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 (m³/s)	Month	Discharge (m³/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 $Y_c = 24$ kN/m³ and $\sigma_a = 2500$ kN/m². [10]
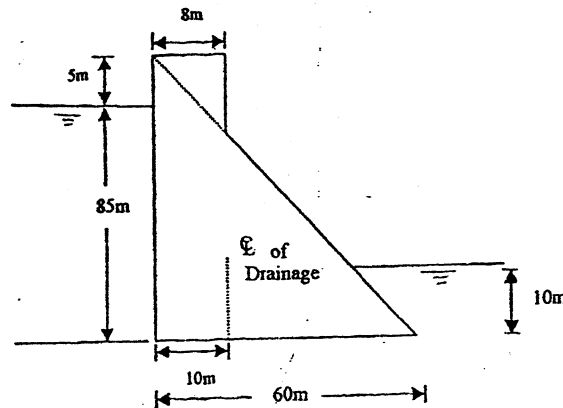
5. Discuss design criteria of an earthen embankment dam. [6]

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 m³/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 m³/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 m³/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 All questions.
✓ The figures in the margin indicate Full Marks.
✓ 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 (m³/s)	100	80	80	105	200	500	1100	1200	800	350	200	120

   The storage capacity avaliable for this project is 1100 million m³. 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 300m³/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/cm². 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/cm² 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 1.45m³/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/m³ and 24kN/m³ 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 *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ 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 $8 \times 10^6 m^3$ with an initial storage of $4 \times 10^6 m^3$, 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 ($w_c = 25 kN/m^3$)
   (ii) Water pressure ($w = 10 kN/m^3$)
   (iii) Uplift pressure
   (iv) Silt pressure the depth of silt as 20m
   (v) Earthquake forces, $\alpha_h = 0.1$
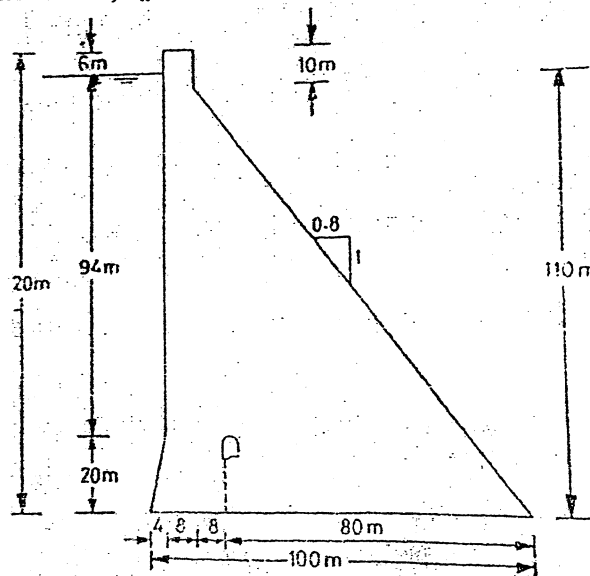
b) Determine the maximum and minimum vertical stresses to which the foundation of the dam will be subjected from the following data:

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 $15 \times 10^6 m^3$. [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 _All_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ Assume suitable data if necessary.

1. a) During a low water week a river has an average daily flow of 40 m³/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]
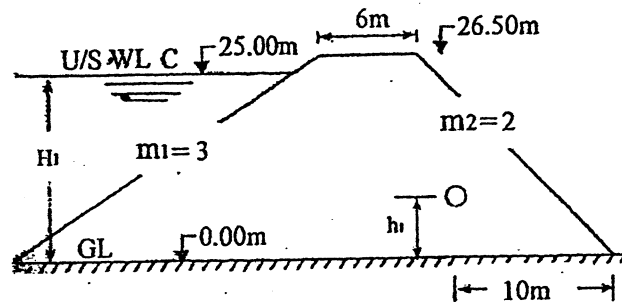
   b) Explain the necessity of grouting and drainage galleries in concrete gravity dam.
   Draw an elevation view of a concrete gravity dam showing the alignment of drainage galleries and series of grout holes.
   Drawing a section of concrete gravity dam show arrangement of vertical formed drain, trap drain and drainage hole. [2+4+4]

3. a) Design a settling basin for a high head project in a river which utilizes 60 m³/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 m³/s of water at head of 25m. The cost of pipe line in place is given by US$250hd² 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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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 / 1	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.
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1. a) A run-of-river hydroelectric power station is proposed across a river at a site where a net head of 30m is available on the turbine. The river carries a sustained minimum flow of 25 m³/s in dry weather and behind the power station sufficient pondage is provided to supply daily peak load of demand with a load factor of 65%. Assuming the plant efficiency of 60%, determine the maximum generating capacity of the generator to be installed at the power house. If the daily load pattern indicates 20 hours average load and 4 hrs of peak load, determine the volume of pondage to be provided to supply the daily demand. [4+4]

   b) You are developing 300 MW reservoir type project in a river basin of Nepal. Briefly mention what steps you would follow from planning to commissioning of the project. [5]

   c) What do you mean by pumped storage power plant? How it can benefit the Nepal's power sector? [3]

2. a) Derive the equations for principal stress and shear stress at toe and heel of a gravity dam with tail water present and also considering hydrodynamic pressure produced by an earthquake. [8]

   b) Drawing section of concrete gravity dam show arrangements of vertical formed drain, trap drain and drainage hole. What are the general criteria for size, depth and pattern of grout holes for certain grouting in gravity dam foundation. [2+2]

   c) Find the seepage discharge through the homogenous earthen embankment dam with 3m width of central impervious core as shown in figure. Given:

   (i) Height of the dam = 45m with free board as 3m,
   (ii) Upstream water level = 42m, top width of the dam = 8m,
   (iii) U/S and D/S side slope of the dam = 1V:3H
   (iv) Coefficient or permeability of the dam material = 4 × 10⁻⁶ m/s and that of impervious core = 5 ×10⁻⁸ m/s. [4]

Fig: Earthen Dam with Impervious Core
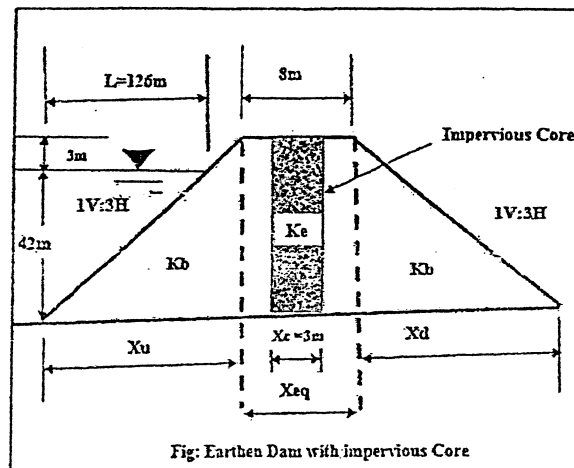
3. a) Find the dimensions of the settling basin for a high head project of Himalayan river which carry a discharge of 30 m^3/s and a gross head of 100m. The sediment size to be removed is up to 0.20mm and fall velocity $\omega = 2$ cm/sec.
   If the turbulence is considered, what will be the dimension of the basin? Check the length of settling basin using Velikanov's method given correction factor $\lambda = 1.5$. [8]

   b) What do you mean by intake? Write down its functions. [1+2]

   c) Determine the necessary length of a rack of a bottom intake with the intercepted flow of 8 m^3/s and width of the rack is 10m. Inclination of the rack is 30°. Thickness, spacing and contraction factor of the bars are 10 mm, 15 mm and 0.82; respectively. [5]

