

   Factored moments: M_{ux} = 130 kN.m

   : M_{uy} = 90 kN.m

   Size of column = 300×450 mm

   Do ductile detailing for transverse steel.

3. a) Differentiate between working stress and limit state methods. [5]

   b) Design a restrained floor slab for a room 4m×5m in size to support a live load of 5 kN/m^2, with two adjacent sides discontinuous. Use M20 concrete and Fe415 grade steel. Sketch the details of reinforcements. [15]

4. a) Design an isolated footing to support a square column of 400×400 mm. The column (400×400mm) carries a service load of 1200 kN. The allowable soil pressure is 150 kN/m^2. Use M20 concrete and Fe415 grade steel. Unit weight of soil above footing base = 18 kN/m^3. Necessary missing data assume suitably. [10]

   b) A L-beam of effective and flange width as 925 mm, effective depth as 450 mm, depth of flange as 100 mm, breadth of rib as 250 mm is reinforced with 4-20 mm bars as tension reinforcement and 3-16 mm dia bars as compression reinforcement. Find the ultimate moment of resistance of the section at limit state of collapse. Use M20 grade concrete mix and Fe415 grade steel. [10]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS:456-2000, IS:1893, IS:13920 are allowed.*
- ✓ *Students are not allowed to use SP16 except for the column design.*
- ✓ *Assume suitable data if necessary.*

1. a) Distinguish the differences between the working stress method and limit states design. What is modular ratio? Why should it be considered in the design? [4+1+1]

   b) A RCC T-beam of 1650 mm width of flange, 120 mm depth of flange, 250 mm width of web, and 525 mm effective depth has to carry a factored bending moment of 760 KN-m. Determine the reinforcements required. Use M20 concrete and Fe 500 steel. [14]

2. a) What is flexural bond? Derive expressions for flexural bond stress. Why do the cover and spacing of bars affects the bond strength? [1+4+1]

   b) Design a slab pannel for a room size of 6.3m × 4.5m. The slab is supported on beams with two adjacent edges discontinuous. The super imposed load on the slab is 5 KN/m^2. The materials used are M25 concrete and Fe 500 steel. Check for deflection and cracking control are necessary. Also sketch all reinforcement detailing (Plan and sections). [14]

3. a) What is ductility? Why should it be considered in the design? List the various precautions to be undertaken in the case of R.C.C. columns subjected to earthquake loads. [1+2+2]

   b) Design a column with unsupported length of 3.25m and subjected to biaxial bending for the following data: Effective lengths L_{ex} = 3m and L_{ey} = 2.75m, size of column = 400mm × 600mm, factored axial load (P_u) = 2250KN, and factored moments, M_{ux} = 256KN-m, M_{uy} = 160Kn-m. Assume M30 concrete, Fe500 steel, and moderate exposure. Also, sketch the reinforcement detailing with appropriate transverse reinforcement. [15]

4. a) A rectangular beam of width 250mm and effective depth 450 mm is reinforced with 4-22 mm dia. bars at mid-span of which two bars are bent at the ends at 45°. The beam is provided with shear reinforcement of two-legged 10mm diameter vertical stirrups throughout the beam at a spacing of 220 mm c/c. calculate the shear resistance of the beam. Adopt M25 concrete and Fe 415 steel. [6]

   b) Design a footing to support a 300 mm × 400 mm column. The column carries a factored axial load of 1400 KN and a factored moment of 90KN-m. The allowable soil pressure is 200 KN/m^2 at 1.5m depth. Use M20 concrete and Fe415 steel for footing; and M25 concrete and Fe415 steel for column. Assume that the column is reinforced with 6-22 mm dia bars. Unit weight of soil above footing base = 20 KN/m^3. Note that the moment is reversible sketch the detail. [14]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS:456-2000, IS:1893, IS:13920 are allowed.*
- ✓ *Students are not allowed to use SP16 except for the column design.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain under-reinforced, balanced and over-reinforced sections in Limit state design. [6]

   b) A simply supported rectangular RC beam of effective span 4.2 m and overall dimensions 230 mm × 450 mm is reinforced with 4-20 mm dia. bars in tension. Determine the moment of resistance. Take permissible stresses for M20 concrete and Fe415 grade steel. [6]

   c) A rectangular RC beam of size 250 mm × 500 mm (effective depth) is subjected to a factored shear force of 110 KN. The beam is reinforced with 3-22 mm dia. bars in tension. Design the shear reinforcement. Consider M20 concrete and Fe500 steel. [8]

2. a) Design a slab panel having one short edge discontinuous for a room size of 4 m × 5 m. The edges of slab is supported on walls of width 250 mm. The slab is carrying a live load of 4 KN/m^2 and floor finish of 0.75 KN/m^2. Use M20 Concrete and Fe415 steel. Sketch the reinforcement detailing in plan and sections. Check for deflection and development length are necessary. [15]

   b) What is anchorage bond? Derive the expression $L_d \le 1.3\frac{M_1}{V} + L_o$, with usual notations. [1+4]

3. a) Explain the limit state of serviceability and its requirements in RCC structure. Also list the different types of splicing of reinforcements in RC structure. [4+1]

   b) A RC column of size 35 cm × 40 cm with unsupported length of 3.10 m is subjected to a factored axial load of 1500 KN and biaxial moments, M_{ux} = 125 KNm and M_{uy} = 88 KNm. The ends of the column are effectively held in position but not restrained against rotation. Design the column for longitudinal and transverse reinforcements, and sketch the details. Use M25 Concrete and Fe500 grade steel. [15]

4. a) Design a footing for a square column of size 350 mm × 350 mm reinforced with 8-16 mm dia. bars. The column is subjected to a factored axial load and moment of 1100 KN and 60 KN-m, respectively. The allowable bearing capacity of soil is 150 KN/m^2 at a depth of 1.5 m. Use M20 Concrete and Fe 500 steel for footing, and M30 Concrete and Fe 500 steel for column. Assume that the moment is reversible. Sketch the details (Plan and sections). [14]

   b) Draw the typical reinforcement drawing for a flight and a landing of RCC staircase. Also define the effective span for staircase. [5+1]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

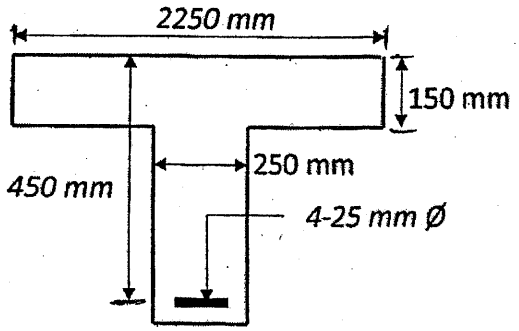
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Design codes IS 456, IS 1893, IS 13920 and SP 16 are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) Find the moment of resistance of a RCC beam 250 mm wide and 500 mm effective depth if it is reinforced with 3-16 mm dia bars. The permissible stresses for concrete and steel are given as 7 MPa and 230 MPa. The value of modular ratio is taken as 13.33. [6]

   b) Find the ultimate moment resisting capacity of a beam as shown in figure. Consider M 20 and Fe415 grade of concrete and steel. [14]



2. a) Design and detail an interior pannel of a slab resting on RCC beams on all sides for a room having clear dimensions of 4.5m*6.5m. The slab is subjected to a super-imposed live load of4KN/m^2 and floor finishes load of 2.5 KN/m^2. Take M20 concrete and Fe415 steel. [15]

   b) What is ductility? What are the significances of ductility in RC structures? [2+3]

3. a) Design the longitudinal reinforcements to be provided for a short column 400×500 mm subjected to following forces: [15]

   P_u = 1600 KN

   M_{ux} = 20.0 KN-m

   M_{uy} = 150 KN-m

   Use M25 concrete and Fe415 steel

   b) Discuss the methods of crack control as per IS456-2000 in RC structures. [5]

4. a) Design an isolated footing for a square column 450 mm× 450 mm, reinforcement with 8-20 dia bars and carrying a service load of 1600 KN. Assume bearing capacity of soil as 250 KN/m^2 and depth of foundation as 1.5 m. Adopt M20 concrete and Fe 500 steel. Also check the development length and bearing stress in concrete. [14]

   b) What do you understand by idealized stress-strain diagram of concrete and steel bar? Draw idealized stress-strain diagrams. Define characteristics strength of concrete and steel. [2+2+2]

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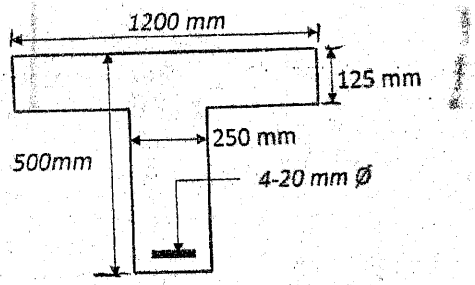
02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Design codes IS 456, IS 1893, IS 13920 and SP 16 are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) Find shear reinforcement required for a beam as shown in figure below. Beam is subjected to design SF of 250KN. Consider M25 and Fe500 grade of concrete and steel. [6]



b) A simply supported RCC beam of effective span 5.5 meter and overall dimensions 230mm×550mm is subjected to superimposed load of 50 KN/m excluding its self weight. Design the beam for limit state of collapse in flexure. Also check whether the beam is safe in deflection or not. Adopt mild exposure condition and use Fe 415 steel. Take effective cover to re-bars as 50 mm. [14]

2. a) A rectangular slab panel 5.5m×4.0m (clear span) is continuous over three edges and discontinuous over one short edge. The slab is to rest on 250mm wide beam. The slab is subjected to live load of 5KN/m^2 and floor finishes load of 1.0 KN/m^2. Design the slab. Sketch the arrangement of reinforcement bars at support and mid span separately with torsional re-bars. Check whether the section satisfies the deflection criteria. (Check for shear and development length not necessary) [15]

b) Why limit state method is better than working stress method. Explain in brief. [5]

3. a) Design the longitudinal and transverse reinforcements to be provided for a short column of size 35cm×45cm subjected to the following forces. [15]

Factored axial load P_u = 1800 KN
Factored moment M_{ux} = 175 KN-m
Factored moment M_{uy} = 105 KN-m
Reinforcements are distributed equally on two sides. Use M25 concrete and Fe500 steel. Unsupported length = 3.1 m

b) Define the term ductility in RC design. Draw a neat sketch of a beam-column joint including ductile details. [1+4]

4. a) Explain how a RC structural member subjected torsion, shear force and bending moment is designed. [6]

b) Design an isolated rectangular footing for a column of size 300mm×400mm. The column is reinforced 8-20 mm dia bars with M25 concrete. The column is carrying a factored axial load of 1200 KN and the factored moment of 120 KN-m. Sketch the details of designed reinforcements in plan and sections. Also check the bearing stress and development length required. Adopt M20 grade concrete for footing. Grade of steel used is Fe415. Assume bearing capacity of soil = 200 KN/m^2 at 1.25 below GL. [14]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *Use of IS: 456-2000; IS 1893 and SP16 are allowed. But, use of SP 16 is allowed only for column design.*

1. a) State all the possible safety and requirements of limit state and define limit state of strength and serviceability. [4]

   b) Design a rectangle footing to carry a column load of 1150 kN and BM of 250 kN-m from 600×600 mm square column with the 20 mm diameter longitudinal steel. The bearing capacity of soil is 200 kN/m^2. Consider depth of foundation as 1.5 m. Take unit weight of earth is 17 kN/m^3. Use M20 concrete and Fe 415 steel. [16]

2. a) How do you consider earthquake loads while designing RCC structures? Explain briefly. [4]

   b) Design a slab for a room of size 3.6 m × 4.2 m prevented uplifting by walls (230 mm thick) loads for a intermediate storey of a residential building. Use M20 grade of concrete and Fe 415 grade of steel. Sketch the reinforcements. Carry out all necessary checks require in slab design. Take live load = 3kN/m^2, floor finish = 1 kN/m^2. [16]

3. a) Derive the formula $L_d \le \frac{M_1}{V} + L_0$, where the symbols have their usual meanings. [4]

   b) Determine the longitudinal and transverse reinforcements in a short rectangular column subjected to a factored axial load of 2000 kN and factored moment M_{ux} about major axis of 190 kN-m and M_{uy} about minor axis of 95 kN-m. The size of the column is 300 mm×500mm and the unsupported length of 3 m. Adopt M30 concrete and Fe 500 grade steel. [16]

4. a) Explain with the help of sketches the requirements on reinforcement detailing in beams to ensure sufficient ductility. [6]

   b) A L-beam has a flange of effective width 900 mm and depth of 100 mm. The web below is 250 mm×500 mm. Determine the amount of reinforcement required for the cross-section if it has to carry a factored bending moment of 615 kN-m and SF of 50 kN. Adopt M20 concrete mix and Fe 500 grade steel. [14]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *Use of IS: 456-2000; IS 1893 and SP16 are allowed. But, use of SP 16 is allowed only for column design.*

1. a) Using working stress method, design a rectangular section 300 mm width and 450 mm height carrying 30KN/m load in the effective span 3.6m. Use mild steel and M20 grade of concrete. [4]
   b) Enlist and make sketch of three kind of mechanical splices. [2]
   c) Design a short rectangular column of size 450mm×300mm and unsupported length 3 m subjected to an axial ultimate load of 1500KN and ultimate moments 150KNm and 80KNm a long major and minor axes respectively. Adopt M30 grade of concrete and Fe500 grade of steel. Sketch the final design. [14]
2. a) Write down the steps of design of a beam subjected to BM, SF and Torsion. [4]
   b) Design slab of a room of size 6.5m×4m for a live load of 4.5 KN/m^2 and floor finish of 1 KN/m^2 of slab are rigidly fixed with beam. Take width of beam 230 mm. Use M20 concrete and TMT bars. Draw top and bottom reinforcement detailing with sections. Carry out all checks required for slab design. [16]
3. a) Write provisions of ductile detailing of column with neat sketches. [6]
   b) Design an isolated footing to carry a column load of 1300 KN and BM of 100 KN-m from both axes of column. Column is 500 mm×500mm in size with 25 mm diameter longitudinal steel. The bearing capacity of soil is 220 KN/m^2. Consider depth of foundation as 1.70 m. Take unit weight of soil as 18.5 KN/m^3. Use M25 grade concrete and Fe415 steel. [14]
4. a) Discuss in detail the working stress method versus limit state method of design with their respective advantages and disadvantages. Compare balance, under reinforcement and over reinforced sections in limit state and working stress design methods. [8]
   b) A RC beam 300 mm× 500 mm is reinforced with 5-25 mm bars in tension and 5-12 mm bars in compression each at a clear cover of 25 mm. If effective span of the beam is 4.30 m. find the moment of resistance of the beam at ultimate state. Use M25 concrete and Fe 415 grade steel. [12]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ IS 456-2000, IS 1893-2002, IS 13920-1994 and SP16 are allowed to use.
- ✓ *Assume suitable data if necessary.*

1. a) Design the longitudinal and shear reinforcements required for a rectangular beam with simply supported effective span of 4.75 m. The beam is carrying 10 KN/m from 125 mm thick slab and live load of 5 KN/m; floor finish of 3.5 KN/m and partition wall 10 KN/m. The size of beam is restricted to 250 × 400 mm. Assume mild exposure condition as per IS 456 and steel as Fe 415. [15]

   b) What is the principle of earthquake resistant design? Write ductility requirements of RC column. [5]

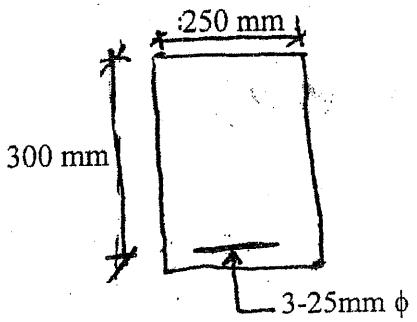
2. a) Determine the longitudinal and transverse reinforcements of RC column for the following data: [14]

   Size of column = 500 mm × 500 mm
   Factored load, P_u = 1000 kN
   Factored moment M_u = 150 kN-m
   Unsupported length = 6 m with both ends fixed and effectively held position
   M20 concrete and Fe 415 steel

   b) Show that $L_d = \dfrac{0.87 f_y \phi}{4\tau_{bd}}$ and $L_d = 1.3\dfrac{Ml}{V_u} + ld$ where symbols have their usual meanings. [6]

3. a) Design a floor slab for a room 5.4 m× 6.6 m clear in size to support a superimposed service load of 5 KN/m^2. Two adjacent edges of slab are continues. The support width of slab on all four sides is 300 mm. Also check whether the slab is safe in deflection or not. Draw neat sketches of slab showing top and bottom arrangements of reinforcements with section of slab along short span. (Design for shear and bond is not necessary) [14]

   b) Using working stress method, determine the moment of resistance of the section of beam as shown in figure below. Take σ_{cbc} = 7 N/mm^2 and σ_{st} = 140 N/mm^2. [6]



4. a) An isolated reinforced concrete footing has to transfer a service load of 800 KN from a square column of 300 × 300 mm. Consider concrete grade M20, Torsteel and soil bearing capacity 180 KN/m^2. Design the isolated footing and draw neat sketch of footing showing all reinforcements. [12]

   b) Describe the design of beam subjected to bending moment shear force and torsion. [8]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ IS 456-2000, IS 1893-2002, IS 13920-1994 and SP16 are allowed to use.
- ✓ *Assume suitable data if necessary.*

1. a) Is the limit state method better method of design of concrete structures than the working stress design method? Give reasons for your answer. [6]

   b) Explain the terms "balanced", "over reinforced" and "under-reinforced" sections in bending in Limit state method with corresponding strain and stress in concrete and steel. [6]

   c) A RC beam has an effective depth of 450 mm and a breadth of 250 mm. It contains 4-20 mm dia. TOR steel bars, out of which two bars are to be bent up at 30° near the support. Calculate the shear resistance of the bent up bars. Use M20 mix. What additional stirrups are needed, if it has to resist a design shear force of 125 kN. [8]

2. a) What is the characteristic strength of material and characteristic load? How design strength of material and design load are calculated. [5]

   b) Design an internal panel of reinforced concrete slab for room having clear dimensions of 3m×4m. The slab rest on 230 mm wide beam. Consider 15 mm thick PCC floor finish and live load of 4kN/m^2 on slab. Use M20 concrete and Fe 415 grade steel. Check slab in shear and deflection also. Show top and bottom arrangement of reinforcement. [15]

3. a) Design a RC column with the following data: [14]
   Size of column = 300 mm ×450 mm
   Axial load = 1200 kN
   M_{ux} = 200 kN-m
   M_{uy} = 300 kN-m; l =5m; $l_{ex} = l_{ey}$=3.5m
   Take M25 concrete and TMT bars.

   b) Specify methods of controlling deflection and crack with in RC structures. Explain emperical method of controlling deflection. [6]

4. a) What are the factors affecting the ductility. Explain the ductility requirement of R.C.C beam as per IS 13923. [6]

   b) A column of section 400 mm×400 mm is subjected to an axial load of 800 kN and uniaxial moment of 300 kNm at service state. Design a reinforced concrete footing for this column using M20 grade concrete and Fe 415 steel. Take allowable bearing capacity of soil = 100 kN/m^2. [14]

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Structures *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *IS 456 is allowed to use. SP-16 is allowed only for design of column.*

1. a) Differentiate working stress and limit state design methods. [5]

   b) Design a simply supported rectangular beam with the span 6 m for bending and shear. The beam carries live load of 8 kN/m. Use M20 concrete and Fe 415 steel. [15]

2. a) Write the basic assumptions of limit state of collapse in flexure. Derive formula of moment of resistance for balanced section of beam. [5]

   b) Design a simply supported slab not having adequate provision to resist torsion at corners and to prevent the corners from fitting. The factored live load is 4 kN/m^2 and the load of the floor finish in 0.5 kN/m^2. The effective spans are 6 m and 4.5 m. Use M 20 and Fe 415. The width of the support is 300 mm. Show neat sketches of reinforcement detailing. [15]

3. a) What is detailing of reinforcement? Derive the formula of development length of reinforcing bar? [5]

   b) Design an isolated footing for a rectangular column, 400 mm × 600 mm with 8-25 mm diameter longitudinal bars carrying a service load of 3500 kN. Assume safe bearing capacity of soil as 175 kN/m^2 at a depth of 1.8 m below ground level. Use M 20 and Fe 415 grade of concrete and steel. [15]

4. a) Explain types of shear failure in beam. [5]

   b) Design biaxialy loaded column for the following data: [15]

      i) Size of column 400 mm ×600 mm
      ii) Factored moment Mux = 200 kNm
      iii) M 20 concrete and Fe 415 steel
      iv) Factored load, Pu = 1500 kN
      v) Factored moment Muy = 250 kNm
      vi) Effective length = 3.5 m
      vii) Unsupported length = 4 m.