4. a) What are the functions of a Surge tank? Write down the formulas to calculate the maximum upsurge and down surge, time of oscillation and minimum area of Surge tank with usual notations. [6]

   b) Estimate the minimum length of the concrete apron (So = 0.001) for stilling basin downstream from an overflow spillway. The spillway crest is 15m long and consider a discharge of 115 m3/s. Manning's roughness factor n = 0.025. Assume the stilling basin is the same width as the spillway crest. Assume any other suitable data if necessary. Refer figure below. [10]
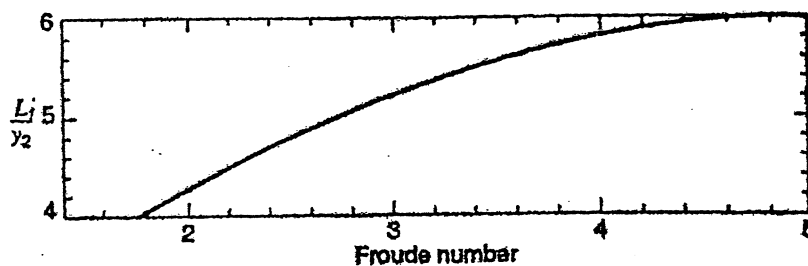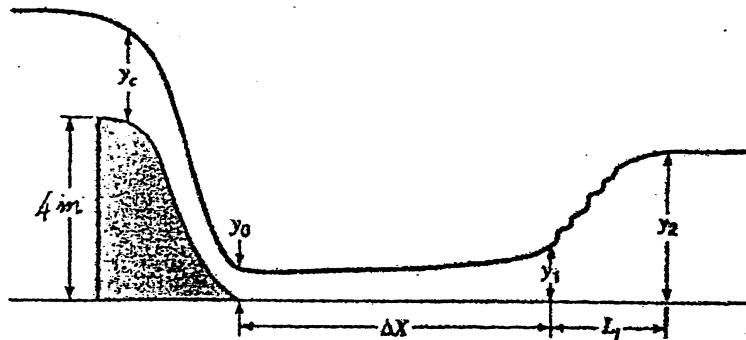
5. a) A Pelton turbine has to be designed for the following data. Power developed = 6867 KW, net head = 350m, Overall efficiency = 80%, Speed = 550 rpm, coefficient of velocity (Kv) = 0.98 and speed ratio (Ku) = 0.46. Ratio of jet dia to wheel dia $\left(\dfrac{d}{D}\right)$=1:12. Find discharge, number of jets, diameter of jet and diameter of wheel. [6]

   b) Name the major institutions involved in hydropower development sector in Nepal. Briefly outline the hydropower development policy of Nepal. [4]

   c) In a hydropower project the available river discharge is 300 m^3/s and the net head is 30 m. If the speed of the turbine is to be 166.7 rpm and the overall efficiency is 88%, determine the number of units required for the turbine cases given below. [3+3]

   (i) Francis turbines with specific speed not exceeding 267 rpm.
   (ii) Kaplan turbines with specific speed not exceeding 650 rpm.

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| Exam.		Back	
Level	BE	Full Marks	80
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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 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/m² and 35° respectively. $\gamma_{con} = 24 KN/m^3$, check the stability of dam against flotation, overturning and sliding. [8]
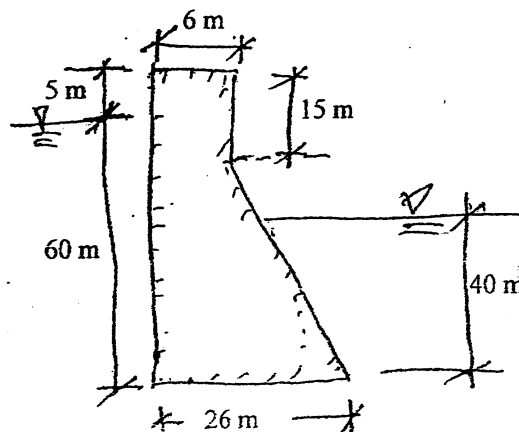
5. a) Design a settling basin for a high head project in a river which utilizes 60 m^3/s discharge and gross head of 300 m. The sediment particle larger than 0.15 mm (fall velocity = 1.5 cm/s) need to be trap in the basin. Consider effect of turbulence as well. [7]

   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 $\sigma_u = 1400$ 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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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/m³ and $\gamma_w = 10$ KN/m³.   [10]
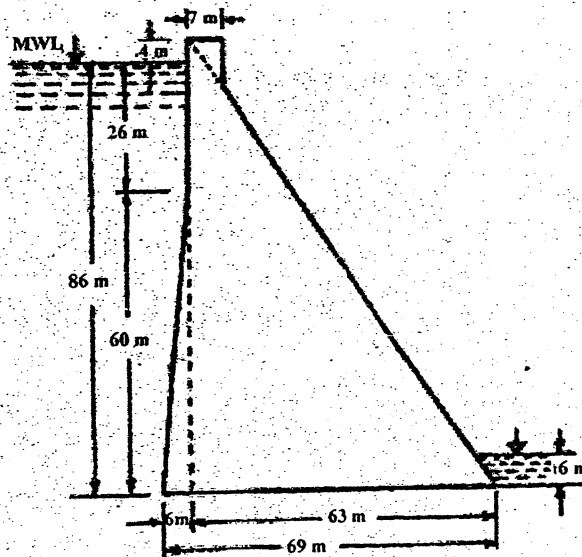
   b) Derive an equation for determining the length of discharge face for an earthen dam without filter. The downstream slope lies between 30° and 60°.   [6]

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 m³/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 m³/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 m³/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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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 m³/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, $W_{total} = 3.0 \times 10^4$ kN. 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/m². [10]

RL 160.0m

RL 140.0m

RL 120.0m

W

18m

RL 100.0m

8m   47m
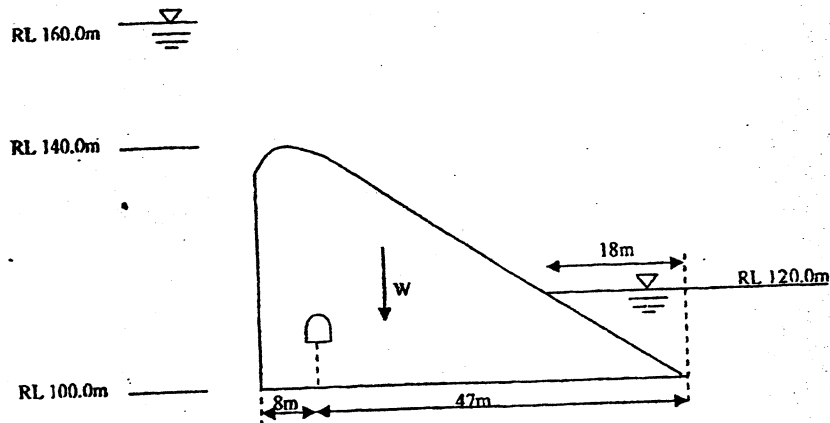
b) Design a hydraulic jump stilling basin for the maximum discharge of $25m^3s^{-1}m^{-1}$ flowing from an overall spillway, with the spillway crest 50m above the downstream. gravel river bed with a slope $S_0 = 0.001$ and $n = 0.028$. [6]