5. a) What are the principles of earthquake resistant design? Write the ductile detailing provision for beam. [10]

   b) A reinforced concrete beam has 700 mm × 450 mm size 8 m span. It contains 6-25 mm bars in which two bars are bent at 45° near end of the support. Calculate the shear reinforcement if factored shear force at support is 400 kN. Use M 20 and Fe 415 steel. Draw the sketches also. [10]

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BCE

06G TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

Regular / Back			
	E	Full Marks	80
	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Concrete Structures

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Four questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Prove that $S_v = \frac{087 f_y . A_{st} . d}{V_s}$ or $L_d = \frac{0.87 f_y . \phi}{4 \tau_{bd}}$. The symbols have their usual meanings. [5]

   b) A beam of 6m span is simply supported and carrying 24 kN/m live load and 3 kN/m dead loads excluding self weight. The beam is made of M20 concrete and Fe415 steel. Design the beam. Shear design is not required. [15]

2. a) Discuss briefly Limit State of Serviceability conditions. [5]

   b) Determine the reinforcement in a biaxially loaded column with the following parameters; [15]

   Size of column = 400mm × 600mm
   Factored load, P_u = 1500 kN
   Factored moment, M_{ux} = 300 kNm
   Factored moment, M_{uy} = 200 kNm

   Assume M25 concrete and Fe 415 steel.

3. a) Explain about detailing of reinforcement in staircases. [5]

   b) Design a reinforced concrete rectangular footing for a square column of size 450mm × 450mm, which is subjected to an axial load of 1650 kN and uni-axial moment of 240 kNm at service state. Consider allowable bearing capacity of soil as 120 kN/m^2. Show design summary and reinforcement detailing with neat sketch. [15]

4. a) What do you understand by splicing of bars? Write down the primary conditions for the application of splicing in reinforced concrete structures. [5]

   b) Design a two-way slab resting on RCC beams on all sides for a room having clear dimensions of 4m × 6m. The slab is subjected to a super-imposed live load of 2.5 kN/m^2 and floor finishes (screeds and flooring) load of 2.75 kN/m^2. Take M20 concrete grade and Fe415 steel grade. [15]

5. a) Draw idealized stress-strain curve for both steel and concrete and discuss on the design value of stresses. [5]

   b) A rectangular beam 180mm × 400mm is prestressed by a cable with an eccentricity of 75mm above the centroid at the supports and an eccentricity of 50mm below the centroid at the mid-span. Initial prestress is 900 N/mm^2 and area of the cable is 500mm^2. Calculate the prestressing force at the other end of the beam if its span is 10m. Assume $\mu = 0.50$ and $K = 0.0016$/m. [15]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

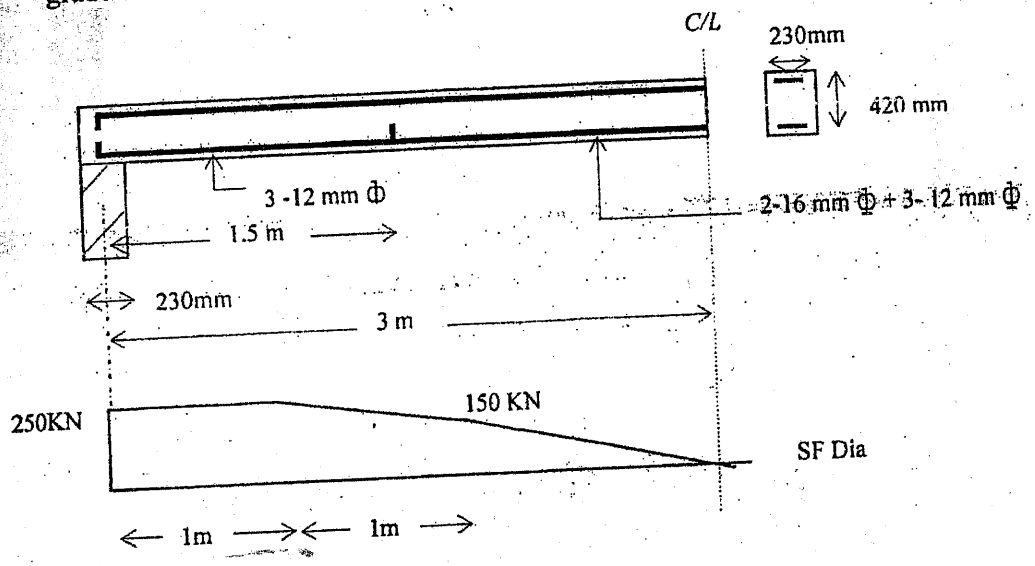
Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Concrete Structures *(EG722CE)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *IS 456, IS 1343 and SP 16 are allowed to use.*
- ✓ *Notations given are of usual meaning.*

1. a) List the name of reinforcing bars available in Nepali Market. How these bars are characterized. Show stress strain diagram used in design of RC structures for these bars. [1+2+ 5]

   b) Design shear reinforcement for the reinforced concrete beam as shown in figure and show a neat sketch showing all reinforcement. Consider M25 and Fe 415 grade of concrete and steel respectively. [12]

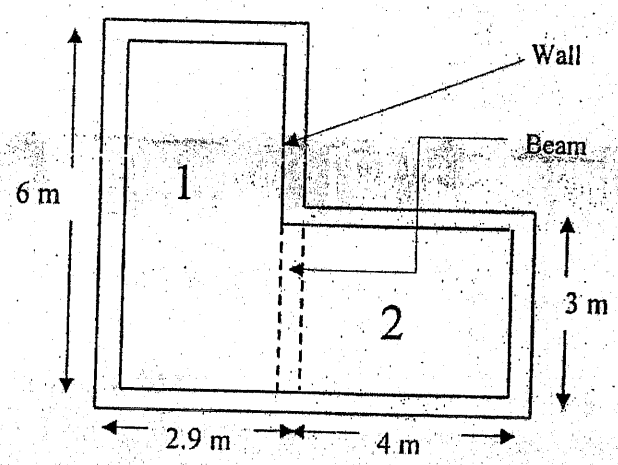


2. a) Define under reinforced, over reinforced and balanced concrete section with respect to their depth of neutral axis, depth, moment resisting capacity and stresses in steel and concrete in working stress and limit state design method. [8]

   b) Design a column with transverse reinforcement, which is subjected to design bending moment of 300KN-m and design axial load of 700KN. Unsupported length of column is 4.75m and supports of column are rigidly fixed and effectively held in position. Consider M25 and Fe500 grade of concrete and steel. [12]

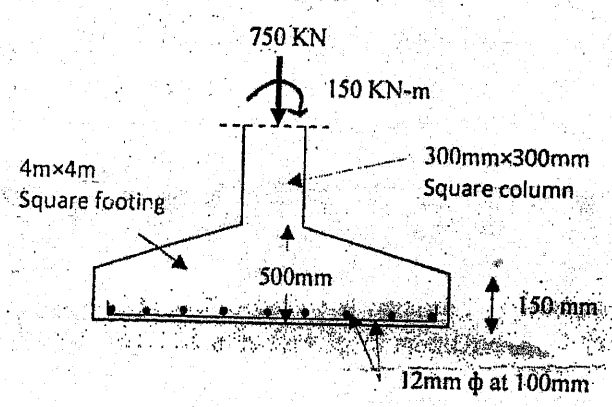
3. a) Derive mathematical expression for moment resisting capacity and depth of neutral axis of a T- beam when $x_u > D_f$ and $D_f \leq 0.43x_u$ [6]
Where, x_u – Depth of neutral axis, D_f – Thickness of flange

b) Briefly explain, how the slabs of the floor given in the diagram are designed. Design the slab panel '2' for bending and show arrangement of reinforcing bars. Take live load = 3.5 KN/m^2 and surface finish = 0.7 KN/m^2. [2+12]



4. a) Define development length. Show $L_d \leq 1.3M_f/V_u + L_o$ at support when end of beam contained compressive force. [2+6]
Where, L_d - Required development length, M_f - M. R. of beam at support
V_u- Design SF at support, L_o- Additional anchorage length at support

b) Check the depth of isolated footing (as shown in figure) in one way shear, two way shear and bending. Consider M25 and Fe 415 grade of concrete and steel and clear cover to reinforcement 40mm. [12]



5. a) What is prestressed concrete? Give its rationale. How losses of prestressing are assessed in the design of prestressed concrete structure? [10]

b) Describe how a beam section is designed, when it is subjected to torque, bending moment and shear force. [10]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BAG, BGE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering (*CE 701*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What is a project? What are its main attributes? Write the major activities carried out in the implementation phase of a project. [1+2+5]

   b) Discuss on scope of project engineering. Explain in detail the project operates in dynamic environment with suitable example. [2+6]

2. a) Why project appraisal is necessary for initiating a project? What are the major aspects that needed to be considered to carry out the appraisal of project? [2+4]

   b) Why project proposal is considered as the important document for imitating any project? Explain in regards with its contents. [6]

3. a) Find all the components of CPM from the following information: (USE AOA) [12]

S.N.	Activity	Duration (Weeks)	Predecessor	Successor
1	A	1	-	C, E
2	B	6	-	C, D
3	C	2	A, B	F
4	D	2	B	H
5	E	4	A	G
6	F	3	C	G, H
7	G	4	E, F	I
8	H	2	D, F	I
9	I	5	G, F	J
10	J	3	I	-

   b) Explain the differences between CPM and PERT. [4]

4. a) Differentiate between Monitoring and Evaluation. What are different tools of project quality control? [2+4]

   b) Suppose you have a project that is scheduled to be completed in 10 days at a budgeted cost of 100,000. At the end of day 6, you do an analysis and you determine the job is 70% complete and you have spent 65000. [6]

      i) Is the project ahead, behind schedule or on time?
      ii) Is the project expected to complete on budget, under or over budget?
      iii) What is project's SPI and CPI at Day 6^{th} ?

5. a) Define risk. Explain on different types of project risk. [2+4]

   b) How could you effectively manage risk in a project? Explain on qualitative and quantitative risk management system. [2+4]

6. a) Define the term project finance and what are the sources of financing in any project? Write down and explain about the determinants of structure decision to be undertaken for investment proposal. [2+4]

   b) Differentiate between conventional and project financing. A project has an initial investment of Rs 25,00,000 and the salvage value of Rs. 5,00,000. The annual revenue of the project is Rs 10,00,000 and the annual expenses is Rs 2,00,000. Calculate ARR, NRV, Profitability index (PI) and simple payback period of a project. [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2081 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BEL, BAG, BGE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering (*CE 701*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Describe, what are the activities to be performed in termination phase of project life cycle. [4]

   b) Differentiate between goal and objective of any project giving suitable example. Define project environment and explain how task environment of any project influences ability to achieve project's objectives even though it provides resources and limitations. [4+4]

2. a) Define project appraisal. State and explain what are the contents to be included in the project appraisal report. [1+5]

   b) Why any project needs to be formulated properly and concisely? State and analyse the various techniques used in project formulation to provide project parameters in terms of reference (ToR) of a project. [2+4]

3. a) Draw a network diagram from the following data: [10]

   i) Find Critical Path, Critical activities. (ii) Find ES, EF, LS, LF, TF, FF, Ind.F and Int.F.

Activities	Predecessors	Duration (Weeks)
A	None	1
B	None	3
C	A	2
D	A, B	4
E	B	3
F	C, D	5
G	D	1
H	D	2
I	E, H	6
J	E, H	3
K	F, G, I	2
L	K, J	4

   b) What is Work Breakdown Structure (WBS)? Discuss importance of WBS. [2+2]

4. a) Differentiate between quality assurance and control. What are the different types of cost associated with quality? [2+6]

   b) A project is undertaken where the work has to be completed within 60 days with a budget of Rs. 20,000. The cost breakdown per month is Rs. 10,000. The work scheduled in each month is half of the total work to be completed. According to the progress reports, at the end of the first month, only 25% of the total work has been completed and 50% of the total budget has been spent. Also, for the completion of 25% work, the actual cost incurred is 50% of the total budgeted cost. Perform EVA and comment on performance. [6]

5. a) Define concept of risk in project. Explain different categories of project risk. [2+4]

   b) Elaborate risk management cycle. How the project risk can be managed effectively? [2+4]

6. Write down sources of project financing. Explain about steps of capital budgeting process. Discuss net present value (NPV) used in capital budgeting decision. [2+3+2]

7. Write short notes on: [3×3]

   a) Importance of Work Breakdown Structure (WBS)
   b) Project monitoring, evaluation and controlling
   c) Project quality control

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BEL, BAG, BGE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering (*CE 701*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define the project in your word and explain its phases. [6]

   b) Explain characteristic of project comparing with final year project. [6]

2. a) Describe step by step process of project appraisal. [6]

   b) Describe different methods of project formulation. [10]

3. a) Draw a network diagram for a hydropower project having information as given below. Find out ES, EF, LS, LF, TF, FF and IntF, IndF and then analysis the situation of the project stating Critical Path, Project Completion Time and Critical Activities. [12]

Activity	Duration (month)	Predecessors
A	3	-
B	5	-
C	8	-
D	4	A
E	7	A
F	2	B
G	1	C
H	7	A
I	4	E,F,G
J	9	C

   b) What is project planning? Explain the importance of project planning. [4]

   c) Define Resource Schedule. What are key difference between Resources Leveling and Resources Smoothing? [1+3]

4. a) Differentiate between quality assurance and quality control. Explain the different types of cost associated with quality. [8]

   b) You have a project that is schedule to be completed in 10 days at a budgeted cost of Rs. 100,000. After the completion of 6 days, you do an analysis and you determined the job is 70% of work is complete and the expenditure is Rs. 65,000. Based on this data, is your work performance is on track? Perform EVA and comment on your own performance. [6]

5. Why risk analysis is important during project planning? What might be the different types of risk in a project? What are the strategies for risk response planning? [2+4+4]

6. a) Explain capital structure planning. [3]

   b) A project has a capital structure consisting of 4000 ordinary share @ Rs. 100 per share and loan capital of $ 600,000 @ 10% interest per year. It wants to raise additional capital of $1 million and has two option: [5]

      i) 4000 ordinary share @ Rs. 100 per share and loan capital of 6000,000 @ 10% interest per year;

      ii) 2000 ordinary share @ Rs. 100 per share, Rs. 300,000 preference share @ 12% dividend per year; and loan capital of 500,000 @ 12% interest per year.
      Select best option if EBIT = Rs. 350,000 and tax rate = 30%.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BAG, BGE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering (*CE 701*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What are different bases and the type on that bases of project classification? [6]
   b) Describe with suitable example considering running project of Nepal. How the different operating/Task environment making these project more complex and uncertain? [6]
2. a) What is project proposal? Explain step by step procedure for developing a project proposal. [2+6]
   b) Why project appraisal is necessary? Distinguish between the technical and financial proposal of a project. [2+4]
3. a) Draw a network diagram for a road project having information as in table. Find out ES, EF, LS, LF, TF, FF and Int F, Ind F and then analysis the situation of the project starting critical path, project completion time and critical activities. [12]

S.N.	Activity	Duration(days)	Predecessor
1	A	6	-
2	B	4	-
3	C	5	-
4	D	2	A,B
5	E	4	C,D
6	F	2	D
7	G	5	D
8	H	8	D
9	I	5	G
10	J	6	E,G

   b) Explain in brief about Gantt chart, link barchart and milestone chart with example. [8]
4. a) Define quality. Distinguish between Quality Assurance and Quality Control. List out different factors disturbing Quality of the projects in Nepal. [2+2+2]
   b) Er. Jack has to complete 450 cum brickwork in canal construction in 40 days. According to contract agreement, the cost per cum brickwork is Rs. 16000. After the brickwork is started, the monitoring team visited the project in 20 days; they found that only 30% of the total cum brickwork is completed. The actual cost per cum expensed is Rs. 16500. Based on the above statement, find Cost Variance, Schedule Variance, Cost Performance Index and Schedule Performance Index and also analyze the situation and analyze the situation of the project. [6]
5. a) Describe different sources of Risk. [6]
   b) Explain different methods of Qualitative and Quantitative analysis of Risk. [6]
6. a) What are the difference source of project Finance to establish the construction company? ABC project has total capital of Rs. 6,00,000, that consists of 2,000 shares @ Rs 100; 2,50,000-perference share at 16% interest and remaining borrowed from bank as loan @ 15% interest. Earnings before interest and tax in a year is Rs. 1, 25,000. Calculate earnings per share and book value of share if tax is 30%. [1+4]
   b) Explain the concept of project finance. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BEL, BAG, BGE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE 701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What is project environment? How can you say that the project operates under the dynamic environment? Explain with an example. [2+5]

   b) What are the major activities that are required to be carried out during the initiation phase of a project? [5]

2. a) Explain the procedure for developing project proposal. [6]

   b) Explain in brief about different techniques of project formulation. [6]

3. a) In which situations we have to use Bar chart, CPM and PERT for scheduling of the project. [2]

   b) Draw the network diagram and Compute EST, EFT, LST, LFT, TF, FF, IF and interfering floats of each activities of a project having precedence relationship is given below. The time duration are in days. [12]

Activity	A	B	C	D	E	F	G	H	I	J
Predecessors	-	A	A	A	B	D	C	G	E	F, H, I
Duration	10	12	8	6	10	8	4	10	6	4