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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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 m³/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/m³, permissible shear stress of joint as 1400 KN/m², 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 60m³/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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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/m³, Assume unit weight of the concrete as 24 kN/m³, allowable compressive stress in foundation and concrete as 2,500 kN/m² and 3,000 kN m², angle of friction between concrete and foundation as 36° and unit shear resistance between foundation and dam as 700 kN/m². [4+4+2]
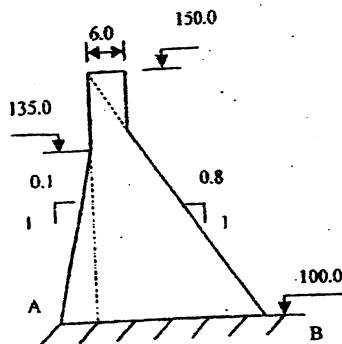
b) Write with neat sketch, expressions for computing seepage and phreatic surface in Earthen dams for two cases; homogeneous and without drain and dam with toe drain. [2+3]

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 m³/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 m³/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 ϕ = 43°. [3+5+3+5]

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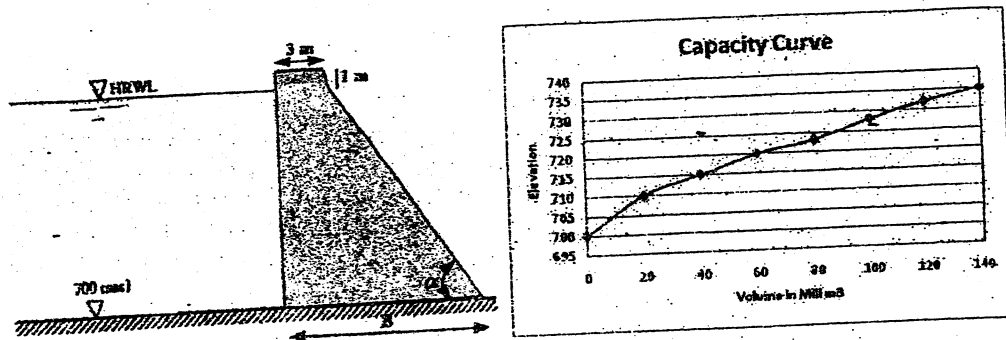
a) Find all main forces acting on the dam when the water level in the reservoir is at HRWL. Give your answer in terms of base width "B".

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 m³/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. [2+2+1+2+1+4]

   Determine:
   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]
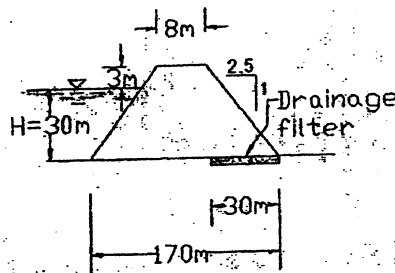
   b) Write the purpose of use of filter material in earthen dam. Explain its design principle. [4]

   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 m³/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 m³/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 m³/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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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 (m³/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/m²
   tan ϕ = 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 m³/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 m³/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:
   Q = 15 m³/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 5m³/s. Take the efficiency of the turbine as 90%. What will be the specific speed of such turbine? [7+1]

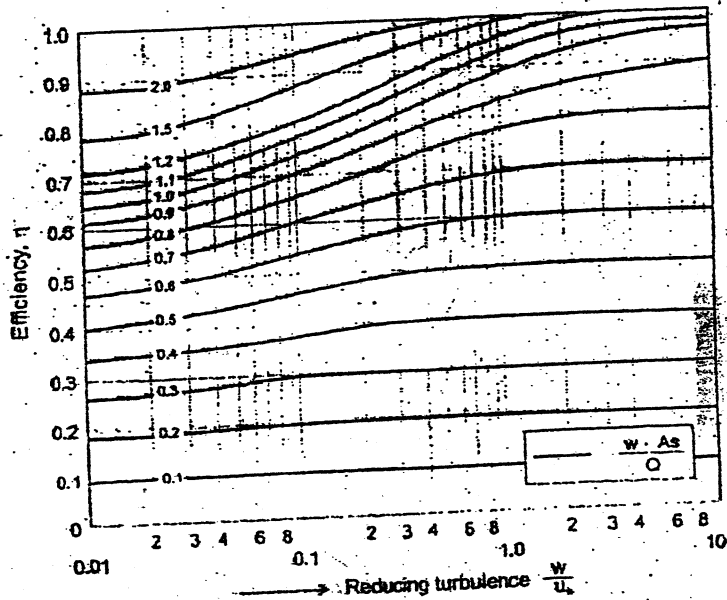8. Describe with sketch different types of power house and their general arrangement. [4]
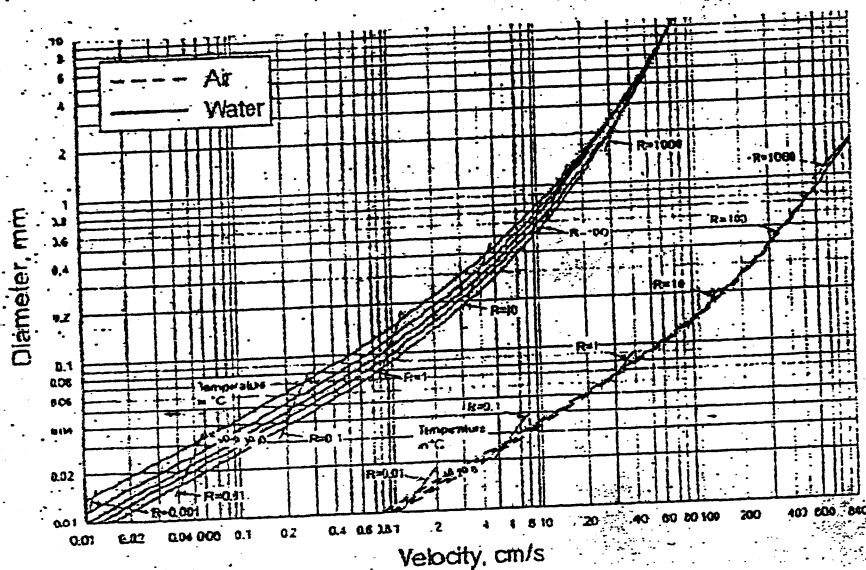

Figure 3: Camps Diagram

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

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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 m³/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 m³/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 m³/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 5m³/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]
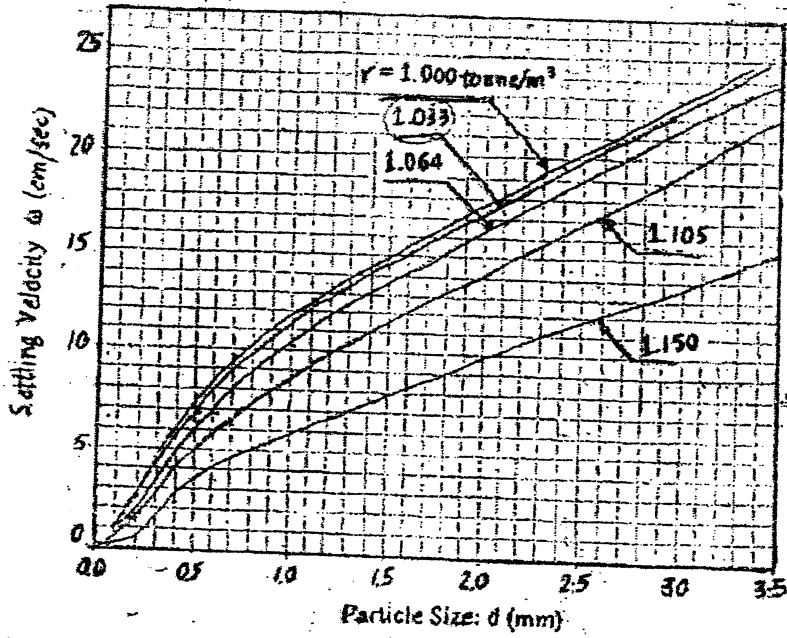
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Fig 1   Settling Velocity in Stagnant Water plotted against the Densi
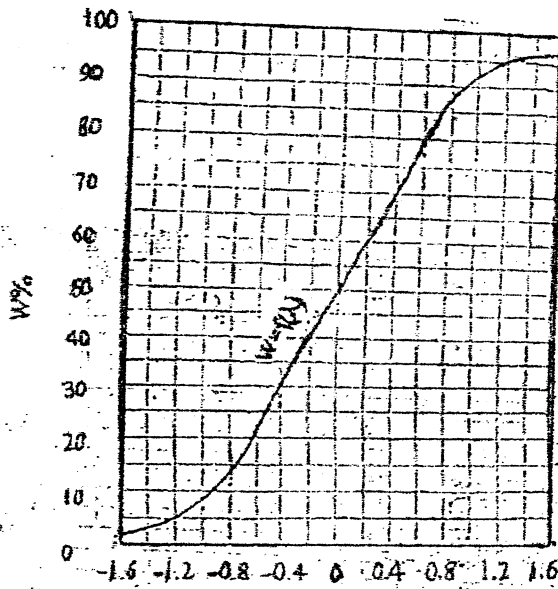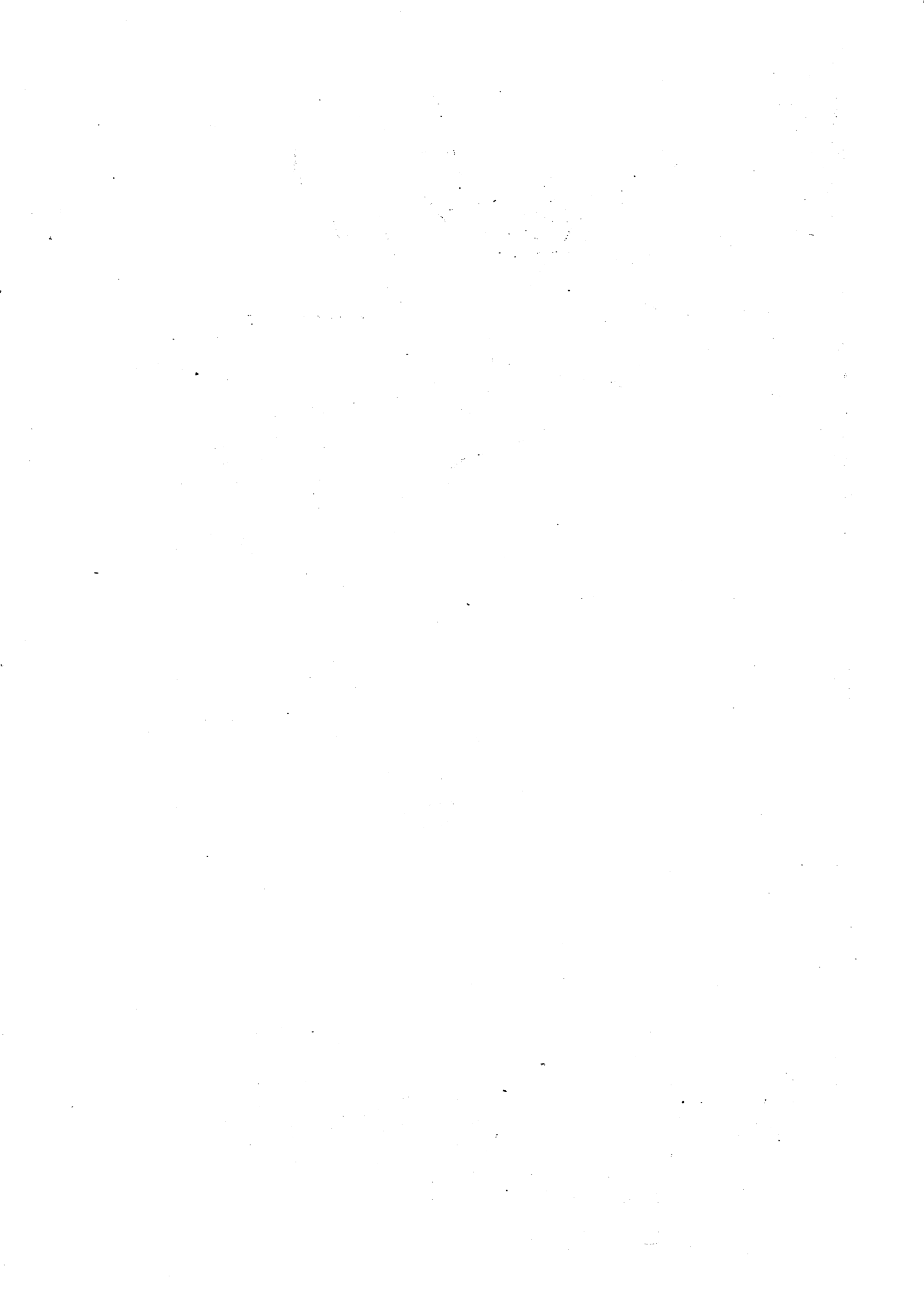of Silty Water and Particle diameter (After L Surdy)

Fig 2   Velikanov's relationship $W = f(\lambda)$ for designing Settling bas

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 m³/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 m³/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/m³. 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 12m³/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 m³/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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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 (m³/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/m³), 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 m³/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 m³/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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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 20012 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 45m³/s and overall efficiency is 82%. [8]

Months	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Q(m³/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 = 5m³/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 m³/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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01   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

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

Subject: - Hydropower Engineering (EG764CE)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any _Five_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ Assume suitable data if necessary.

1. a) Briefly discussing the major sources of electric power generation, highlight the major merits of hydropower over other sources in Nepalese context. [3+3]

    b) Drawing neat sketch (plan and section with all components), discuss the principal characteristics of a peaking run-of-river hydropower plant. [3+3]

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

2. The mean monthly flow of a typical Nepalese river is as follows

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q (m^3/s)	88	76	86	102	140	250	705	1000	610	260	130	100

    a) Draw mass curve showing the time of maximum spillage and deficit time of the year. If the firm flow is to be ensured, what is the capacity of the reservoir required? [4+2]

    b) Compute the installed capacity, firm and secondary energy and plant factor of the power plant based on the following data: [8]

      • Probability of exceedance of flow as 0.30
      • Minimum environmental release as 10%
      • Gross head of plant as 210m
      • Hydraulic, turbine, generator and transformer efficiency as 96%, 93%, 98% and 99% respectively.
      • The outage (forced shutdown) of the plants as 3%

    c) Draw power duration curve showing firm and secondary energy. [2]

3. a) Give a suitable design for a 20m high dam for a site where both clay silt and sand gravel are available in abundance and where foundation is pervious to a depth of 10m, Assume suitable data, Give reasons favoring the suggested design. [10]

    b) A homogenous earthen dam is 21.5m high and has a free board of 1.5m. A flow net was constructed and the following results were noted: [6]

      Number of potential drops = 12
      Number of flow channels = 3

    The dam has a horizontal filter of 15m length at its drawdown end. Calculate the discharge per meter length of the dam if the coefficient of permeability of the dam material is 2.7×10^{-3} cm/s

4. a) How do you determine the wall thickness and size of an embedded penstock? Why optimization of penstock is needed? Explain with mathematical expressions. [6+2]

b) Determine the size of a fore bay for a hydropower project having following data: [8]

Design discharge = 14 m³/s
Diameter of penstock = 1.9m
Velocity in penstock = 5.4m/s
Limiting velocity = 0.2m/s - 0.8m/s
Retention time = 3 mins
Transitional slope = 1 in 5

5. a) A Francis turbine developing 10 MW under a head of 20m has a draft tube with inlet diameter 2.6 m and is placed 1.5m above tail water. If the vacuum gauge connected to the draft tube indicated reading of 5m of water, determine the efficiency of turbine if efficiency of draft tube is 75%. [8]

b) Describe the different methods of energy dissipation below the spillway structure, with sketches. [8]

6. a) Determine (i) minimum number of Francis turbines required for a hydroplant on a stream having 250 cumecs flow and 25m head. The generator is directly coupled to the turbine which has specified speed of 250, efficiency of 85%. The frequency of generation is 50 cycles/s and number of poles used is 20. (ii) What will be the minimum number of Kaplan turbines with a specific speed of 700? [6+2]

b) Design a hydraulic jump stilling basin for a maximum discharge of 40 m³/s flowing from an overflow spillway, with the spillway crest 40m above the downstream gravel river bed with a slope 0.00515 and n = 0.025 [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: - 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 $L_d \leq 1.3\dfrac{M_1}{V_u} + L_0$ 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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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 / 1	Time	3 hrs.