4. a) Discuss Cost control, Cost Control Cycle and method of Cost Control in brief. [1+2+3]

   b) A construction work had to be completed in 10 days with 50 labor days at Rs 1000 per day i.e., with total cost of Rs 50,000. At the end of third day, only 25% work was completed with the use of 18 labor days at Rs 800 per day. Perform EVA and comment on its performance. [8]

5. Why project risk management is necessary? What are the different nature of risk? Discuss on the major types of risks that might occur in planning and implementing the hydropower project? [2+4+6]

6. Define capital budgeting and its importance. A firm has equity capital consisting of 5000 ordinary share @ Rs 100 per share and Rs. 3,00,000 preference share at 12% interest per year and Rs. 2,00,000 loan at 10% interest per year. If firm's earnings before interest and tax is Rs. 3,50,000 and tax rate applicable is 25%. Determine earning per share and book value. [3+4]

7. Write short notes on: [3×3]

   a) Feasibility Study
   b) Project Proposal
   c) SWOT analysis

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BAG, BGE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE 701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define Project and describe it's characteristics in brief. [6]
   b) Discuss Project Risk Management. As a project manager how will you manage risk in a Project? [6]
2. What is project appraisal? Discuss on the content and the procedure for developing a good proposal? [2+10]
3. Find all components of CPM from the following information using AOA method. [14]

S.N.	Activity	Predecessors	Duration (week)
1	A	-	3
2	B	-	2
3	C	A	4
4	D	B	3
5	E	B	3
6	F	C	3
7	G	C, D	2
8	H	E	5
9	I	F, G, H	3

4. a) Define project Schedule control. Explain about schedule control cycle. How to keep project on schedule? Explain it. [6]
   b) A company has signed fixed cost contract to installed 1000 new parking meters at cost of Rs. 20,00,000. Old parking meters have to be removed from their stands and replaced with new ones. The cost of doing this is Rs. 2000 per meter. It is estimated that 25 meters is installed each day. On the review date at day 18 only 400 meters has been installed and it was found that actual cost of work performed equals to Rs. 10,00,000. Find out all the parameters of earned value analysis and comment on the performance status of this project. [8]
5. a) Why risk response planning is important in project? What are the response strategies for negative risk? [6]
   b) What do you mean by Project Procurement management? Explain different process adopted for procurement in construction project? [6]
6. Describe Capital Budgeting Process. A project has total capital of Rs. 10,00,000 which consist of Rs. 4,00,000 preference share @12%, 2,50,000 debt@10% and 3500 ordinary share @ Rs. 100. If the earnings before interest and tax is Rs. 8,00,000. Determine EPS and book value of share value of share if tax rate applicable is 20%. [3+4]
7. Write short notes on: [3×3]
   a) Project management and its function
   b) Resource leveling and its process
   c) Quality control and its techniques

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BAG, BGE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE 701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Discuss citing project characteristics. How a project can be differentiated form other permanent systems? [5]
2. Mention project life cycle and discuss various activities carried out in each phase of a project. [6]
3. Define bilateral, multilateral and joint venture project. Explain the major elements that influence the external environment of a project. [3+4]
4. Explain the necessity of an appraisal in a project. Explain in detail the techniques of project formulation. [4+4]
5. What is dummy activity? Write down the use of critical path in a CPM network diagram. Find all the components of CPM from the following information. Use AOA method. [1+3+13]

S.N.	Activity	Duration (week)	Predecessor
1	A	1	-
2	B	3	-
3	C	2	A, B
4	D	5	B
5	E	3	B
6	F	1	C, D
7	G	3	D
8	H	4	D, E
9	I	5	F, G, H

6. Define resource leveling and smoothing? Prepare a 4 level WBS of any engineering project of yours interest. [2+4]
7. As a project manager how will you control the project during implementation phase? Explain with an aid of project control cycle. [6]
8. A project has a planned budget of Rs. 30,00,000 and schedule of 24 months. During its implementation you have monitored the following data: Perform EVA and comment on the performance and also the draw S-curve to forecast the final completion budget and schedule. [8]

Months	5	10	15	20
Work completed	20%	45%	60%	70%
Actual Expenditure (Rs)	7,00,000	13,00,000	20,00,000	24,00,000

Or,

How EVA is used in controlling cost of a project during project implementation. Explain EVA with 3 different examples requiring different approach in control.

9. Define project risk management. What is qualitative and quantitative risk analysis? What are the major steps that you take in managing risks? [2+6+4]
10. What is capital budgeting? Explain its features. [2+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BEL, BAG, BGE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE 701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define project. Explain the how technology and capital can be transferred in a joint venture project with a suitable example? [2+4]

   b) Differentiate between a goal and objective of the project. Explain goal setting criteria of a project with a suitable example. [2+6]

2. a) Write down three number of objectives and three number of limitations of any project proposal. Explain a good project proposal should give answer of which types of questions. [3+3]

   b) Differentiate between project appraisal and project formulation. Explain in details about techniques of project formulation. [2+4]

3. a) Define Work break down Structure (WBS) with example specifying levels and code. [8]

   b) Draw network diagram. Compute EST, EFT, LST, LFT, TF, FF, interfering float and independent float. Write down the significance of calculating total float in network analysis. [16]

Activity	A	B	C	D	E	F	G	H	I
Predecessor	-	A	A	A	B	C	D	C, E	F, G
Successor	B, C, D	E	F, H	G	H	I	I	-	-
Duration (day)	5	4	2	3	2	1	3	1	2

4. a) Define monitoring, evaluation and controlling. What are the major difficulties faced by a project manager in implementing the project control system in Nepal. [3+5]

   b) 50 units of plantation have to be done in 3 weeks period. Per unit cost of plantation is estimated as Rs 2500 of which progress monitoring was done 1 week after the work was started. Only 20 units of plantation was found completed and the account record showed that the actual expenditure per unit was Rs 2500. Perform EVA and comment on the performance. [6]

5. a) Define project risk. Write down tools and techniques used for risk identification in a project. As being a engineering student, how do you carry out risk response planning. [2+4+4]

   b) Is preference shares are sources of project finance? Explain it. Explain about the determinants of capital structure decision made in any business firm. [2+4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BEL, BAG, BGE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE 701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What is project? Explain its dimensions and characteristics. [2+5]
   b) Explain different environments within which a project need to be conducted. [5]

2. a) Why project appraisal is necessary for initiating a project? What are the major aspects that needed to be considered for carrying out the appraisal of a hydropower project? Discuss. [2+6]
   b) Explain in detail the procedure for developing the project proposal. [6]

3. a) Why schedule is important in planning a project? Find all the components of CPM from the following information. Use AOA method. [3+14]

S.N	Activity	Duration (month)	Predecessor	Successor
1	A	1	-	C, D
2	B	3	-	E
3	C	2	A	F, G
4	D	2	A	H
5	E	5	B	I, J, K
6	F	1	C	I
7	G	3	C	I, J, K
8	H	3	D	I, J, K
9	I	5	E, F, G, H	L
10	J	1	E, G, H	L
11	K	4	E, G, H	M
12	L	1	I, J	-
13	M	2	K	-

   b) Prepare a bar chart of an irrigation project mentioning at least 6 activities. Also show the milestones in a chart. [7]

4. a) What is project control cycle? Explain it with elements of control. [2+4]
   b) Perform EVA on the basis of following given information of "Earthquake Affected Monasteries Reconstruction Project" (EMRP) which was monitored after 6 months of its implementation. State controlling statements on the basis of your evaluation. [8]

Descriptions of project	Standard (Budget/Plan) information	Descriptions of project	Monitored information regarding progress (Completed)
1. Number of monasteries to be reconstructed	753 units	1. Reconstructed monasteries	179 units
2. Reconstruction project to be completed in	30 months	2. Average expended reconstruction cost per unit	Rs. 7.8 millions
3. Average reconstruction cost per unit	Rs. 9.3 millions		

5. a) Define risk, its types and sources. As a project manager how would you rectify the possible risk on your project? Give your answer considering all possible steps falls under Risk Management. [10]
   b) What are the sources of project finance? A project has an initial investment of Rs. 3,00,000 which gives annual return of Rs. 50,000 for 8 years. The salvage value after 8 years will be Rs. 10,000. Make your investment decision based on ARR, Payback period, IRR and Profitability index (PI) method. [2+4]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BEL, BGE, B. Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the importance of project appraisal. Differentiate between technique and finance proposal of a project. [8]
   b) Discuss the techniques of project formulation. [8]
2. a) Explain project appraisal and its importance. [8]
   b) Describe the essence of writing a good proposal. [8]
3. a) Draw CPM network diagram and compute ES, EF, LS, TF, FF, Int.F and IF from the information given below. Also compute project duration and mark the critical path. [12]

Activity	A	B	C	D	E	F	G	H	I
Duration (week)	5	4	0	6	7	8	6	3	2
Predecessor	-	-	A	A	B,C	B,C	D,E	F	GH

   b) Write the advantages of Bar chart. [4]
4. a) What would be the impact on project due to unmanaged risk in project? Write down risks in project in different phases of project life cycle. [8]
   b) Explain and justify that risk transfer and risk reduction are techniques of risk response planning in any project. [8]
5. a) Explain project control cycle and write the factors to be considered during quality control of a project. [8]
   b) Describe project finance. Capital structure of a firm consists of 500 ordinary share @ Rs 100/share and 300 preference share @ Rs 100/share at 15% interest per year. Firm has a loan of 30,000 @ 12% per year firms earning before interest and tax is 40,000. Determine earning per share and book value. Tax rate = 40% [8]

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05 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BGE B. Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Describe that the specified job/task is a project? Write the major activities carried out in the implementation phase of a project? [4+4]

   b) Explain in detail the project operates in dynamic environment. [8]

2. a) Write various analysis to be carried out for project appraisal. [8]

   b) Explain in details about the contents of writing a good project proposal. [8]

3. a) Draw CPM network diagram and compute EST, EFT, LST, LFT, TF, FF, Int.F and IF from the information given below. Compute project duration and mark the critical path. [12]

Activity	A	B	C	D	E	F	G	H	I
Duration (week)	3	2	0	4	7	5	8	6	1
Predecessor	-	-	A	A	B,C	B,C	D,E	F	G,H

   b) Explain total float and independent float. [4]

4. a) Explain project control cycle and write the factors that should be considered during the quality control of a project. [4+4]

   b) 50 units of plantation have to be done in 4 weeks period. Per unit cost of plantation is estimated as Rs. 200 of which progress monitoring was done 3 weeks after the work was started. Only 60% work was found completed and the account record showed that the actual expenditure for plantation per unit was Rs. 300. Perform EVA and comment on works. [8]

5. a) Define risk and its types. How could you manage risk in a project effectively? Justify with risk management cycle. [2+6+2]

   b) What are the sources of project finance? A firm has equity capital consisting of 5000 ordinary share@ Rs 100 per share and Rs. 3,00,000 preference share at 12% interest per year and Rs 2,00,000 loan at 10% interest per year. If firm's earning before interest and tax is Rs 3,50,000 and tax rate applicable is 25% determine earning per share and book value. [6]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BEL, BGE, B.Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Defin " Describe Joint Venture Project and Possibility of Technology Transfer through. [1+4]
   b) What is Project Environment? How does political environment affect project in Nepal? [1+4]
2. a) Describe the importance of project appraisal. Explain the difference between Economic Appraisal and Financial Appraisal. [2+4]
   b) Define Project Proposal. Differentiate between Technical Proposal and Financial proposal. How does client evaluate the proposal for awarding the contract of Construction and Consulting works? [1+2+3]
3. a) Define Project plan. Explain the advantages of planning Engineering Projects. [1+3]
   b) Define Total Float, Free Float and independent float. Draw a CPM network and Find EST, EFT, LST, LFT, TF, FF, IntF and IndF. Show critical path also. [16]

Activity	A	B	C	D	E	F	G	H	I	J
Successor	B, C, D	E	F, H, I	G	H	J	I	J	J	
Duration-Days	2	3	4	5	4	3	2	1	2	3

   c) Define resource schedule. Differentiate between resource levelling and resource smoothening. [4]
4. a) Define Monitoring and Evaluating. Explain project control cycle with suitable example. [1+5]
   b) Define quality. Differentiate between quality assurance and quality control. As a site engineer what steps would you follow to control quality? [1+2+3]
5. a) Define project risk. Differentiate between internal and external risks. What are the sources of internal risks in Nepal in the present context? Explain internal risks for the implementation of hydropower project in Nepal. [1+2+2+2]
   b) Define Risk Management. Describe the steps of risk management. [1+4]
6. a) Define Project Finance. What are the features of sound and appropriate capital structure? A company has total Capital of Rs 1500000 which consists of Rs. 400000 shares, Rs. 200,000 preference share issued at 12% interest per year and Remaining loan issued @ 8% interest. Calculate EPS if earnings before interest and tax in a year is Rs 300,000 and tax rate is 20%. [1+2+2]
   b) Define Capital Budgeting and explain its importance. What are the methodologies of evaluating projects financially and Which method is most reliable? [1+2+2]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2073 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BGE, B.Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define project. List out all characteristics of project. [2+3]
   b) Define project environment. Explain external environment with example. [1+4]
2. a) Why do we prepare project proposal? Explain the process of writing project proposal. [1+5]
   b) List out all techniques of project formulation. Briefly discuss the methods of feasibility analysis. [2+6]
3. a) Prepare a bar chart of any engineering project consisting of at least 6 activities. [5]
   b) Find all components of given CPM network. [13+2]

Activity	A	B	C	D	E	F	G	H	I	J	K	L
Durations	3	4	3	5	3	4	2	4	2	5	7	2
Predecessors	-	-	A	B	B	A,D	A,D	C	C	F,H,I	F,I	E,F,G,I
Successors	C,F,G	D,E	H,I	F,G	L	J,K,L	L	J	J,K,L	-	-	-

What is significance of critical path analysis?

4. a) Most of the construction projects in Nepal have poor project implementation with time and cost overrun. Justify your answer highlighting the points on causes of project delay. [5]
   b) Define quality and Discuss on its control techniques. [1+3]
   c) Suppose you are making brick for construction work. Suppose the following are your plan.

   Project Plan:
   - 5 hours to make a total of 1000 bricks
   - Budgeted cost per brick is $ 0.05
   - Total budget is $ 50.00 for brick ingredients (or $ 10/hr)

   Progress report at end of 1st hour
   - 150 bricks have been made
   - Total actual cost of ingredients used for 150 bricks is $ 9.00

   Use earned value to examine progress and also comment on performances. [6]
5. Define Risk and Project Risk. Briefly explain the types of project risk. How could you manage the risk in a project effectively? Justify with risk management cycle. [2+2+6]

6. a) Define the term capital budgeting decision. A five years project has initial investment of Rs.1,00,000 with Rs.40,000 salvage value. The average gross income of five years is calculated as Rs.18000. Calculate ARR of project if tax applicable is 50%. Depreciation is straight line. [1+3]

b) List out features of sound capital structure. A firm has equity capital consisting of 3000 ordinary share @ Rs 100 per share, Rs.3,00,000 preference share at an interest of 12% per year and loan of Rs.9,00,000 borrowed at an interest rate of 10% per year. The firm wants to raise Rs.15,00,000 more to finance its investment and is considering two alternative methods of financing i.e.

(i) To issue 4,000 common shares @ Rs. 100 each, 5,00,000 preference share @ 12% and to borrow Rs.6,00,000 at 10% interest and

(ii) To issue 3000 common shares @ Rs.100; to issue 4,00,000 preference share at an interest rate of 12% and to borrow Rs.8,00,000 at 10% interest.

If the firm's earnings before interest and tax is Rs.5,00,000 and the tax rate applicable is 25%, determine earning per share to decide on the best alternatives. [2+5]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BEL, BGE, B. Agri	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Discuss project phases and life cycle giving examples of activities carried out in different phases and stages of life cycle. [10]

OR

Classify project and discuss its characteristics in detail including the importance of good project environment.

2. Define project proposal. A well prepared project proposal should give answer of what types of question, explain it. Discuss elaborately about different aspect to be considered in feasibility study of a road project. [2+2+5]

3. a) List down planning tools used in any project. Milestones chart is improved version of a bar chart, Justify it, with example. Explain WBS. [2+4+2]

   b) Draw a network diagram and find out EST, EFT, LST, LFT, TF, FF independent float, interfering float, project completion time of a building project having following details. What is the significance of critical path in the network analysis? [13]

Immediate Predecessor	-	-	-	A	A	B	C	C	D	E,F,G	H
Activity	A	B	C	D	E	F	G	H	I	J	K
Duration (Weeks)	10	12	9	8	5	13	6	4	15	7	9

4. a) What is the difference between evaluation and controlling? Discuss about elements of project control. [5]

   b) For a particular project budgeted cost of work schedule was Rs. 9,50,000 and budgeted value of the work performed was Rs.8,00,000 at a point of reporting date i.e at 20 weeks from starting date. But, the actual cost of work performed was Rs. 10,00,000 and the project completion time is 45 weeks. The project having estimated cost of Rs. 50,00,000. Based on above information, draw features of that project and comment on each parameter of earned value analysis. [7]

5. a) How risk can be identified and analyzed for a rural road project. Explain the procedure. [5]

   b) What are the methods that could be used in risk management after identifying major risk. Justify giving suitable example how risk transfer is taken as risk response planning. [5]

6. Define the term project finance and what are the sources of financing in any project? Write down and explain about the determinants of capital structure decision to be undertaken for investment proposal. [3+5]

7. Write short notes on: (any two) [5×2]

   i) Cost-benefit analysis
   ii) Resource leveling
   iii) PMIS
   iv) Project software

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BGE, B. Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define project. Explain the characteristics of project with appropriate examples. [1+4]
   b) How project goal or objectives are set? Explain goal setting criteria. [5]
2. a) What are the objectives of project appraisal? Explain Financial and Technical Appraisal in detail. [2+4]
   b) Define project proposal. Discuss cost benefit analysis for a road project. [2+4]
3. a) Define planning and scheduling. Prepare a Linked Bar-chart for a construction project with at least 10 activities. [2+4]
   b) Define Critical Activities and Float. Draw a CPM network [AOA or AON] and find EST, EFT, LST, LFT, TF, FF, IntF and IndF. [2+5+6]

Activity	A	B	C	D	E	F	G	H	I	J	K	L
Predecessor	-	-	A	A,B	B	C,D	D	D	E,H	E,H	F,G,I	L
Duration Days	1	3	2	4	3	5	1	2	6	3	2	4

   c) What is WBS? Discuss importance of WBS. [4]
4. a) Define Monitoring and Control. Explain why project controlling is difficult in Nepal. [3+3]
   b) What is EVA? A construction work had to be completed in 10 days with 50 labour days at Rs 1000 per day i.e with total cost of Rs 50,000. At the end of third day, only 25% work was completed with the use of 18 labour days at Rs 800 per day. Perform earned value analysis and comment on the performances. [1+5]

OR

Define quality. Explain how quality can be controlled in construction of urban roads. [6]

5. a) Define Project Risk. How risk can be analysed? Explain with example of hydropower project. [1+4]
   b) How risk can be managed? Explain how you manage three risks in hydropower project you identified above. [5]
6. Define Capital Budgeting decision. Explain its importance. Calculate Explain ARR of a project with initial cost of Rs. 100000 and salvage value of Rs 20000 after 5 years. Stream of income in year 1 to year 5 are Rs. 15,000; 20,000; 25,000; and 20,000 Tax rate is 25%. Assume suitable method of depreciation. [1+2+2]
7. Write short notes on: (any two) [4×2]
   i) Project life cycle
   ii) Planning software MS project
   iii) Elements of project control
   iv) Environmental analysis for project formulation

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BEL, B.Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain Work Breakdown Structure as a tool of project planning and state the importance of project planning.

   b) Draw the CPM network diagram (or Precedence diagram) from the following activity relationships: Compute total minimum project time of completion, critical activities and ES, EF, LS, LF, TF, FF, IntF and IndF.