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

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✓ 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 $4.0 KN/m^2$ and partition wall load on slab as $1.0 kN/m^2$. 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/m². Consider the depth of foundation as 1.8m. Take unit weight of earth as 18KN/m³. 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/m² and floor finish 1.5KN/m². 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
2076 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 (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 rectangular RC beam of overall dimensions 300 mm × 500 mm is reinforced with 4-25 mm dia. bars in tension at an effective cover of 50 mm. The beam is simply supported over an effective span of 5m. Calculate the total uniformly distributed load the beam can carry inclusive of its self weight. Use working stress method of design. Adopt M20 concrete and Fe415 grade (TOR) steel. [8]

    b) A T-beam of effective flange width of 1600 mm, depth of flange 110 mm, breadth of web 300 mm and overall depth 460 mm is reinforced with 4-20 mm bars in tension at an effective cover of 40 mm. Determine the moment of resistance of the section using M20 grade concrete and Fe415 grade steel in Limit state method of design. [8]

2. a) Derive the formula $L_d \leq 1.3 \dfrac{M_1}{V} + L_0$, where the symbols have their usual meanings. [6]

    b) Design an isolated footing to carrying an axial factored load of 1600 kN. The column is 400 mm by 400 mm in size with 20 mm dia longitudinal bars. The bearing capacity of soil is 180 kN/m². For footing, adopt M20 grade concrete and 415 grade HSD bars. Check for shear is necessary. [10]

3. Design a slab for a room of size 5 m × 4 m for a live load of 4 kN/m² and floor finish of 1.2 kN/m². The slab is supported on 250 mm thick brick masonry walls with two adjacent edges discontinuous. Use M20 grade concrete and Fe415 grade bars. Carry out all checks required for the slab design. Sketch the reinforcement detailing plan and sectional view. Also sketch the torsional reinforcement if required. [16]

4. a) Determine the longitudinal and transverse reinforcements in a short RC column subjected to factored axial load of 1400 kN and factored moment M_{ux} of 200 kN-m and M_{uy} of 110 kNm. The size of the column is 300 mm × 400 mm and unsupported length of 3m. Adopt M20 concrete and Fe500 grade (TMT) bars. Also, do the ductile detailing of transverse reinforcements. [12]

    b) Define development length. Why splices are required in RCC structure. [4]

5. a) Explain how a RC structural member subjected to bending, shear and torsion is designed by IS code method. [5]

    b) Write down the provisions of ductile detailing for columns with neat sketches. [6]

    c) Describe methods of controlling deflection and crack width in RCC structures. Describe the empirical formula for calculating the design surface crack width. [3+2]

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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/m² and superimposed load of 1.20 kN/m². 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/m². 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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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 $L_d \leq 1.3\dfrac{M_1}{V_u}+L_0$ 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/m² and live load of 4.0 KN/m². 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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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 $L_d \leq 1.3 \frac{M_1}{V} + L_o$, 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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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/m², 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/m². Use M20 concrete and Fe415 grade steel. Unit weight of soil above footing base = 18 kN/m³. 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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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/m². 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/m² 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/m³. Note that the moment is reversible sketch the detail.   [14]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / 1	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]
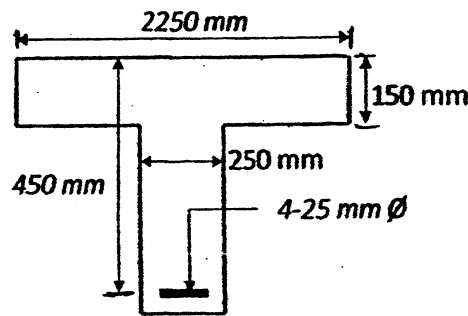
2. a) Design and detail an interior pannel of a slab resting on RCC beams on all sides for a room having clear dimensions of 4.5m*6.5m. The slab is subjected to a super-imposed live load of 4KN/m² and floor finishes load of 2.5 KN/m². Take M20 concrete and Fe415 steel. [15]

   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/m² 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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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]
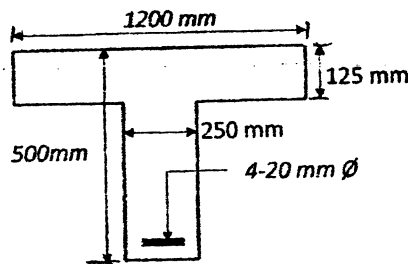
   b) A simply supported RCC beam of effective span 5.5 meter and overall dimensions 230mm×550mm is subjected to superimposed load of 50 KN/m excluding its self weight. Design the beam for limit state of collapse in flexure. Also check whether the beam is safe in deflection or not. Adopt mild exposure condition 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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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 $L_d \leq \dfrac{M_1}{V} + L_0$, 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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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 $L_d = \dfrac{0.87f_y\phi}{4\tau_{bd}}$ and $L_d = 1.3\dfrac{Ml}{V_u} + ld$ where symbols have their usual meanings.

   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/m². 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/mm² and σ_{st} = 140 N/mm². [6]
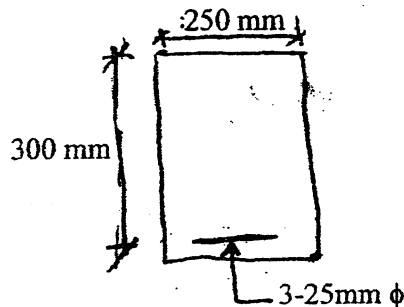
4. a) An isolated reinforced concrete footing has to transfer a service load of 800 KN from a square column of 300 × 300 mm. Consider concrete grade M20, Torsteel and soil bearing capacity 180 KN/m². Design the isolated footing and draw neat sketch of footing showing all reinforcements. [12]

   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
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/m² and floor finish of 1 KN/m² 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/m². Consider depth of foundation as 1.70 m. Take unit weight of soil as 18.5 KN/m³. 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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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.*
✓ *Assume missing data if necessary possibly complying to IS: 456-2000.*
✓ *Use of IS: 456-2000, IS: 1343 and SP-16 are allowed. But, use of SP-16 is allowed only for column design.*

1. a) Explain, in brief the types of load which is generally occurred in reinforced cement concrete structure design. [6]

   b) A reinforced concrete beam section of 300 mm width and 700 mm effective depth is reinforced with 3 bars of 20 mm as shown in figure below. Determine the moment of resistance and the maximum stresses induced in the materials. Take M20 concrete and Tor-steel. [14]

section at 1-1
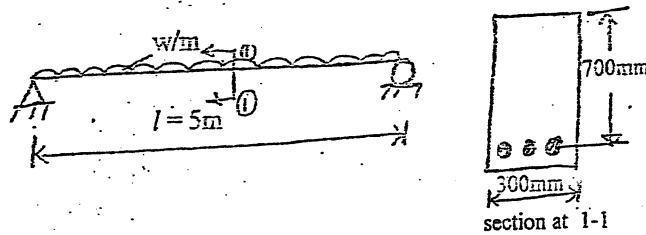
   *If the effective span is 5 m, also find the safe load, the beam will carry during service period. Use working stress method.