Activity	A	B	C	D	E	F	G	H	I
Duration	3	5	5	6	2	3	4	2	6
Predecessor	-	A	A	A	B,C	C	D,E,F	D	G,H
Successor	B,C,D	E	E,F	G	G	G	I	I	-

   Also mark the critical path in the network diagram.

2. a) Define project and explain it's characteristics in brief. What are the major differences between project management and traditional management? Explain about the external environment of the project.

   b) Define project formulation and project appraisal. Write the procedure for developing a project proposal. What are the drawbacks of cost-benefit analysis of project formulation?

3. a) Why project planning is necessary to operate any project in dynamic environment? Linked bar chart is one of planning tool in project scheduling, justify this statement with suitable example. Is there limitations of this chart?

   b) Find out the expected time of each contractor to complete a given project having following details. Also, find out which contractor you prefer for operation and why?

Contractor	t_o	t_l	t_p
A	5	7	13
B	6	11	12
C	3	5	7

4. a) Discuss "monitoring, evaluation and control" is a must to succeed in a project. Explain project management information system and justify "the right information at the right time reduces the risk of wrong decision".

   b) Explain the term 'project finance' and describe features of sound capital structures. Write down and explain with example what are the factors to be considered to take capital structure decision.

5. a) Define risk management planning. Explain in details about internal and external risks in project. Justify giving suitable example how risk reduction is taken as risk response planning.

   b) A project has total capacity of $1,000,000 which consists of 4,000 shares @ $100; $300,000 preference shares @ 18% interest; and remaining loan @15% interest. Earning before income and tax in a year is $200,000. Compute the Earning per Share (EPS) and Book Value of Share, if Tax Rate is 20%.

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, B.Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define Project. Elaborate Labor intensive, Capital Intensive, Joint Venture and Multilateral projects. Explain various elements of task environment. [2+4+4]
2. a) What is project appraisal? Explain marketing, management and environmental appraisal. [2+6]
   b) Define project proposal. Explain in brief about procedure for developing a project proposal. [2+6]
3. a) Draw the network diagram of the given project having following activities. Obtain project duration, critical path, TF, FF and interfering float. Prepare the resource aggregation chart and allocate the mason using early start schedule. [8+5]

Activity	Duration (days)	Mason (per day)
1-2	3	1
2-3	3	2
2-4	4	4
2-5	2	2
3-10	3	2
4-6	2	3
4-7	4	3
5-9	4	4
6-8	2	2
7-9	4	1
8-9	3	2
9-11	3	4
10-11	2	2
11-12	2	1

   b) Discuss on Work Breakdown Structure. [3]
4. a) Define Monitoring and Evaluation. Explain project control cycle. [2+4]
   b) Why cost control is important? A contractor agreed to build 50 doghouses in 90 days at a price of $1000 per unit. 20 days later, the contractor has finished 10 doghouses with an actual cost of $8500. What is the status of the project? [2+4]
   c) What is PERT? Discuss with example. [4]
5. Define Risk. Explain various sources of project risks. Describe important steps of risk management. [2+5+5]
6. a) What is capital structure planning? Discuss with examples. [5]
   b) What is capital budgeting decision? Explain its importance. Discuss Net present value used in capital budgeting decision. [5]

OR

What are the sources of financing large projects?

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BEL, B.Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define project. Explain any four characteristics of engineering projects. [1+4]
   b) What is Project Environment? Explain Task Environment in detail. [1+4]
2. a) Elaborate the statement "Technical Appraisal is most important in project". [6]
   b) Define Technical and Financial proposal. Explain the contents of Technical proposal. [2+4]
3. a) Draw a network diagram and find EST, EFT, LST, LFT, TF, FF independent float and interfering float of building project having following details. What is the significance of critical path in the network diagram. [12+2]

Predecessor	-	-	-	-	B	E	C	A,F	C,E	D,G
Activity	A	B	C	D	E	F	G	H	I	J
Duration (in weeks)	6	10	11	9	5	8	12	8	7	4

   b) What are the steps in project planning process? Write down work breakdown structure (WBS) for a building project and why it is necessary in construction project? [5+5]
4. a) Define project Monitoring and Evaluation. Explain project control cycle. [2+4]
   b) Define Quality. List various factors affecting quality of projects in Nepal. Differentiate between Quality Assurance and Quality Control. [2+2+2]
5. a) What is Risk? Explain various types of risks in project. [1+5]
   b) List different types of risks for the implementation of hydropower projects in Nepal and recommend appropriate risk response plan for those risks. [6]
6. Explain capital structure planning and features of sound capital structure. A project cost Rs.50,000 and has a scrap value of Rs.10,000. It stream of income before depreciation and taxes during first year through five years is Rs.10,000; Rs.12,000; Rs.14,000; Rs.16,000 and Rs 20,000. Assume 30% tax rate depreciation on straight line basis. Calculate ARR of the project. [4+6]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, B.Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Differentiate between labour intensive and capital intensive projects with example? Explain project Goal setting ~~critical~~ criteria with an aid of suitable example. [3+5]
2. Define project formulation and project appraisal. Describe procedure for developing a project proposal. [2+2+8]
3. a) Explain Bar chart with its advantages and limitations. [8]
   b) Define the term planning and explain the features of good project planning? Find all the components of CPM from the following information: [4+12]

S.N	Activity	Duration	Predecessor	Successor
1	A	3	-	D
2	B	6	-	E,G,I
3	C	2	-	F
4	D	2	A	G
5	E	1	B	H
6	F	3	C	I
7	G	7	B, D	-
8	H	3	E	-
9	I	4	B, F	-

4. a) Justify the statement "quality costs more, but lack of quality costs even more" giving examples of total quality cost included to achieve good quality. [6]
   b) A construction company is planned to fix 100 units of precast window in 20 days with a budget of 25 lakhs. The progress status was reviewed on 10 days from date of start of fixing and only 40 units were fixed with the expenses of 9 lakhs. Find out all the parameters of earned value analysis and comment on its performance. [6]
5. Define risk and risk management. Explain about internal risk of any construction project that is facing by a Nepalese construction company. Explain with suitable example risk transfer. [2+8+2]
6. a) Define Capital Structure. XYZ company has total capital of Rs.10,00,000 which consists of 40% share and 60% loan issued @ 12% interest. It requires Rs.20,00,000 more to invest in a project and is considering for following three options. [1+6]
      i) Rs.8,00,000 share and Rs.12,00,000 loan @14% interest
      ii) Rs.5,00,000 share; Rs.7,00,000 preference share @15% interest and Rs.8,00,000 loan @14% interest and
      iii) Rs.10,00,000 share and Rs.10,00,000 preference share @ 15% interest.
      Which is the best option based on Earning Per Share Calculation if the Earning before interest and tax in a year is Rs.5,00,000 and tax applicable is 30%
   b) Define Capital Budgeting decision. Explain ARR or return on Equity. Recommend appropriate measures that Government should take to attract private sector in Hydropower projects. [1+2+2]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BEL, B.Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Differentiate between Bilateral, Multilateral and Joint Venture project with example? Discuss the external environment in which a project is operated. [4+6]
2. Define concept of project appraisal. Explain about contents of technical and financial proposal. Also explain input analysis of project formulation. [2+7+3]
3. a) Construct the CPM network for a project with following activities: [16]

Activities	A	B	C	D	E	F	G	H	I	J
Predecessor	-	-	A,B	B	A	C	E,F	D,F	G,H	I
Days	4	7	4	3	2	1	6	5	8	9

Find:

i) Critical path
ii) Project completion time
iii) EST, EFT, LST, LFT, Total float,
Free float (F_F), independent float (I_dF) and Interferring float (If)

b) Define the terms resource histogram, resource levelling limited resource allocation and work break structure. [2+2+2+2]

4. a) Write the concept of Monitoring, Evaluation and Controlling and also explain project control cycle. [3+4]

b) Why cost control is important in project? 15 houses were to be completed in three months with per unit cost of Rs 25,00,000/-. In one month 4 houses were completed with total expenditure of Rs 96,00,000/- use earn value analysis to find the status of the project. [3+4]

5. Define 'risk'. Explain various sources of project risk. Elaborate risk response planning. [1+5+4]
6. Define the term project financing. Explain features of capital structure planning. A project has total capital of Rs 5,00,000 which consists of 2000 shares @ Rs 100, 1,50,000 preference share 18% interest and remaining loan @ 14% interest. Earning before interest and tax in a year is Rs 1,00,000. Calculate EPS and book value of share if tax rate is 25%.[2+4+4]

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12/16

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, B.Agri.	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Project Engineering *(CE701)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define a project. Explain the characteristics of project and project life cycle in detail. [2+4+4]
2. Define project appraisal. Write procedure for developing a project proposal. Discuss on techniques of project formulation. [2+4+6]
3. a) Why scheduling is important in planning phase of project? Find all the components of CPM from the following information: [3+13]

S.N	Activity	Duration (days)	Successor
1	A	2	D,E
2	B	5	D,E,H,I
3	C	3	H,I
4	D	4	F,G
5	E	2	G
6	F	4	J
7	G	1	J
8	H	3	J
9	I	2	-
10	J	3	-

   b) Prepare a work breakdown structure and draw simple bar chart of a project which includes at least twelve activities. [3+5]
4. a) What are the factors that cause difficulties in project? [4]
   b) You have a project that is scheduled to be completed in 10 days at a budgeted cost of Rs.1,00,000/- . After the completion of 6 days, you do an analysis and you determined the job is 70% of work is complete and the expenditure is Rs.65,000/- . Based on this data is your work performance is on track? Perform EVA and comment on your own performance. [5]
   c) Define quality. What are the techniques of quality control in a project? [1+4]

OR

Explain the relationship between cost, schedule and quality in a project.

5. Why we need analysis of project risk? Explain about sources of risk in a project. What do you mean by qualitative and quantitative risk analysis? [2+4+4]
6. What is capital budgeting decision? Why it is important? A hydropower project costs Rs.30 crore, life is expected to be 40 years and salvage value is Rs.10 crore. Annual income is Rs.6 crore and annual O and M cost is 3% of initial cost. Is it worthwhile to invest if MARR is 10? Use PW and BCR methods to evaluate. [2+2+6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

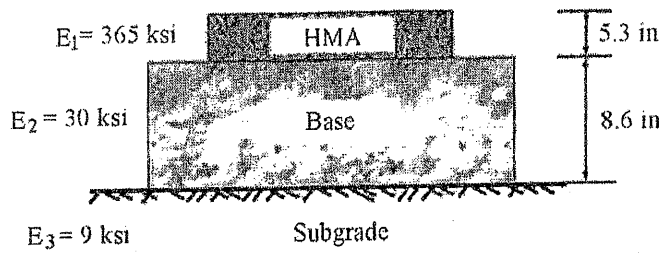
Subject: - Transportation Engineering II (*CE 703*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Explain human-vehicle-environment system. Discuss physical characteristics of driver that affect traffic performance. [8]
2. Define the capacity of a road and list out its type. Two veh. A and B approaching at rt. Angle, A from west and B from south, collide with each other. After the collision, vehicle A skids in a direction 45 deg. north of the west and veh. B, 50 deg. east of north. The initial skid distance of veh. A and B are 35 and 25m respectively before collision. The skid distance after collision are 30m and 10m respectively. If the weight of veh. A and B are 3.5 and 6 tonnes respectively, calculate the original speed of vehicles. The avg. skid resistance of the pavement is found to be 0.55 [2+6]
3. Using the data in the table below, come up with cycle length and actual green for all 2 phase signal. Assume lost time per phase = 3 seconds, yellow time of 3 seconds and all red time of 4 sec. [8]

Veh/hr	Approach			
	East	North	West	South
Flow	488	338	115	217
Saturation flow	1725	1725	1725	1725

4. Define PIEV theory. Categorize LOS and discuss the factors need to be considered to evaluate LOS. [2+6]
5. The flexible pavement was designed for two lane two way road as shown in figure. The drainage coefficient for base layer is 1, layer coefficient for surface and base layer are $\alpha_1 = 0.323 \log_{10} E_1 - 1.42$, and $\alpha_2 = 0.249 \log_{10} E_2 - 0.977$, Where E_1 and E_2 are in PSi. Determine the initial commercial vehicle per day, the road was designed for. Traffic growth rate = 6%, construction period = 2 yrs, design life = 10 yrs, VDF = 2.5. [8]



6. Describe four types of rigid pavement with simple sketch. Discuss the importance of standard axle load in flexible pavement design. [5+3]
7. Explain briefly mass haul diagram with neat figure. Define free haul, overhaul and economic haul distance. [5+3]
8. What are the equipment's and plants needed for the various activities of road construction? Write down the material and construction procedure of DBSD. [8]
9. Describe the term maintenance, rehabilitation and reconstruction. Describe the typical types of rigid pavement failure with sketches where possible. [8]
10. Enumerate the factors to be considered for selecting the bridge site. Describe method of providing drainage in tunnel construction. [8]

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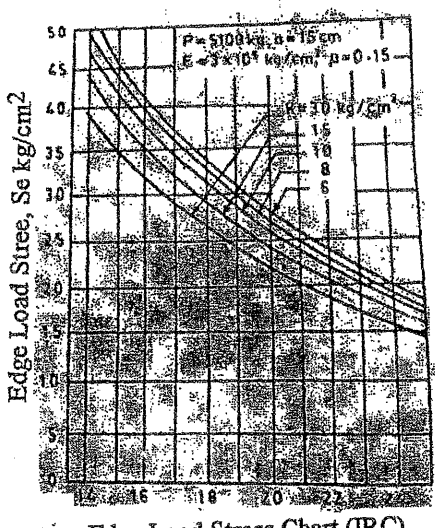
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering (*CE 703*)

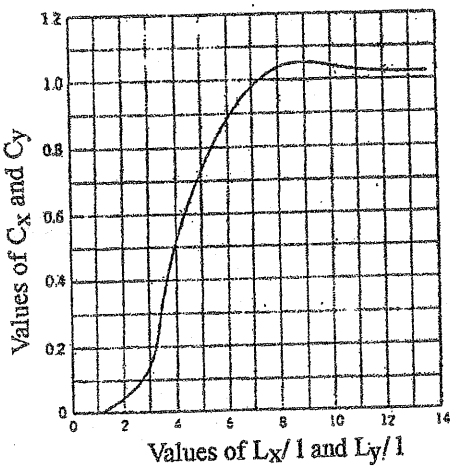
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define parking accumulation, parking turnover, parking load and parking index. Explain speed-density relation and speed-flow relation with required graphs. [4+4]
2. A passenger car of mass 430 kg moving east collides with a truck of mass 1299 kg that is moving south. Initial skid distances of the car and the truck are 15 m and 10 m respectively. After collision they lock together and skid through a distance equal to 8 m in direction 65 degrees south of east before stopping. Compute the initial speeds of the car and the truck. Assume average coefficient of friction as 0.5. [8]
3. What are the advantages of one way traffic movement? Draw a right angle four arm intersection of two roads and show various conflict points, if both roads with two way movements? Classify the type of conflicts. [8]
4. An isolated signal with pedestrian indication is to be installed on a right angled intersection with road A,18m wide and road B, 12m wide. The heaviest volume per hour for each lane of road A and B are 300 and 250, respectively. The approach speeds are 55 and 40 kmph for road A and B respectively. Design the timing of traffic and pedestrian signals. [8]
5. What are the factors that affect in pavement design? How are they considered in AASHTO method? [1+7]
6. A CC pavement slab of thickness 20cm is constructed over a granular subbase having modular of reaction 15 kg/cm^2. The maximum temperature difference between the top and bottom of the slab during summer day and night is found to be 18°C. The spacing between the transverse contraction joint is 4.5 m and that between longitudinal joints is 3.5 m. The design wheel load is 5100 kg, radius of contact area is 15 cm, E value of CC is 3×10^5 kg/cm^2, Poisson's ratio is 0.15 and coefficient of thermal expansion is 10×10^{-6} per °C and friction coefficient is 1.5. Find the worst combination of stresses at the edge. [8]



Edge Load Stress Chart (IRC)

Bradbury's Warping Stress Coefficients



Values of Lx/ l and Ly/ l

7. Define Mass Haul Diagram with its characteristics. Write down the construction procedure of soil cement stabilized base course. [8]

8. Explain the types of bituminous pavements. How the quality of bituminous pavement can be controlled in the field? [8]

9. Explain the maintenance of bituminous surface. Describe the typical types of rigid pavement failure. [8]

10. List out the characteristics of an ideal bridge site location. Discuss the need of good ventilation system in tunnels and outline methods of providing it. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II (*CE 703*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Explain the importance of vision to Road users. The acceleration of a vehicle is given by the equation below:

   $dv/dt = 2 - 0.04\ v$

   Compute the time when the acceleration of the vehicle will be 1.0 m/s^2 if the vehicle was initially travelling at 100 kph. [8]

2. a) Table below shows volume counts on an approach of an urban intersection from 8.30 AM to 10:30 AM. [4+4]

Time	Count (PCU)
8:30 – 8:45	500
8:45 – 9:00	390
9:00 – 9:15	300
9:15 – 9:30	300
9:30 – 9:45	260
9:45 – 10:00	350
10:00 – 10:15	400
10:15 – 10:30	490

   Determine (i) peak hour (ii) peak hourly volume (iii) peak hour factor, and (iv) the design flow rate for the approach.

   b) Travel time data (in seconds) of 14 vehicles traversing a two kilometer road segment are:

   80, 90, 96, 84.7, 72, 79.1, 120, 97.3, 85.7, 78.3, 80.9, 93.5, 76.6, and 86.7

   Estimate (i) the time mean speed and (ii) the space mean speed (iii) What will be the average density of the above traffic stream if the mean headway is 8 sec?

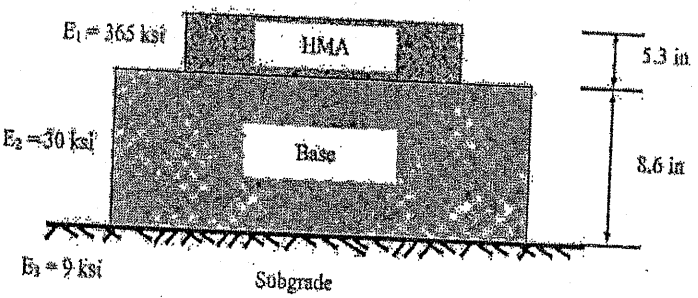
3. Mention the need of crash studies. Discuss the steps to design highway lighting system. [2+6]

4. Road P is 13.5 m wide and road Q is 10.5 m. An isolated signal with pedestrian indications are to be installed at right angled intersection. The peak volumes per hour for road P and road Q are 250 and 200 respectively. The approaching speeds for road P and Q are 60 kmph and 45 kmph. Design the traffic and pedestrian signal timings. [8]

5. List out the differences between flexible and rigid pavement. Explain the terms radius of relative stiffness (l) and modulus of subgrade reaction (k) used in the design of rigid pavements. [4+4]

6. Figure below shows the section of a flexible asphalt pavement designed using AASHTO method. Determine the number of equivalent single-axle loads (ESALs) that the asphalt pavement structure is capable of carrying at a reliability level (R) of 90% [Z-value is equal to -1.282] overall standard deviation (S0) of 0.5, ΔPSI of 2.0, and m2 = 1.0. Assume ,material coefficient a1 = 0.401 and coefficient of Layer 2 (the base layer) given by the following formula $a2 = 0.249 \log (E_2) - 0.977$ [8]

$$\text{Log}_{10} W_{18} = z_R s_o + 9.36 \log_{10}(SN+1) - 0.2 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2-1.5}\right]}{0.4 + \frac{1094}{(SN+1)^{5.19}}} + 2.32\,\text{Log}_{10} M_R - 8.07$$



7. Define soil stabilization and list out the equipments used for road construction. List out the characteristics of Mass haul Diagram. [8]
8. Describe the construction procedure of bituminous premix carpet including the requirements on materials, equipment and the tests for quality control. [8]
9. Differentiate highway maintenance from highway rehabilitation. Discuss about the major causes of flexible pavement failure. [8]
10. List out the component's parts of bridge. Discuss the management of drainage and ventilation in tunneling. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II (*CE 703*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary tables are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Describe the critical physical mental and psychological characteristics of driver that affect his/her traffic performance. [8]
2. Assuming the liner speed-density relationship, the mean free speed is observed to be 90 kmph near zero density and the corresponding jam density is 150veh/hr. Average length of vehicle is 6.1 m. [8]
   a) Write down the speed-density and flow density equation.
   b) Draw v=k, v-q and q-v diagram indicating the critical values.
   c) Compute speed and density corresponding to flow of 800veh/hr.
   d) Compute the avg headways, spacing, clearance and gap when the flow is maximum.
3. Discuss traffic capacity of road and its types. Prepare a neat sketch of a rotary intersection with its geometric elements. [8]
4. The design hour traffic and saturation headway at a four-legged intersection are: [8]

Approach	North (N)	South (S)	East (E)	West (W)
Design hour flow	450	430	350	315
Saturation headway (sec)	2.25	2.33	2.5	2.75

   Design a two phase signal for the intersection based on Webster method and draw the phase diagram. Use amber time of 2 sec on each phase for clearance and start-up loss time phase per phase of 1.5 sec.
5. Discuss the step by step procedure for the determining of rigid pavement thickness based on IRC guidelines. [8]
6. Design a flexible pavement for a two lane highway using provided tables and catalogues. Subgrade CBR values obtained from tests conducted at eight locations are: 11%, 7%, 6%, 7%, 4%, 4%, 8%, and 5%. Total both directional traffic as per last count is 340 CV/day with 60% vehicles of 10000 kg axle load and 40% vehicles of 9000 axle load. Use design life of 10 years, expected completion period of 2.5 years from the date of last count and a traffic growth rate of 7%. State your assumption for estimating the design traffic. [8]
7. List out different soil stabilization methods. Write down construction procedure of soil cement stabilized road including details of equipment and material requirement. [2+6]
8. Describe the construction procedure of Asphalt Concrete including the requirements on material, construction steps, plants and equipments and the tests for quality control. [8]
9. What are the most common failures of flexible pavement? Describe the deflection approach for the design of overlay for flexible pavement. [8]
10. Describe the importance and methods of lighting and ventilation in road tunnels. [8]

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$$G_{TU\,Max} = \frac{1}{1-|S_{11}|^2} \cdot |S_{21}|^2 \cdot \frac{1}{1-|S_{22}|^2}$$

Traffic classes

Traffic classes	Range (10^6 esa)
T1	< 0.3
T2	0.3 - 0.7
T3	0.7 - 1.5
T4	1.5 - 3.0
T5	3.0 - 6.0
T6	6.0 - 10
T7	10 - 17
T8	17 - 30

Subgrade strength classes

Class	Range (CBR %)
S1	2
S2	3 - 4
S3	5 - 7
S4	8 - 14
S5	15 - 29
S6	30

Material Definitions

Double surface dressing

Granular roadbase, GB1 - GB3

Granular sub-base, GS

Granular capping layer or selected subgrade fill, GC

	T1	T2	T3	T4	T5	T6	T7	T8
S1	SD 150 / 175 / 300	SD 150 / 225* / 300	SD 200 / 200 / 300	SD 200 / 250* / 300	SD 200 / 300* / 300	SD 225 / 325* / 300		
S2	SD 150 / 150 / 200	SD 150 / 200 / 200	SD 200 / 175 / 200	SD 200 / 225* / 200	SD 200 / 275* / 200	SD 225 / 300* / 200		
S3	SD 150 / 200	SD 150 / 250	SD 200 / 225	SD 200 / 275*	SD 200 / 325*	SD 225 / 350*		
S4	SD 150 / 125	SD 150 / 175	SD 200 / 150	SD 200 / 200	SD 200 / 250	SD 225 / 275		
S5	SD 150 / 100	SD 150 / 100	SD 175 / 100	SD 200 / 125	SD 225 / 150	SD 250 / 175		
S6	SD 150	SD 150	SD 175	SD 200	SD 225	SD 250		

Note: 1 * Up to 100mm of sub-base may be substituted with selected fill provided the sub-base is not reduced to less than the roadbase thickness or 200mm whichever is the greater. The substitution ratio of sub-base to selected fill is 25mm : 32mm.

2 A cement or lime-stabilised sub-base may also be used

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE 703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What are the critical characteristics of road users? Explain the factors affecting road user's characteristics. [8]
2. The following table gives the particulars collected by floating car method on a stretch of road of length 3.5 km. Determine the flow, density and average speed of the streams along each direction. [8]

Trip	Direction of trip	Average travel speed (kmph)	No of vehicles		
			Overtaking	Overtaken	From opposite direction
1	E - W	28	7	4	238
2	W - E	25	5	3	156
3	E - W	28	3	5	250
4	W - E	23	2	1	170
5	E - W	30	5	3	220
6	W - E	23	2	2	140
7	E - W	28	5	2	260
8	W - E	25	3	2	130

3. Give your arguments on the selection of intersection at grade and grade separated intersection. Suggest measures for improving night visibility on highways. [4+4]
4. An isolated signal with pedestrian's indication is to be installed on a right angles intersection with road H of 18 m wide and road F of 12 m wide. The heaviest volume per hour for each lane of road H and F are 500 and 350 respectively. The approach speeds are 60 and 45 Kmph, for H and F roads respectively. Design the timings of traffic and pedestrians signals. [8]
5. Define axle load, Legal axle load, standard axle, ESAL and ESWL. Draw the sketch of different layers of flexible pavement and their explain functions. [5+3]
6. List the different activities in road construction works. Describe the requirements of equipment, materials and construction steps for earthen road. [8]
7. Write down the construction procedure of double bituminous surface treatment including details on material requirement. [8]
8. What is pavement evaluation? How the defects of cement concrete road can be maintained? [4+4]

9. Discuss the temperature stresses in rigid pavement. Design spacing and dowel bars of expansion joint for a concrete pavement with following details using IRC method: [3+5]

a) Design wheel load = 5100 kg
b) Design load transfer = 40%
c) Slab thickness = 25 cm
d) Expansion joint width (δ) = 2 cm
e) Maximum seasonal variation of temperature = 40°C
f) Coefficient of thermal expansion of concrete = 10×10^{-6} / °C
g) Modulus of elasticity of concrete = 3×10^5 kg/cm^2
h) Poisson's ratio of concrete = 0.15
i) Permissible flexural stress in dowel bar (F_f) = 1400 kg/cm^2
j) Permissible shear stress in dowel bar (F_s) = 1000 kg/cm^2
k) Permissible bearing stress in concrete (F_b) = 100 kg/cm^2
l) Modulus of subgrade reaction = 8 kg/cm^2
m) Diameter of dowel bar (d) = 2.5 cm

Bradbury's formulae to determine load transfer capacity of one dowel bar in flexure (P_f), shear (P_s) and bearing (P_b) with length of embedment (L_d) are given by:

$$P_f = \frac{2d^3F_f}{L_d + 8.8\delta}; \quad P_s = 0.785d^2F_s; \quad P_b = \frac{F_bL_d^2d}{12.5(L_d + 1.5\delta)}$$

10. How ventilation is managed in tunneling? Discuss the river training works carried out for the protection of road. [4+4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE 703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Explain Vehicle Damage Factor (VDF) used in design of flexible pavements. An existing two-lane single carriageway highway is proposed to be widened to a 4-lane divided highway. Design a new flexible pavement for the proposed highway for the following information using provided design catalogues: [2+6]

   (i) 4-lane divided carriageway
   (ii) The expected traffic in the year of completion of construction is 4000 commercial vehicles per day in both direction with 30% heavy trucks of 100kN axle load, 50% light trucks of 80kN axle load, and 20% tractors of 70kN axle load.
   (iii) Design life = 15 years
   (iv) Percentage CBR values obtained from seven different locations along the stretch of the highway are 9, 7, 8, 5, 4, 5, 6.5 respectively.
   (v) Traffic growth rate = 8%

CBR 4%				
Cumulative traffic (msa)	Total Payment thickness (mm)	Pavement Composition		
		bituminous surfacing		Granular base and sub base (mm)
		BC(mm)	DBM(mm)	
10	700	40	80	base = 250 subbase = 330
20	730	40	110	
30	750	40	130	
50	780	40	160	
100	800	50	170	
150	820	50	190	

CBR 5%				
Cumulative traffic (msa)	Total Payment thickness (mm)	Pavement Composition		
		bituminous surfacing		Granular base and sub base (mm)
		BC(mm)	DBM(mm)	
10	660	40	70	base = 250 subbase = 300
20	690	40	100	
30	710	40	120	
50	730	40	140	
100	750	50	150	
150	770	50	170	

2. Discuss tools, equipment and plants used in road construction. List out the characteristics of Mass haul Diagram. [4+4]

3. Describe the construction procedure of bituminous concrete road and check needed for quality control. [8]

4. Describe pavement maintenance and its types with examples. [8]

5. What are the methods of providing tunnel ventilation? Explain the factors controlling the selection of bridge sites. [8]

6. Describe driver's characteristics and their influence in traffic performance. [8]

7. Two vehicles approaching at right angles, A from West and B from South, collide with each other. After the collision, vehicle A skids in a direction 51° North of West and vehicle B, 61° East of North. The initial skid distances of the vehicles A and B are 39m and 21m respectively before collision. The skid distances of vehicles A and B after collision are 15m and 36m respectively. If the weights of vehicles B and A are 6 and 4.4 tonnes respectively, calculate the original speeds of the vehicles. Take average skid resistance as 0.55. [8]

8. At right angled crossing of road A and road B isolated signal with pedestrain indicators is to be installed. The road is 14.4m wide and road B is 12m wide and the peak hour volumes are 280 and 230 PCU per hour and the approach speeds are 50 and 35 kmph respectively. Design the vehicular and pedestrian signal timing. [8]

9. Explain the design factors to be considered in rotary intersection design. [8]

10. Explain the temperature stresses in rigid pavement. Write down the design procedure of dowel bar in expansion joints. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE 703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Necessary charts are attached herewith.*
- ✓ *Assume suitable data if necessary.*

1. Explain different vehicular characteristics that influence traffic performance. [8]
2. Discuss different types of intersection. Write the advantages and limitations of grade separated intersection. [8]
3. a) The vehicle arrivals at the section of road are assumed to be Poission distributed with an average arrival rate of 1 vehicle every 5 minutes. What is the probability of
   (i) Exactly 3 vehicles arrive in a 15 minute interval
   (ii) less than 3 vehicles arrive in a 15 minute interval?
   (iii)More than 3 vehicles arrive in a 15 minute intervals? [4]

   b) Calculate the capacity of rotary with entry and exit width of 8m, the width of non-weaving section is 9m. width of rotary is 12m, length of weaving section is 60m. The ratio of weaving to total traffic in weaving section is 0.7. [4]
4. The average normal flow of traffic on the cross roads 1 and 2 during design period are 450 and 350 PCU/hr. The saturation headway on these roads are estimates as 2.5sec and 3.75 sec respectively. The all red time required for pedestrian crossing is 15sec. Design two phase signal by Webster's method with neat phase diagram. Take amber time of 2 sec on each phase for clearance and start-up loss time of 2 sec and 3 sec for roads 1 & 2 respectively. [8]
5. What are the various factors to be considered in design of flexible pavement and indicate their significance? [8]
6. A proposed flexible pavement design of single lane carriageway consists of 75mm of Asphalt concrete, 120 mm of emulsified stabilized base course and 145mm of granular subbase. The expected commercial traffic volume is 140 cvpd. The expected traffic composition is 30% truck. 30% of mini truck and 40% of bus, whose truck factors are 5.6, 0.6 and 0.1 respectively. The expected annual traffic growth rate is 8% for all vehicles, and 18month required for construction to be completed. The CBR test conducted at 7 locations strating from Ch.0+100 at the interval of 200m distance gave the value of 11,9,7,10,8,6,4. $E_{sub\ base}$=275 MPa, L_{base}=500MPa and $E_{surface}$=2400 MPa. How many years can this pavement last? [8]
7. Define mass haul diagram. Write down the construction procedure of WBM road. [2+6]
8. Describe the construction procedure of Asphalt Concrete including the requirements on materials, plants and equipment and the tests for quality control. [8]
9. Define pavement evaluation. Explain the types of failure & its causes in flexible pavement. [8]
10. Discuss the factors which affect the bridge site selection. List the essential components of bridge with sketches. [8]

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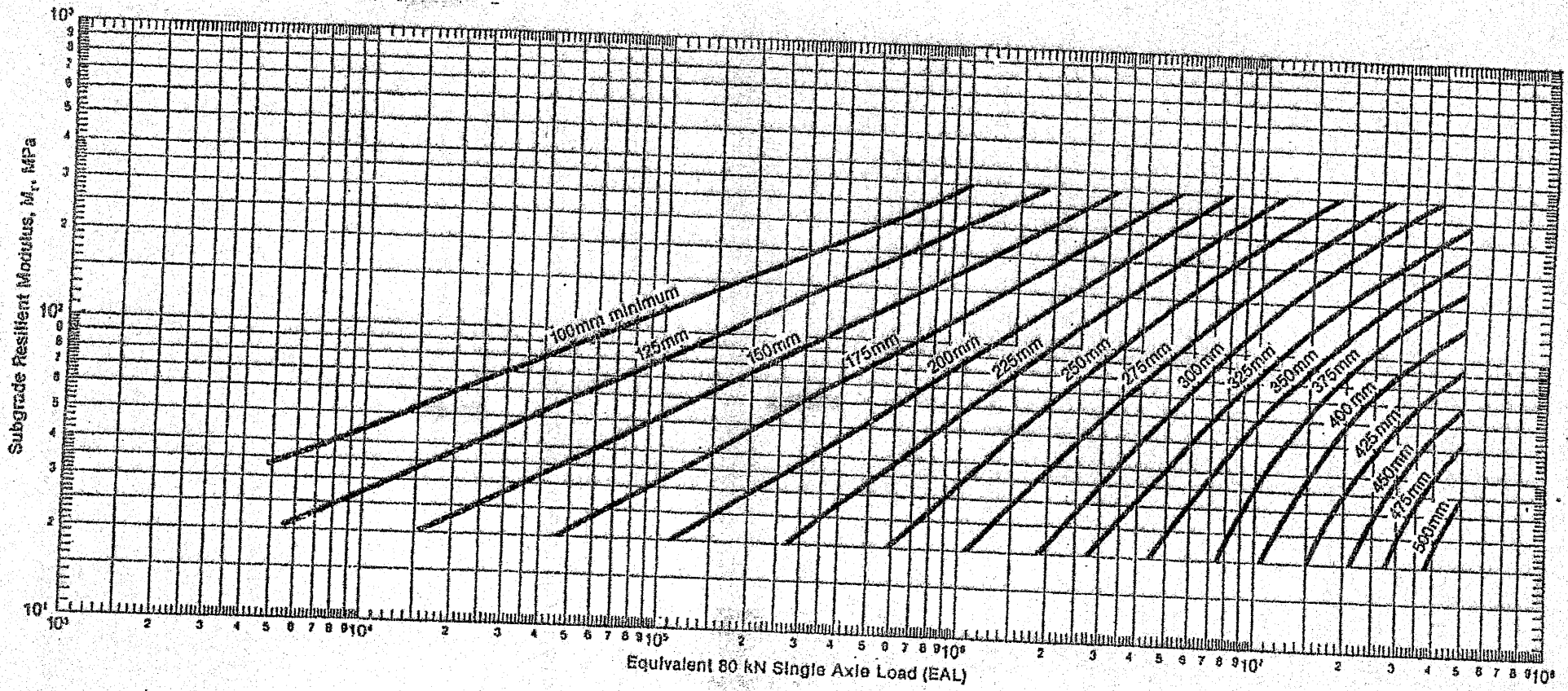
Full-Depth Asphalt Concrete



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE 703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Necessary charts are attached herewith.*
- ✓ *Assume suitable data if necessary.*

1. A bicycle racer practices everyday in the morning. Her route includes a ride along 800 m bikeway and back. Since she is traffic engineer, she has made it a habit to count the numbers of cars in lane A that she meets while riding southward, the number of cars in lane A that overtake her while riding northward and the number of cars in lane A that she overtakes while riding northward as shown in table below. Find average traffic flow and time of lane A. [8]

Average Travel speed (km/hr)	Nos. of Vehicle met	Nos. of Overtaken Vehicle	Nos. of Overtaking Vehicle
32	117	10	74
34	93	25	41
32	30	15	5
33	70	18	9

2. Explain in detail about different physical characteristics of Driver that affect design of traffic facilities. [8]
3. List out the importance of parking and ill effect of illegal parking. Explain about different types of On-Street and Off-street parking facilities with their pros and cons. [8]
4. What are the factors affecting Night Visibility? What are the different types of road marking and traffic island used to regulate and control traffic flow? Explain. [2+3+3]
5. A 4-lane divided highway is to be constructed on a new alignment Traffic volume forecasts indicate that the AADT in both directions during the first year of operation will be 12,000 with 50% Passenger cars (5 kN/axle), 33% of two axle single unit trucks (25 kN/axle) and 17% of three axle single unit trucks (30 kN/axle) = 17%. The vehicle mis is expected to remain the same throughout the design life of the pavement. If the expected annual traffic growth rate is 4% for all vehicles, design pavement with AC of thickness 7.5 cm, base and sub base. CBR of subgrade = 6.5%, $E_{sub\ base}$ = 275 MPa, E_{base} = 500 MPa and $E_{surface}$ = 2400 MPa. [8]
6. Write down the assumption and analysis of Westargard Theory. How the warping stress and friction stress are developed in the Rigid pavement? [8]
7. What are the factors affecting soil stabilization? What do you mean by mechanical method of soil stabilization? Write down the procedure of constructing cement soil stabilized road base. [8]

8. Write down material selection and construction procedure of double surface treatment pavement. [8]

9. Differentiate between Repair and Rehabilitation of highways. Explain about different types of typical rigid pavement failures. Draw a sketches wherever applicable. [8]

10. What are the importance of tunnel? With neat sketch, describe different components of tunnel and tunnel cross sections? [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE 703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ ***<u>Necessary charts and tables are attached herewith.</u>***
- ✓ *Assume suitable data if necessary.*

1. What are the basic requirements of intersection at grade? Write down the design steps of rotary intersection.
2. In a field survey of spot speed measurement, the following twenty observations were taken. Find time mean speed, and space mean speed.