2. a) What do you understand by balanced section, under reinforced and over reinforced sections? Explain with neat sketch. [6]

   b) A cantilever beam 5 m span has to carry a superimposed load 5 kN/m. The beam has a constant cross section of 300 mm × 550 mm through the length. Determine the tension reinforcement if mild steel bars are to be used. Consider limit state design method. [14]

3. a) Why splices are required in RCC construction? [4]

   b) Design a column section with lateralties to carry an ultimate axial load of 2250 kN, and factored design moments of 150 kNm and 100 kNm about major and minor axes respectively. One of the dimensions of the column section is restricted to 300 mm. The materials to be used are: Concrete of grade M 25 and HYSD steel bars of grade Fe 415. Consider effective cover of 50 mm. [16]

4. a) A continuous one way slab consists of three equal spans of effective length 4 m each. The slab depth is assumed to be 110 mm. Take dead load as 3 kN/m² and imposed load 3 kN/m². Design critical section of slab for BM and sketch the slab reinforcement details. Take M20 grade concrete and Fe 415 grade of steel. [10]
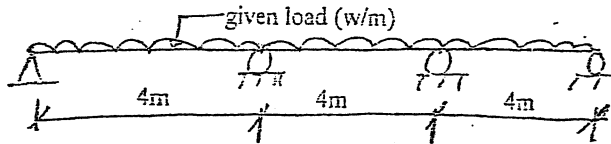
Consider the self weight of slab also.

b) Find the thickness of an isolated footing for a rectangular column 35 cm × 45 cm carrying an axial load of 1200 kN. The net bearing capacity the soil is 110 kN/m². Take M20 concrete and Fe 415 steel. [10]

5. a) Explain different types of torsion in a RC structure. [6]

b) A simply supported reinforced concrete beam of span 16 m, 250 mm wide and over-all depth 550 mm is pre-stressed using a cable with cross sectional area of 250 mm². The cable profile is parabolic with an eccentricity of 75 mm above the centroid of the section at the end supports and 80 mm below the mid-span. If the cable is tensioned from one end only, estimate the percentage loss of pre-stress in the cable due to the effects of friction. Assume required constants suitably. [10]

c) Explain pre-stressing system with neat sketch. [4]

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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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| 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) Explain different types of design methods used in Reinforced concrete structure design. [6]

   b) A column of 4 m length with both ends fixed and effectively held in position is subjected to a design axial load of 1000 KN and factored bending moment of 100 KN-m. Design the rectangular column with its longitudinal and transverse reinforcements. [14]

2. a) A floor consists of 125 mm thick RC slab integrally connected with the beam as shown in figure below. Design an intermediate beam for BM and deflection if the floor is subjected to live load of 4 KN/m² and floor finishes of 0.5 KN/m². [10]
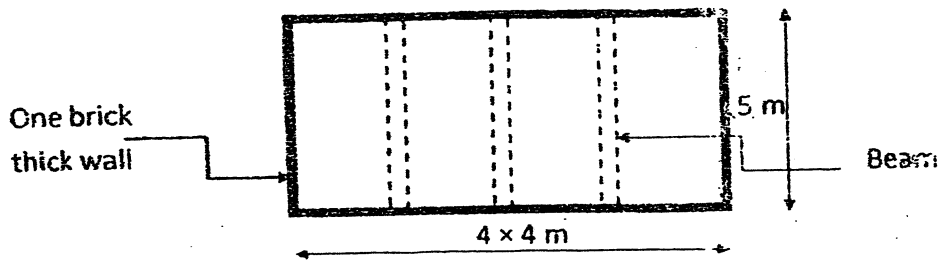
   b) Find the shear resisting capacity of a rectangular beam of 300 mm × 500 mm at the section of bent up bar. Angle of inclination of bent up bar is 45°. Consider M20 and Fe415 grade of concrete and steel. [10]
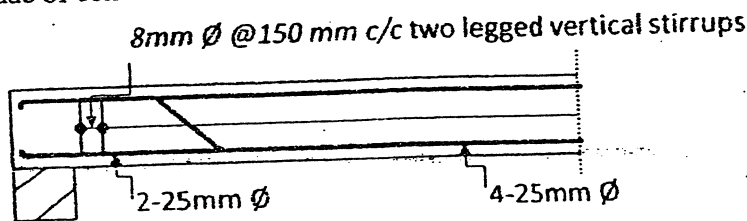
3. a) Explain in details all design steps of R.C.C mat foundation design. [6]

   b) RC slab of the floor of a residential building is subjected to live load of 3 KN/m² and floor finishes of 1 KN/m². Design the slab panel 2 for BM and SF. Draw neat sketches of slab showing top and bottom arrangements of reinforcing bars. [14]
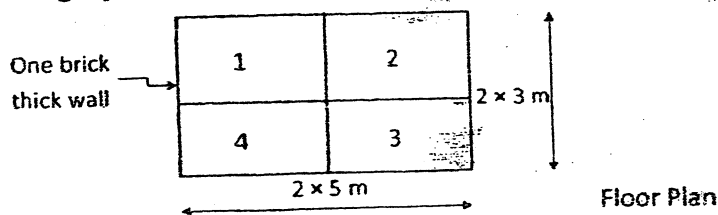
4. a) Design the isolated footing of a column of 350 mm × 500 mm. Column is subjected to design axial load of 2000 KN and design BM of 80 KN-m. Allowable bearing capacity of soil is equal to 175 KN/m². [14]

   b) What are the ductility requirement for beam, column and joints of R.C.C structures? [6]

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01   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

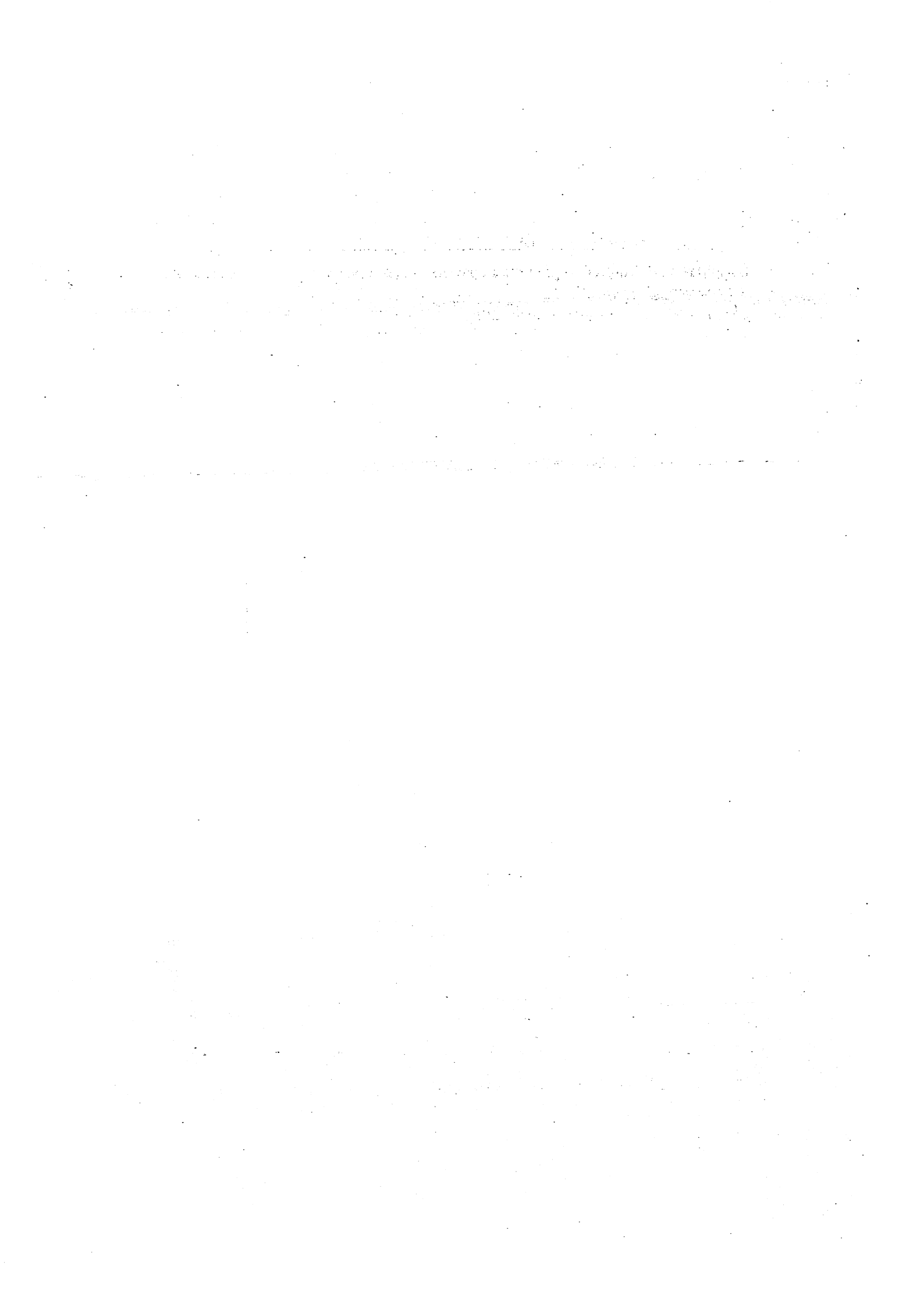| Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / 1	Time	3 hrs.

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**.
✓ Use of IS 456, IS 1343 are allowed. IS 456 - SP 16 is allowed for column design only.
✓ Assume suitable data if necessary.

1. a) Discuss in detail the prestressed concrete versus reinforced concrete. Also discuss the different types of loads and their combinations to be considered in the design of reinforced concrete structures. [5]

   b) A rectangular beam is 250mm wide and 500mm deep upto the centre of reinforcement. Find the reinforcement required if it has to resist a moment of 30 KN-m. Assume that permissible stresses for M15 grade concrete mix and mild steel grade I have been used. [15]

2. a) Show that $L_d \leq 1.3\dfrac{M_1}{V_u} + L_o$. Where symbols have their usual meanings. [5]

   b) A dog-legged staircase is to be provided for a building. The vertical distance between floors is 3.3m. The space available is 2.5m × 5m. Design a stair flight and a landing for a live load of 3 KN/m². Also sketch the reinforcement detailing. Use M15 grade concrete and Fe415 grade steel in limit state design. [15]

3. a) What do you understand by development length and splicing of reinforcing bars? Draw details of various beam column connections in RC structures. [5]

   b) Design a foundation to carry a column load of 1000 kN from 400 × 500mm rectangular column with the 25mm diameter longitudinal steel. The bearing capacity of soil is 200 kN/m². Consider depth of foundation as 2.0m. Take unit weight of earth is 18 kN/m³. Use M20 grade concrete and Fe415 steel. [15]

4. a) Write down the steps to design a beam for torsion. [5]

   b) Design a slab for a room of size 4.5m × 3.5m for a live load of 5 KN/m². The edges are simply supported but corners held down. Use M15 grade concrete mix and Fe415 grade steel. Also, draw the top and bottom reinforcement detailings with their sections. (Adopt Limit State Method of Design) [15]

5. a) Discuss the salient features of working stress design method. Also, explain balanced, under-reinforced and over-reinforced sections using stress-distribution diagram in working stress method of design. [5]

   b) Determine the reinforcement in biaxialy loaded column with the following parameters: 400 × 600 [15]
   Size of column = 400mm × 600mm
   Factored load, Pu = 2500 kN
   Factored moment, Mux = 250 kNm
   Factored moment, Muy = 100 kNm
   M25 concrete and Fe415 steel

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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: - 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. 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 m² 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.
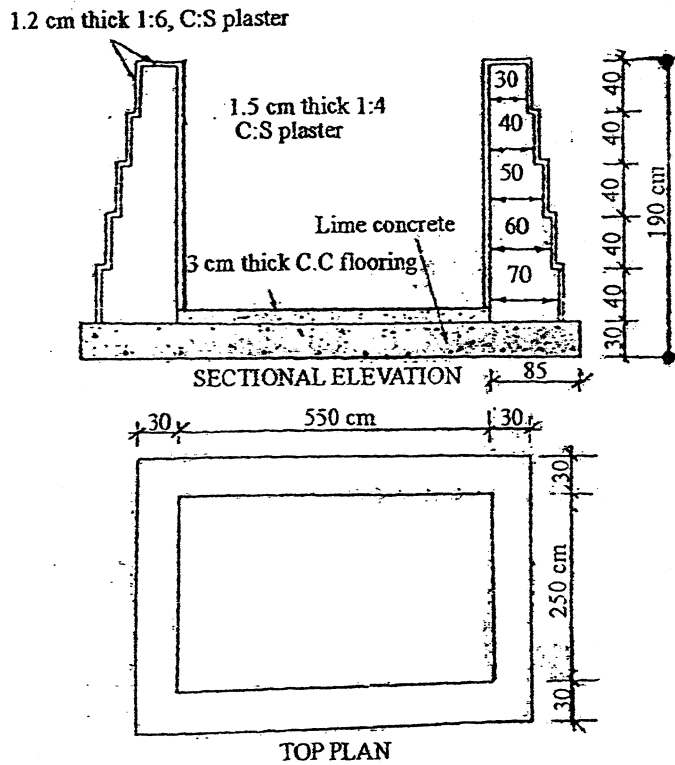   c) Sand filling.
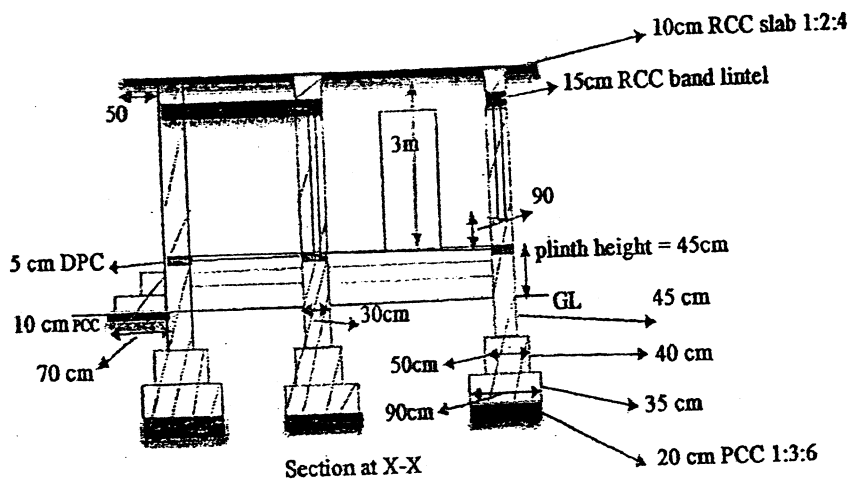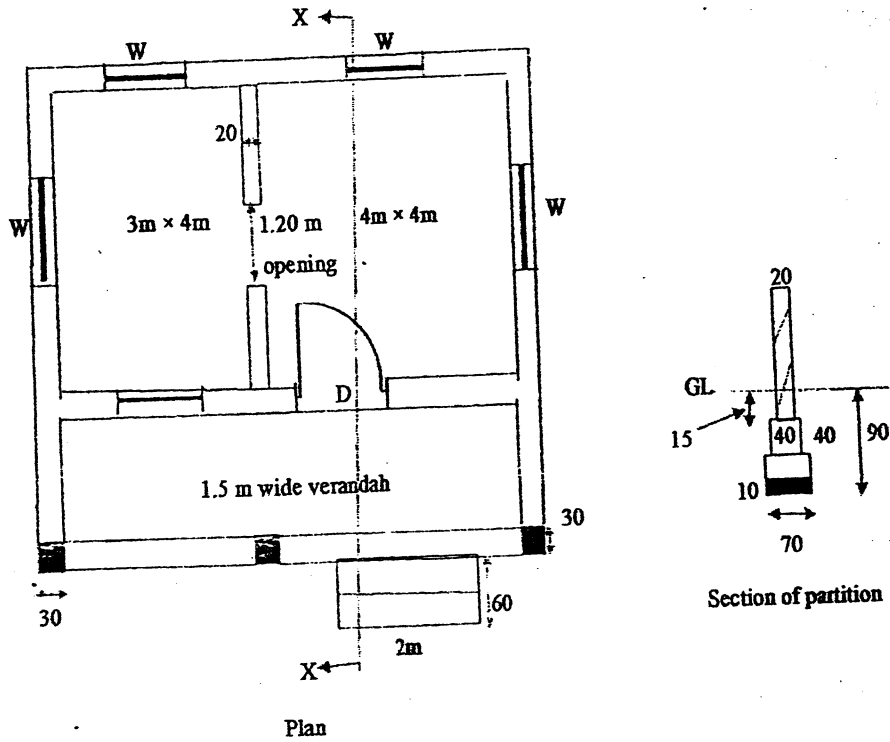   d) PCC for RCC in well cover.