   50, 40, 60, 54, 45, 31, 72, 58, 43, 52, 46, 56, 43, 65, 33, 69, 34, 51, 47, 41.
   Also, assuming these vehicle speeds are fixed over a half km segment, calculate the corresponding travel times and show that the space mean speed calculated using travel times is equal to the point estimate.
3. What are the causes of accident and how accident can be prevented? Describe briefly the factors influencing street light design.
4. The average normal flow of traffic on cross roads A and B, of width 7m both, during design period are 400 and 250 PCU per hour; the saturation flow values on these roads are estimated as 1250 and 1000 PCU per hour respectively. The all-red time is provided for pedestrian crossing with speed 1 m/sec and initial walk time 6 sec. Design two phase traffic signal.
5. Explain the followings:
   a) Traffic and loading factors controlling pavement design
   b) Lane distribution factors and Vehicle damage factors
6. Estimate the thickness of a plain cement concrete pavement for a 7m wide highway following the design procedure recommended by Indian Roads Congress (IRC) wherever applicable. Use given data, IRC load stress charts for edge and corner regions.
   Design wheel load = 5100 kg
   Traffic growth rate = 7.5%
   Present traffic intensity = 1050 cvpd
   Design life = 20 years
   Construction period = 3 years
   Radius of contact area = 15 cm
   Modulus of elasticity of concrete = 3.0×10^5 kg/cm^2
   Poisson's ratio of concrete = 0.15
   Modulus of rupture of concrete = 40 kg/cm^2
   Thermal expansion of concrete = 10×10^{-6}/°C
   Modulus of subgrade reaction = 6 kg/cm^3
   Maximum temperature in summer = 50°
   Maximum temperature in winter = 15°C
   The temperature differential in slab in the region is 17.3, 19.0 and 20.3 degree Celsius for thickness of 15, 20 and 25 cm respectively.

7. What are the various activities involved in road construction? Write the plants and equipment required for bituminous and cement concrete road constructions.
8. Explain construction procedure of water bound macadam road.
9. Explain the maintenance of bituminous surfaces. Describe the typical types of rigid pavement failures.
10. Enumerate the factors to be considered for selecting the bridge site. Why is ventilation important in tunnel?

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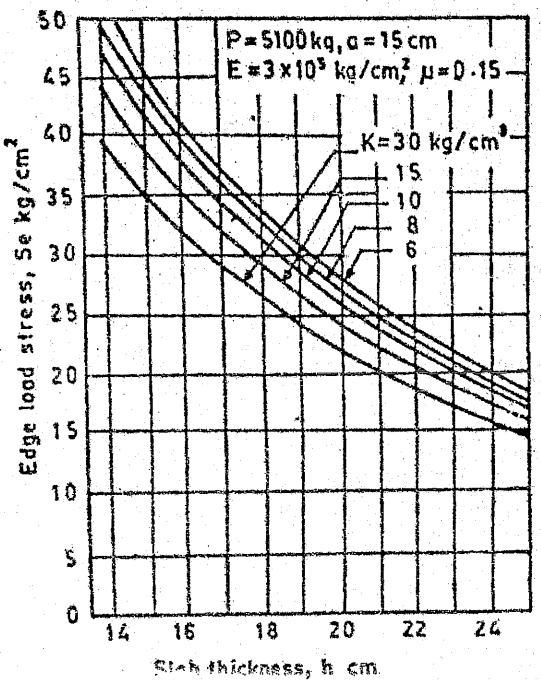
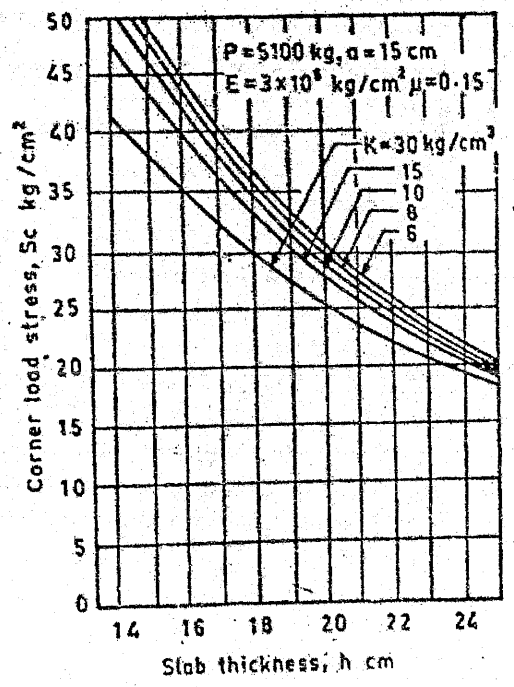
Traffic Classification	Design Traffic Intensity at the End of Design Life (CVPD)	Adjustment in Design Thickness of CC Pavement, (cm)
A	0 -15	-5
B	15 - 45	-5
C	45 -150	-2
D	150 - 450	-2
E	450 -1500	0
F	1500 - 4500	0
G	> 4500	+2

Table for Determination of Coefficient, C

$\frac{L}{l}$ or $\frac{B}{l}$	C	$\frac{L}{l}$ or $\frac{B}{l}$	C
1	0.000	7	1.030
2	0.040	8	1.077
3	0.175	9	1.080
4	0.440	10	1.075
5	0.720	11	1.050
6	0.920	12	1.000





03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. What are the basic requirements of intersection at grade? Mention the importance of street lighting.
2. Explain different types of traffic islands? How accident study is carried out?
3. Two vehicles A and B approaching at right angle. Vehicle A from West and vehicle B from south collides each other. After the collision, vehicle A skids in 49° N of W and vehicle B Skids 27°E of N. The initial skid distance of vehicle A and B are 37 m and 19 m respectively before collision. If weight of vehicle A is 4 tonne and weight of vehicle B is 6 tonne. The skid distances after collision for vehicle A is 15 m and for vehicle B is 36 m. calculate the initial speeds of vehicles if the average skid resistance of the pavement is found to be 0.55.
4. A four-legged right angled intersection is to be signalized with a fixed time 2-phase signal. The design hour flow and saturation flow are as under:

	North (N)	South (S)	East (E)	West (W)
Design hour flow	900	500	800	700
Saturation flow	2500	2000	3200	3000

The lost time is 2 seconds per phase due to starting delays and amber time for north-south and east-west are 3 seconds and 4 seconds respectively. Determine the optimum cycle time. Allocated the green times to the two phases.

5. Explain the factors that controlled the pavement design?
6. Design the flexible pavement for 4-lane single carriage way road with the following parameters:
   i) Initial traffic in each direction = 2000 CVPD
   ii) Design life = 15 years
   iii) Construction period = 3 years
   iv) Traffic growth rate = 8%
   v) Design CBR value = 6%
   vi) Modulus of elasticity of asphalt concrete surface course = 2500 MPa
   vii) Modulus of elasticity of bituminous treated base = 1200 MPa
   viii) Modulus of elasticity of granular subbase course = 125 MPa
   ix) Axle load distribution of commercial vehicles on the road is as follows:

Axel Load (kN)	No. of Axles (%)
10	15
30	15
50	20
70	30
90	10
110	10

7. Describe the materials required and construction procedure of water Bound Macadam road.
8. Describe the construction steps of cement concrete pavement.
9. Describe briefly maintenance, rehabilitation and reconstruction. Describe the methods of pavement evaluation.
10. Draw a neat sketch of bridge with its components. Explain the methods of river bank protection?

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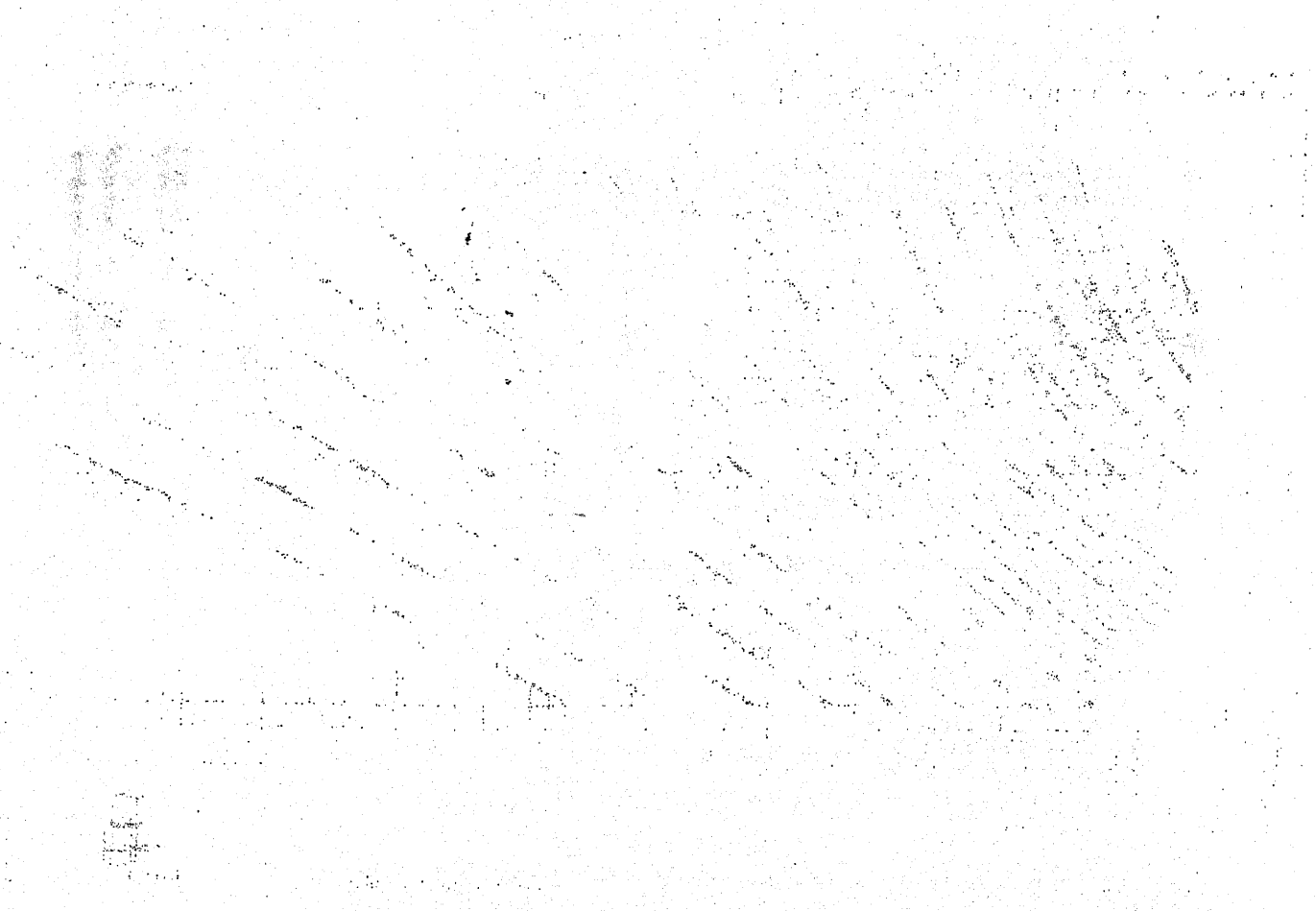

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Discuss the advantages and limitations of rotary intersection. Describe the factors affecting street light design.
2. Describe different types of road capacities and explain the factors affecting capacity and level of service.
3. Speed and delay studies by floating car method were conducted on a stretch of city road of 3 km length running north south. The data collected is given below. Find out
   i) Average traffic volume
   ii) Journey speed
   iii) Running speed of the traffic system along either direction

Trip no	Direction of Trip	Journey time [min]	Total Stopped Delay [min]	No. of Vehicles		
				Overtaking	Overtaken	from opposite direction
1	N-S	5.5	1.5	4	7	250
2	S-N	6.25	1.67	5	5	200
3	N-S	5.36	1.5	5	3	240
4	S-N	6.33	2.25	3	1	230
5	N-S	5.63	1.16	2	6	230
6	S-N	6.3	1.33	2	3	250
7	N-S	5.33	1.67	2	7	210
8	S-N	6.53	1.83	3	2	180
9	N-S	5.16	1.5	2	4	200

4. A traffic stream had a free flow speed of 80 kmph and jam density if 100 veh/km. Calculate the speed and density volume for highest level of service possible if the flow is 90% of capacity flow. Calculate the spacing, headway, gap and clearance when there is capacity flow if the length of vehicle is 6.0 m.

5. Design a flexible pavement by using asphalt institute method from the following data of a stretch of existing two lane roads.

   i) Current traffic of 80 KN equivalent single axle load = $0.95*10^3$ EAL/Day. VDF = 2.0
   ii) Traffic growth rate = 7.5%
   iii) Design period = 15 years
   iv) Construction period = 16 months
   v) CBR sun grade to be taken = 5%
   vi) Elastic modulus of asphalt concrete surface course = 2500 Mpa
   vii) Elastic modulus of granular sub-base course = 125 Mpa

   Also sketch the cross section of pavement. (Refer attach figure)

6. Discuss westergaard's concept of temperature stress in concrete pavement. How spacing of different joints is calculated in rigid pavement.

7. List out the techniques of soil stabilization. Explain the design and construction procedure of soil-cement stabilized road.

8. Explain the construction procedure of bituminous concrete road and check needed for quality control.

9. Benkelman Beam deflection studies were carried out on 12 selected points on stretch of flexible pavement during summer season. The deflection values obtained in mm are given below. If the present traffic consists of 600 commercial vehicles per day, determine the thickness of bituminous concrete overlay required, if the pavement temperature during the test was 32°C and the correction factor for subsequent increase in subgrade moisture content is 1.1. Assume annual rate of growth of traffic as 7.5%, design life as 10 years and the number of years after the last traffic count before the construction of overlay as 2 years and take equivalency factor of 2.0 for bituminous concrete. Adopt IRC guidelines.

   [1.3, 1.42,1.35,1.38, 1.38, 1.58,1.65,1.50, 1.49,1.43,1.53,1.60 mm]

Design Traffic (cvpd)	150-450	450-1500	1500-4500
Allowable deflection (mm)	1.5	1.25	1.00

10. Write the characteristics if ideal bridge site. Explain briefly the method of tunneling in firm ground.

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
Level	BE	**Full Marks**	80
Programme	BCE	**Pass Marks**	32
Year / Part	IV / I	**Time**	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*
- ✓ *Normal graph paper should be provided.*

1. What are the basic requirements of intersection at grade? Describe grade separated intersection with its advantages and disadvantages.
2. Spot speed observation at a particular link provides the following data, calculate maximum speed limit, minimum speed limit, design speed and modal speed for regulation of traffic.

Speed range (kmph)	Frequency
6-10	1
10-14	4
14-18	7
18-22	20
22-26	44
26-30	80
30-34	82
34-38	79
38-42	49
42-46	36
46-50	26
50-54	9
54-58	10
58-62	3

3. Describe highway capacity. Explain the factors which affect capacity and level of service.
4. Assuming linear Speed-density relationship of V = 60-0.43K
   a) Draw V-K, V-Q and Q-K diagram showing critical value
   b) Find the saturation flow?
   c) Find speed and density at flow of 1000veh /hr
5. What are factors affecting pavement design? Write down the steps of IRC design guidelines for rigid pavement.

6. Design a flexible pavement by using asphalt institute method from the following data of a stretch of existing two lane road.

   a) Current traffic of 80KN equivalent single axle load = 0.95×10^3 EAL/day
   b) Traffic growth rate = 7.5%
   c) Design period = 15 yrs
   d) construction period = 16 months
   e) CBR of sub-grade to be taken = 5%
   f) Elastic modulus of asphalt concrete surface course = 2500 MPa
   g) Elastic modulus of bituminous treated base = 1200 MPa
   h) Elastic modulus of granular sub base course = 125 MPa

   Also draw the neat sketches of the pavement layers.

7. What is Mass Haul Diagram? What are the equipment and plants needed for the accomplishment of various activities of road construction?
8. What are various types of bituminous pavements? Explain the construction procedure of Asphalt Concrete pavement.
9. What is highway maintenance? Explain the general causes of pavement failures.
10. What are the factors affecting the choice of location of bridge site? Discuss the river bank protection structures.

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64 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary figures and tables are attached herewith.***
- ✓ *Normal graph paper shall be provided.*
- ✓ *Assume suitable data if necessary.*

1. Explain the contributing factors of road accident. Explain how accident rate can be reduced.
2. Design two phase traffic signal using Webster method. The flow on cross road X and Y during design period is 450 PCU/hr and 325 PCU/hr respectively. The capacity of road Y and X being 1400 PCU/hr and 1200 PCU/hr respectively. Take amber time as 3 sec, all red condition for pedestrian crossing is 15 sec.
3. An officer commutes daily from his home to his office. On an average the trip one way takes 24 minutes, with a standard deviation of 4 minutes. Assume the distribution of trip times to office to be normally distributed
   a) What is the probability that the trip will take at least ½ hours?
   b) If the working hour starts at 9:00 A.M and he leaves his house at 8:45 A.M in the morning, what percentage of the time is he late at work?
4. What are the importance of street lighting? Describe the factors affecting its design.
5. Differentiate between flexible pavement and rigid pavement? Explain the factors which affect pavement design.
6. Design the pavement for a given stretch of a dual three lane carriage way with following data. The result of subgrade soil CBR test at seven locations obtained in that stretch of a road are 11,8,7,6,7,5,4. The existing traffic counted on that stretch of road (ADT) are

Traffic categories	Nos.	Equivalency factors
Truck (loaded)	20	5.67
Truck (empty)	20	0.02
Bus (loaded)	40	0.1
Mini Truck (empty)	10	0.001
Mini Truck (loaded)	20	0.63
Mini Bus (loaded)	19	0.05
Cars	20	0.0005

   Traffic Growth rate = 7%
   Design Period = 10 years
   Construction period from last date of traffic counts = 2 years
7. Explain with mass Haul Diagram the free haul, over haul and economical haul. List various activities in road construction.
8. Define prime coat and tack coat. Write down the construction procedure of Asphalt concrete.
9. Explain the importance of road maintenance. Describe the maintenance of bituminous pavement.
10. Explain the importance and methods of providing tunnel drainage, lighting and ventilation.

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P.T.O

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)	Full Marks	80
Level	BE	Pass Marks	32
Programme	BCE	Time	3 hrs.
Year / Part	IV / I		

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Define traffic engineering. Explain road user characteristics and human-vehicle-environment system.
2. The average normal flow of traffic on cross roads H and F during design period are 400 and 250 PCU per hour, the saturated headway on these roads are estimated as 3 secs and 4 secs respectively. The all red time required for pedestrian crossing is 15 secs. Design two phase traffic signal by Webster's method.
3. What is the importance of parking studies? Describe different types of parking.
4. A vehicle hits a bridge abutment at a speed estimated by investigations as 20kmph. Skid marks of 30 m on the pavement (f=0.35) followed by skid marks of 60 m on the gravel shoulder approaching the abutment (f=0.50). What was the initial speed of vehicle?
5. Explain the concept of cumulative standard axle load. What are the advantages of rigid pavement over flexible pavement?
6. Design a flexible pavement by using Asphalt Institute Method for a two lane two way pavement carrying traffic of 1500pcu/day with growth rate of traffic 5% per annum. The design life is 15 years. The vehicle damage factor is 2.5 and CBR value of sub grade soil is 5%. The modulus of asphalt concrete surface course, bituminous treated base course and granular sub-base course are 2500MPa, 1200MPa and 125 MPa respectively. Assume construction period of 18 months. Draw a neat sketch of pavement layers.
7. What is surface dressing? Write down the construction procedure of DBSD?
8. What are the equipment and plants needed for the various activities of road construction? Describe prime coat, tack coat and seal coat with their usefulness.
9. Explain the typical failures of flexible pavement with neat sketches?
10. Show the various component parts of bridge with a neat sketch. How drainage and ventilation problems are managed while tunneling?

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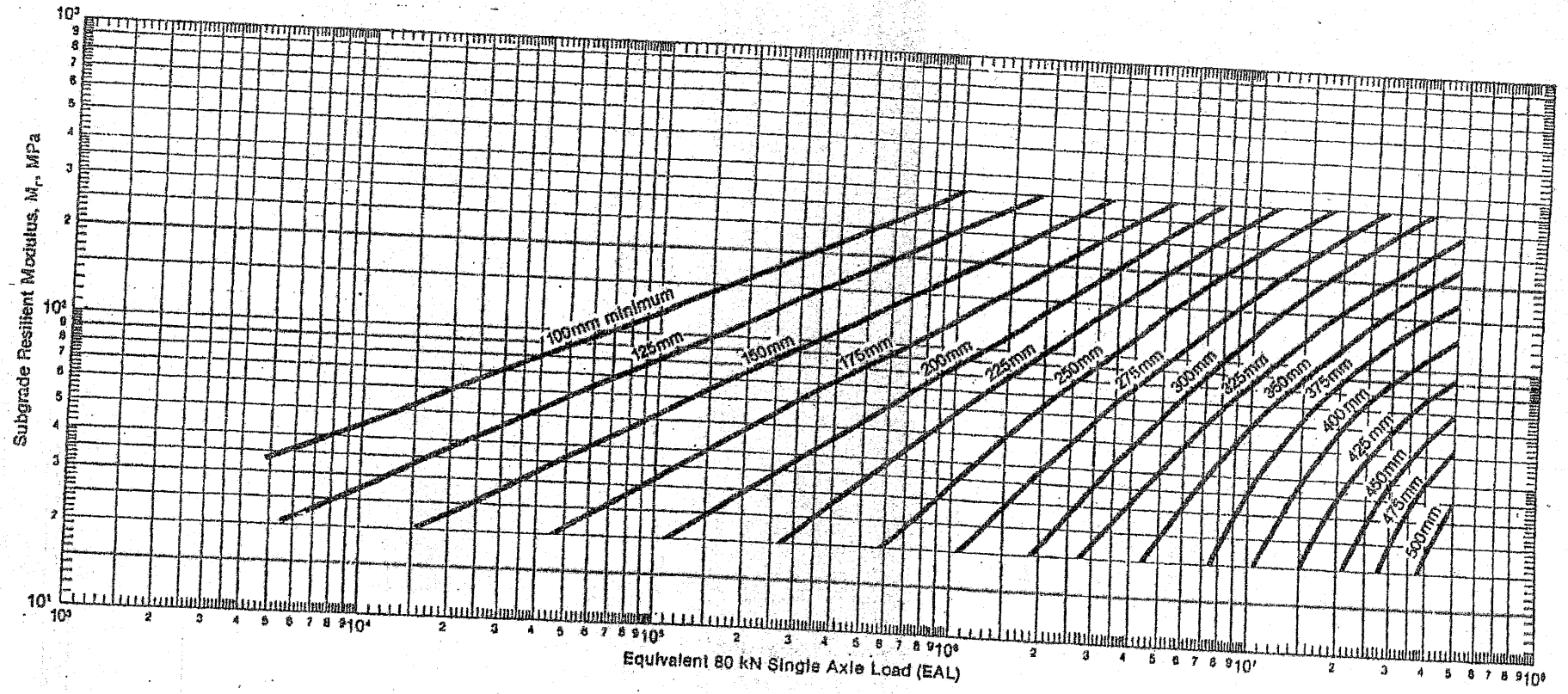
Full-Depth Asphalt Concrete



06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Describe various types of traffic control devices. Write down the advantages and disadvantages of traffic signal.
2. What are the importances of street lighting? Describe the factors affecting street light design.
3. Assuming a linear speed-density relationship, the mean free speed is observed to be 80 km/h near zero density and the corresponding jam density is 130 veh/km. Assume that the average length of vehicles is 6 m.
   i) Write down the speed-density and flow-density equations
   ii) Compute speed and density corresponding to flow of 1000 veh/hr.
   iii) Compute the average headways, spacing, clearance and gaps when the flow is maximum
4. The following data collected for a section of road 25.5 km long during the floating car method study. Assuming the equivalency factor of 1, 2 and 3 for each car bus and truck respectively, Calculate the flow in per/hr journey speed and running speed in both direction of flow.

Direction	Journey time		Stopped delay		No. of vehicles from opposite direction			Vehicles in the same direction	
	Min	Sec	Min	Sec	Car	Bus	truck	Overtaking	Overtaken
N-S	4	25	1	2	40	2	4	3	1
S-N	4	21	1	5	21	2	3	2	3
N-S	4	10	1	3	15	1	2	4	2
S-N	4	14	1	5	20	5	1	6	1
N-S	4	30	1	45	21	3	2	3	3
S-N	4	16	1	15	25	2	1	2	2
N-S	4	12	1	18	27	4	2	5	2
S-N	4	10	1	55	28	1	3	1	1
N-S	4	10	1	13	20	3	2	2	3
S-N	4	20	1	50	29	2	1	4	3
N-S	4	50	1	42	26	1	3	2	2
S-N	4	40	1	35	25	3	3	1	1

5. Differentiate between flexible pavement design and rigid pavement design. Describe Weatergaad's concept for temperature stresses.

6. A road pavement is to be designed for a stretch of road with the following pavement layers:

   (i) Minimum thickness of asphalt concrete on the surface course = 50 mm.

   (ii) Well graded crushed stone aggregate for base course, CBR value = 90%

   (iii) Fairly graded graved for sub-base course, CBR Value= 20%

   (iv) Compacted Soil, CBR value = 10%

   (v) 90th percentile sub grade CBR Value = 4%

   The road has single lane carriage way & caters present ADT of 1200 commercial vehicle per day with annual growth of 6%. The pavement is to be designed for 10 years period. Design the pavement section using IRC recommendation for CBR method. The road is to be compacted with 6 months from initial traffic count

7. What are the various activities involved in road construction? Explain the construction procedure of otta seal.

8. Describe the materials required and construction procedure of Water Bound Macadam (WBM) road.

9. Describe the causes of failures in flexible pavement.

10. Explain the methods of river bank protection? Explain the methods of tunneling in hard soil.

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Normal Graph paper should be provided.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Describe the types of traffic capacity and factors affecting traffic capacity.
2. A two-phase traffic signal is to be installed at a cross road of two streets N-S and E-W at right angles to each other have design hour and saturation flows of 800, 2400; 400, 2000; 750, 3000 and 1000, 3000 for North; South; East and West arms respectively. Only straight-ahead traffic is permitted. Calculate the optimum cycle time and green times for minimum overall delay. Take time lost per phase due to starting delays of 2 seconds and the amber period of 2 seconds.
3. What are the basic requirements of intersection at grade? Mention the importance of street lighting.
4. Two vehicles P and Q weights 5 tonne and 7 tonne approaching right angle, vehicle P from west and vehicle Q from south collide with each other. After the collision vehicle P skids in a direction 54° north of east and vehicle Q 42° north of east. The skid distances of vehicles P and Q before collision are 20 m and 28 m and the skid distances after collision are 26 m and 30 m respectively. Find out the initial speed of the vehicles. Assume average skid resistance of the pavement is 0.46.
5. What are the factors affecting pavement design? Write down the step by step procedure for determining rigid pavement thickness based on IRC guidelines.
6. Design the flexible pavement for a new road with following data:
   a) Two lane single carriageway road in plain terrain
   b) Initial traffic composition in the year of completion of contruction (sum of both directions)

Vehicle type	No.	VDF
Heavy 3 axle truck	40	6.5
Two axle truck	100	4.75
Mini truck	120	1.0
Bus	100	0.5

   c) Traffic growth rate is 8% per annum
   d) Designed CBR of sub grade soil is 6%
   e) Design life is 12 years
   Necessary chart is attached.
7. What do you mean by road construction technology? What are the equipment and plants do you need to execute different activities of road construction?
8. What is otta seal? Write the construction procedure of otta seal.
9. Define highway maintenance. Write down difference between maintenance, rehabilitation and reconstruction. Explain types of road maintenance.
10. Write the characteristics of ideal bridge site. Explain briefly the methods of tunneling in firm ground.

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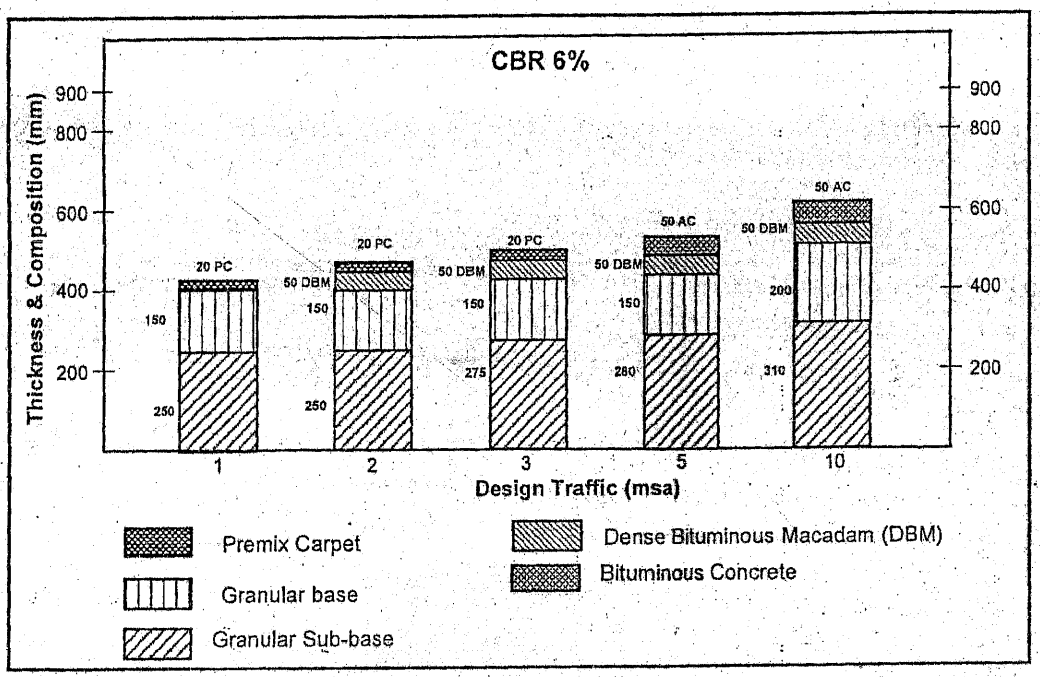
CBR 6%					
Cumulative Traffic, msa	Total Pavement Thickness, mm	Pavement Composition			
		Bituminous Surfacing		Granular Base, mm	Granular Sub-base, mm
		Wearing Course, mm	Binder Course, mm		
1	400	20 PC		150	250
2	450	20 PC	50 DBM	150	250
3	475	20 PC	50 DBM	150	275
5	530	50 AC	50 DBM	150	280
10	610	50 AC	50 DBM	200	310



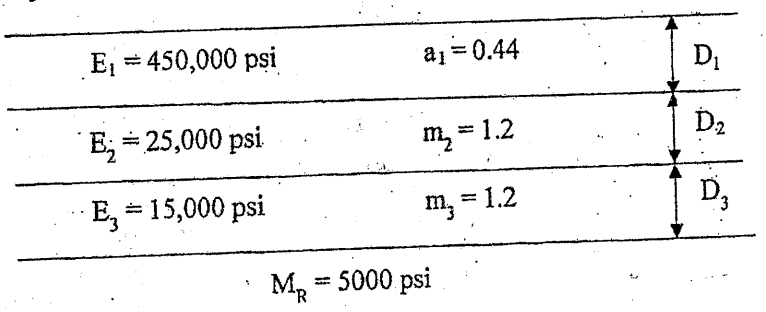
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Normal graph paper should be provided.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Define traffic engineering. Describe road users and vehicular characteristics.
2. What are the uses of origin and destination study? Briefly explain the methods of conducting this study.
3. Average trip time for office is 30 minutes with standard deviation of 5 min. Assuming normal distribution of trip time, calculate the followings:
   a) Probability of trip time being at least 35 minutes
   b) If the working hour starts at 10:00 AM and trip starts at 9:40 AM what is the probability of being late?
4. An isolated signal with pedestrians indication is to be installed on a right angled intersection with road A 15 m wide and road B 12 m wide. The heaviest volume per hour for each lane of road A and road B are 300 and 250 respectively. The amber times for roads A and B are 3 and 2 seconds respectively. Design the timings of traffic and pedestrian signal.
5. What do you understand by legal axle load and standard axle load? Describe the stresses induced in the rigid pavement slab. How spacing between contraction joints is calculated in jointed plain concrete pavement?
6. In the figure below, a pavement system with the resilient moduli, layer coefficient of surface course and drainage coefficients are shown. If predicted ESAL= 15×10^6, R = 90%, $S_o = 0.4$ present serviceability index = 4.2 and terminal serviceability index = 2.7, select the thickness of D_1, D_2 and D_3.



7. Draw a neat sketch of typical pavement structures. Explain in detail the construction methodology of Otta Seal.
8. Explain with a neat diagram the characteristics of mass haul diagram, including free haul, over haul, economic haul, shrinkage and swelling factor.
9. Define road maintenance. Describe the failures of the flexible pavement.
10. What are the methods of providing tunnel ventilation? Explain the major factors controlling the selection of bridge sites.

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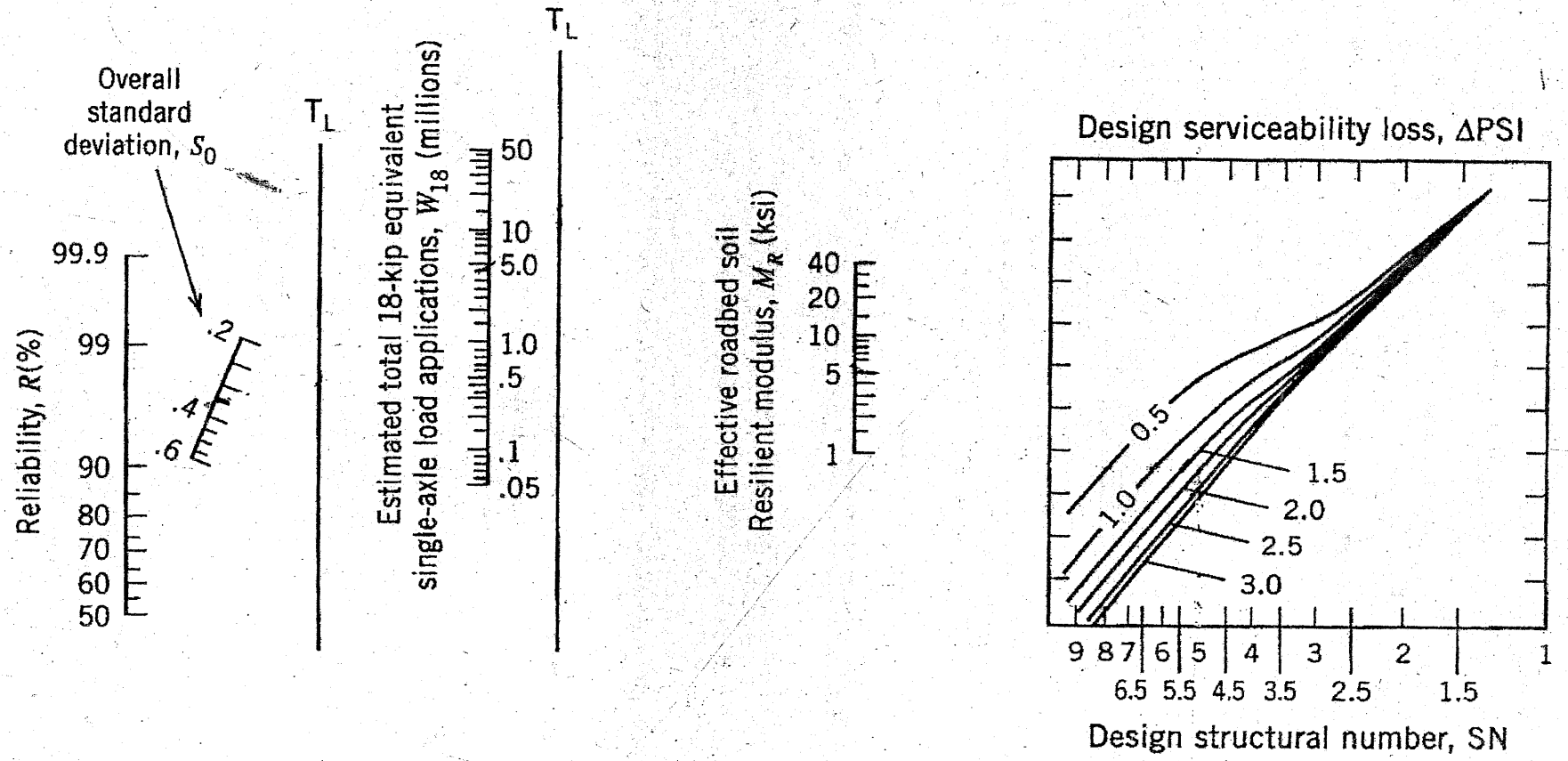
AAHSTO Flexible Pavement Nomograph



03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary chart is attached herewith.***
- ✓ ***Normal graph paper should be provided.***
- ✓ *Assume suitable data if necessary.*

1. What are the objectives of conducting speed and delay study? Describe the methods of conducting speed and delay study. [4+4]
2. Write down the basic requirements of intersection at grade. Draw a neat sketch of full cloverleaf intersection showing all the traffic movement. [4+4]
3. A van of weight 3 tonne hits a parked car of weight 0.8 tonne and both the vehicles skid together through a distance of 4.2 m before coming to stop. [8]
   i) Calculate the initial speed of the van if it does not apply brakes before collision.
   ii) Calculate the speeds of van before collision at collision and after collision if it applies brakes and skid through a distance of 2.8 m before collision.
4. An isolated signal with pedestrian indication is to be installed on a right angled intersection with road C of 12 m wide and road D of 9.6 m wide. The volume of traffic per hour per lane of roads C and D are 450 and 300 respectively. The approach speeds are 60 kmph and 40 kmph for roads C and D respectively. Design the timings of traffic and pedestrian signals, assuming amber periods of road C and D as 4 seconds and 3 seconds respectively. [8]
5. The traffic survey revealed that present ADT of 1200 cv/day (both directions). The annual growth rate of traffic is 8%. The vehicle damage factor is 1.5. The pavement construction of single lane road is to be completed in 3 years from the last traffic count. Design the pavement section by Asphalt Institute method with the following considerations. [8]
   i) Design period = 10 years
   ii) CBR test values of sub grade soil

Penetration (mm)	Load (kg)	Penetration (mm)	Load (kg)
0	0	3.0	56.5
0.5	5.0	4.0	67.5
1.0	16.2	5.0	75.2
1.5	28.1	7.5	89.0
2.0	40	10.0	99.5
2.5	48.5	12.5	106.5

   iii) Elastic modulus of Asphalt concrete surface course = 2800 MPa
   iv) Elastic modulus of Emulsified stabilized base course = 1500 Mpa
   v) Elastic modulus of Granular sub base (CBR ≥ 30%) = 120 Mpa
   Draw the cross section of final pavement layers considering the thickness of Asphalt concrete surface course not less than 5 cm.
6. What are the factors affecting pavement design? Write down the steps of rigid pavement design by IRC method. [8]
7. Describe different types of pavement. Explain the construction method of Asphalt concrete pavement. [2+6]
8. List out the soil stabilization methods. Explain the construction process of mechanical soil stabilized road. [2+6]
9. Differentiate between maintenance and rehabilitation. Explain different types of road maintenance. [2+6]
10. What are the factors to be considered in selecting bridge site? Explain the methods of river bank protection. [4+4]

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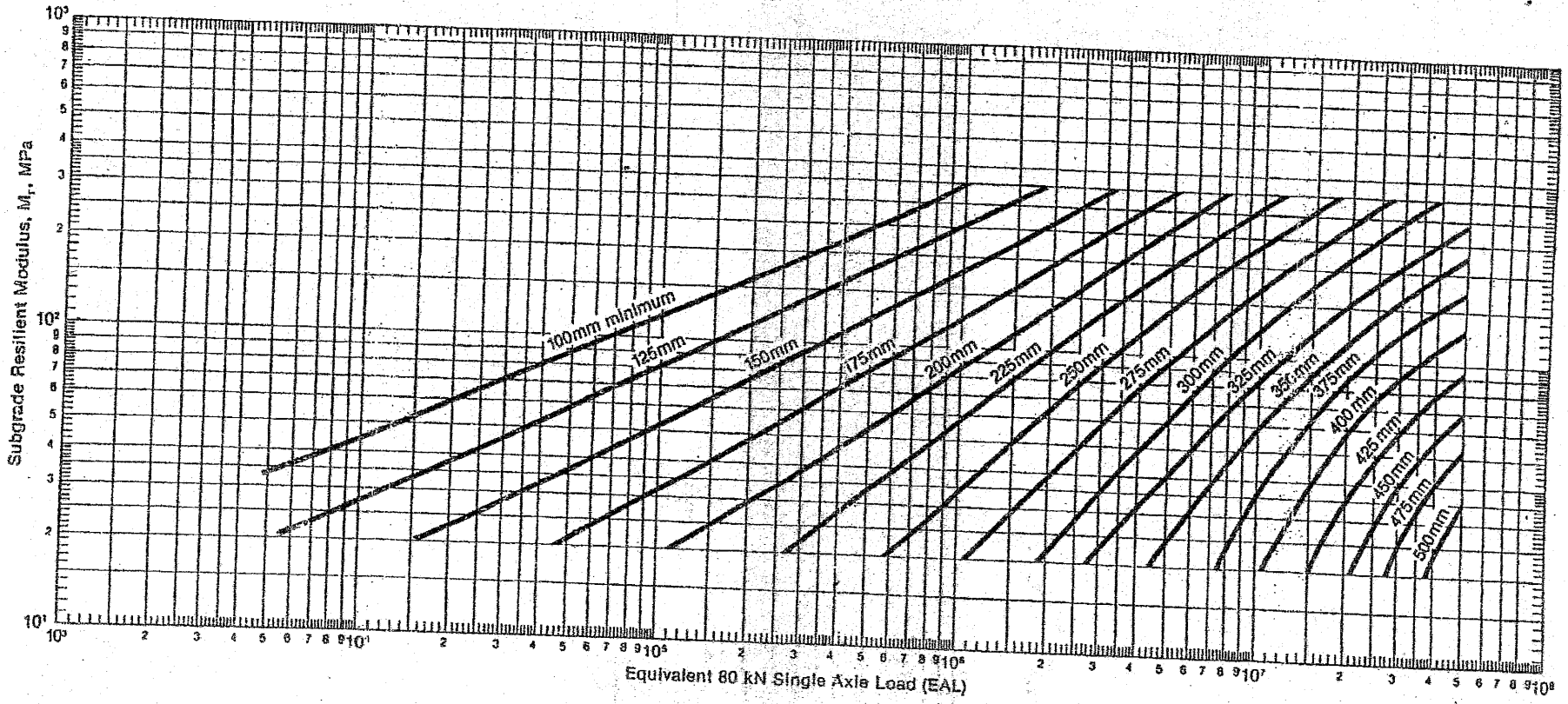
Full-Depth Asphalt Concrete



03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ ***<u>Necessary figures are attached herewith.</u>***
- ✓ *Assume suitable data if necessary.*

1. List the objectives of accident study. Explain briefly causes and preventive measures of accident.

2. Describe channelized intersections with their advantages and disadvantages.

3. The data collected after speed and delay studies by floating car method on a stretch of road 3.2 km long are given below. Determine the average values of volume, journey speed and running speed of the traffic stream along either direction.

Trip	Direction of trip	Journey time (min)	Total stopped delay (min)	No. of vehicles		
				Overtaking	Overtaken	From opposite direction
1	C - D	6.50	1.58	4	7	270
2	D - C	7.48	1.72	5	4	250
3	C - D	6.92	1.62	5	4	300
4	D - C	7.82	1.82	3	3	275
5	C - D	6.33	1.40	3	2	295
6	D - C	8.13	2.10	2	1	280
7	C - D	6.71	1.73	4	4	300
8	D - C	7.40	1.85	3	3	230
9	C - D	6.23	1.60	4	2	275
10	D - C	6.98	1.78	2	1	242

4. An isolated signal with pedestrians indication is to be installed on a right angled intersection with road H of 12 m wide and road F of 9.6 m wide. The heaviest volume per hour for each lane of H and F are 475 and 325 respectively. The approach speeds are 60 and 45 kmph for road H and road F respectively. Design the timings of traffic and pedestrian signals. Assume amber times for road H and road F as 5 and 4 secs respectively.

5. Explain how design traffic is calculated from the data obtained from traffic surveys. Give at least three different examples in various design methods.

6. Design the pavement for an existing two lane single carriageway road with the following details.
   a. Initial traffic in both direction in the year of completion of construction = 5640 CVPD
   b. Design life = 10 years
   c. Design CBR value = 6%
   d. Axle load using the road (CV) = 118 KN

7. Define road construction technology. Describe the various activities to be performed for the road construction.

8. Describe the construction procedure of bituminous concrete road and check needed for quality control.

9. Define road maintenance. Explain different measure to be taken for gully control works.

10. What are the factors to be considered in tunnel lighting? What are the different methods of river bank protection work?

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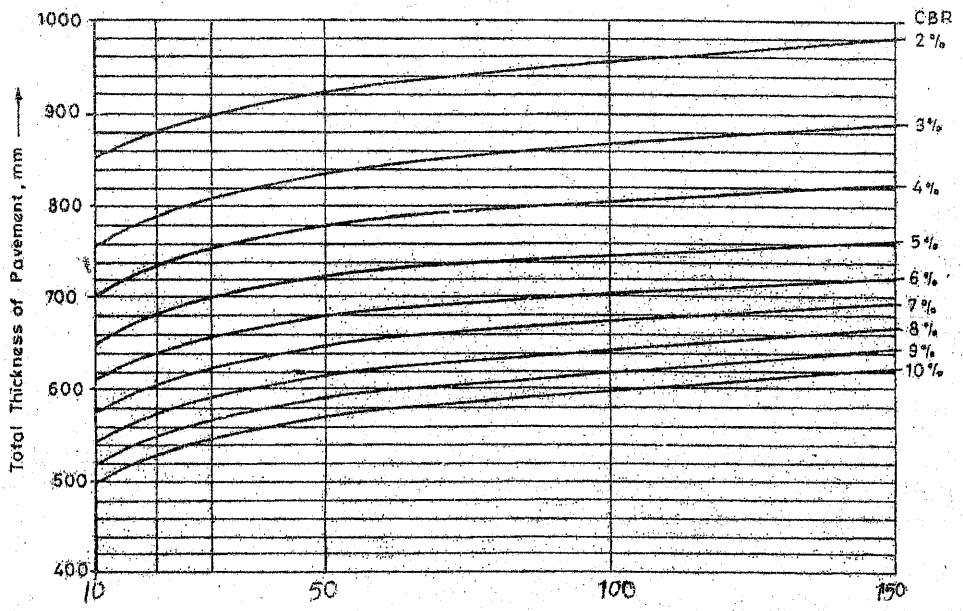
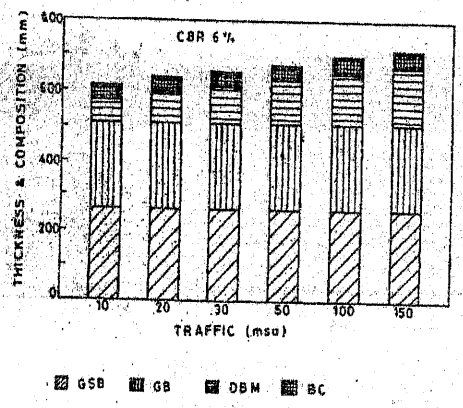
Chart for question no. 6



Cumulative number of standard axles (msa)



CBR 6%

cumulative traffic (msa)	Total pavement thickness (mm)	pavement composition		
		bituminous surfacing		Granular base and sub base (mm)
		BC (mm)	DBM (mm)	
10	615	40	65	base = 250 subbase = 260
20	640	40	90	
30	655	40	105	
50	675	40	125	
100	700	50	140	
150	720	50	160	

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II (CE703)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary charts are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Describe on - street and off - street parking in detail. Where is on - street parking prohibited?
2. Describe road users and vehicular characteristics.
3. What is saturation flow rate? The average normal flow of traffic on cross road A and B during design periods are 375 and 225 pcu per hour. The saturation flow values on these roads are estimated as 1135 and 960 pcu per hour respectively. The all red time required for pedestrian crossing is 14 sec. Design two phase traffic signal by Webster's method. Assume amber time of 2 sec. each for clearance.
4. Two vehicles A and B approaching at right angle, A from west and B from south collide with each other. After the collision, vehicle A skids in a direction 50°North of East and vehicle B skids 60°South of East. If the weight of vehicles A and B are 4 tonne and 5 tonne respectively, the initial skid distances of vehicles A and B before collision are 3.5 m and 4.2 m and after collision 7.0 m and 8.2 m respectively, calculate the initial speeds of vehicles if the average skid resistance of pavement is 0.61.
5. Design a flexible pavement by using Asphalt Institute method from the following data of a stretch of existing two lane roads.

Current traffic of 80 KN equivalent single axel load	= 1000 EAL/day
Traffic growth rate	= 7.5%
Design period	= 15 years
Construction period	= 18 months
CBR of sub-grade to be taken	= 5%
Elastic modulus of asphalt concrete surface course	= 2200 MPa
Elastic modulus of bituminous treated base	= 1000 MPa
Elastic modulus of granular sub base course	= 125 MPa

   Draw a neat sketch of the pavement layers.
6. What are the different factors that affect the pavement design? Compare the flexible and rigid pavements from different criteria.
7. Define road construction technology. Describe the various activities to be performed for the road construction.
8. Draw a mass haul diagram with neat sketch explaining the properties of the diagram.
9. Define road maintenance. Explain different measures to be taken for land slide stabilization.
10. Classify the bridge considering span, loading and materials. Describe the different methods of tunneling in soft soils with the help of neat sketch.

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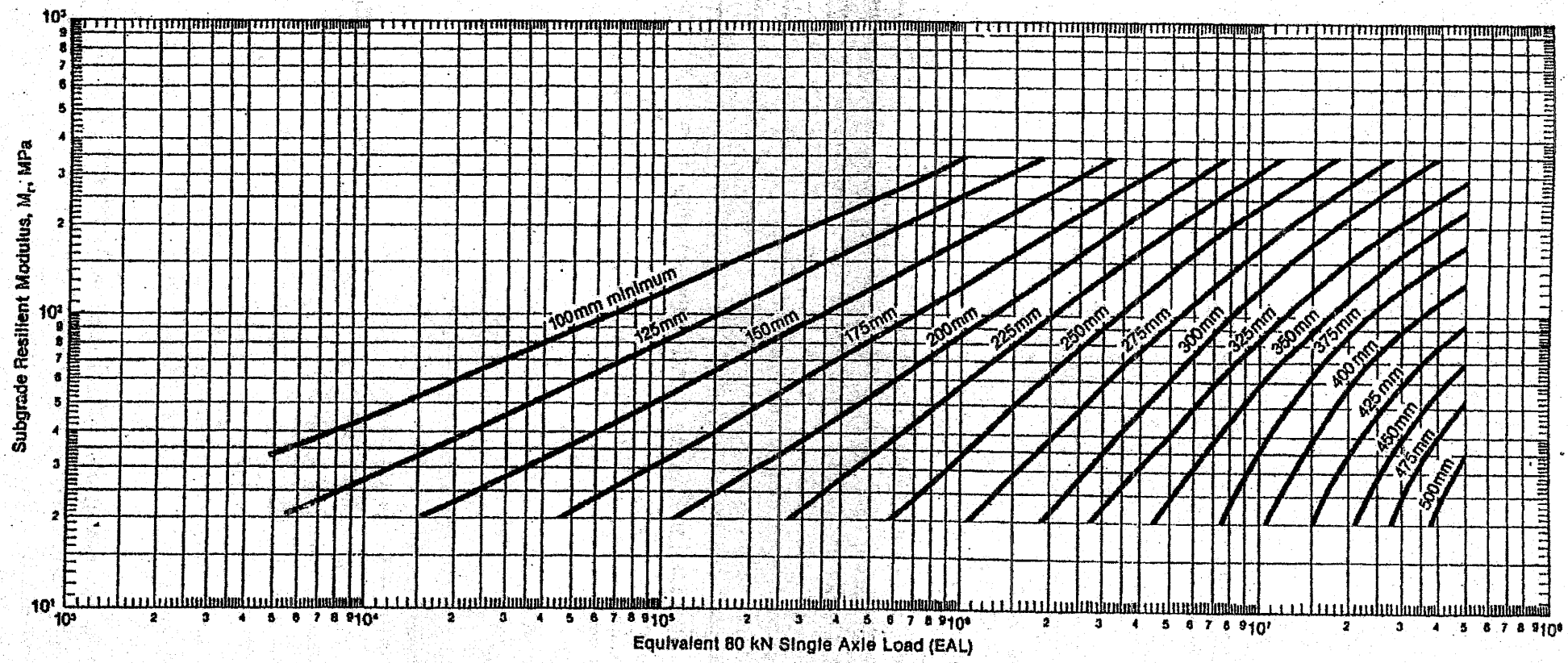
Full-Depth Asphalt Concrete



03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering II *(CE703)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *Normal graph paper should be provided.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Describe different types of traffic capacity and factors affecting traffic capacity.
2. Describe the causes and preventive measures of road accident.
3. A driver travelling at 35 kmph behind another car decides to pass it and accelerate. If the rate of acceleration is given by the relation $\frac{dv}{dt} = (1.12 - 0.014\ V)$ where v is speed in m/sec and t is time in second.

   Find: (i) Rate of acceleration after 10 secs
   (ii) Time taken to attain a speed of 85 kmph
   (iii) How far will car travel in 210 secs
4. At a right angled intersection of two roads, road A with a total width of 13.5m and road B 10.5m. The traffic volume per hour for road A and B are 325 and 275 respectively. The amber periods of road A and road B are 5 secs and 4 secs. Design the timing of traffic and pedestrian signals.
5. Explain the different factors that affect the pavement design.
6. Results of seven tests produced the following subgrade resilient modulus test values 44.8, 67.3, 68.3, 58.6, 68.3, 106.9, 80.0 MPa. The traffic classification at the end of construction is projected as below:

Number of vehicles (both direction)	Truck factor
4000	0.003
2050	0.28
1000	1.06
1100	0.62
1200	1.05

   Design the flexible pavement using Asphalt Institute Method for two lane two way road to cater the above traffic with the following details.
   i) Minimum depth of Asphalt concrete wearing course with modulus of elasticity 2500 MPa = 50mm
   ii) Emulsfied asphalt base course with modulus of elasticity 1250 MPa
   iii) Granular sub-base course with modulus of elasticity 150 MPa
   iv) Annual growth rate of traffic 6.5%
   v) Design period 12 years
   vi) Use 87.5 percentile resilient modulus value for the design.
   Draw the cross section of the pavement layers with your design output.
7. What is Mass-Haul Diagram? What are the equipment and plants needed for the accomplishment of different activities of road construction?
8. Describe prime coat and tack coat. Explain the construction procedure of surface dressing.
9. Explain the importance of road maintenance and methods of road side slope stabilization.
10. Classify the highway bridges. Explain the methods of providing tunnel drainage lighting and ventilation.

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Full-Depth Asphalt Concrete