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Fig: Underground Water tank

INSTITUTE OF ENGINEERING

Examination Control Division

2079 Baishakh

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. Define estimate and explain the necessary things required for estimating.   [1+

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. What are different methods of preparing approximate estimate? In what case do you need to prepare supplementary and approximate estimate, explain with an example.   [

4. Explain the purpose of rate analysis for a project. How the government prepare their rate analysis?   [3+

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.   [

6. Prepare analysis of rates for providing and laying of 20 mm thick premix asphalt concrete road per 275 sq.m area.   [

7. Why project reporting is important? Give the major outlines of project report. Discuss estimate of water supply project.   [2+2+

8. Calculate the following items of works from the attached drawing of building Figure 1.   [5×

   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.

***

Plan

Section of partition

10cm RCC slab 1:2:4

15cm RCC band lintel

3m

plinth height = 45cm

5 cm DPC

10 cm PCC

70 cm

50

90

GL   45 cm

30cm

50cm   40 cm

90cm   35 cm

20 cm PCC 1:3:6

Section at X-X

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

Figure 1
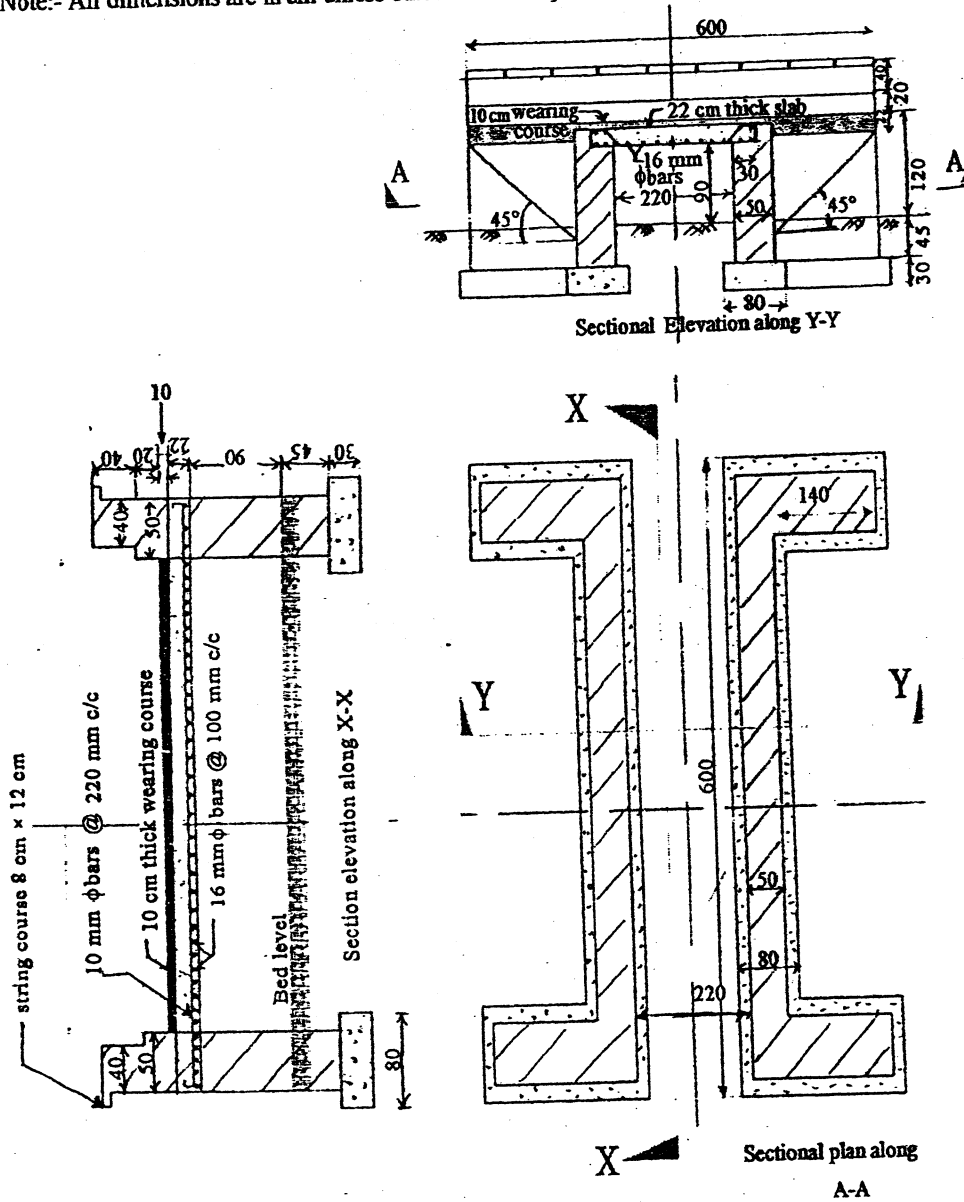
[Note:- All dimensions are in cm unless otherwise stated]

Sectional Elevation along Y-Y

Section elevation along X-X

Sectional plan along
A-A

Figure 2

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: - 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. Explain that estimated cost is never the actual cost. What are the data required for estimating? [3+

2. What are the various methods of taking out quantities of civil engineering? Explain briefly. State the different factors considered during detailed estimation. [4+

3. Prepare a preliminary estimate of the four storied office building having carpet area of 250m² 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. [

4. What are the requirements for rate analysis? Explain the factors affecting the rate analysis. [4+

5. Prepare an analysis of rate for sal wood doors and windows frame per m³. [

6. Prepare the analysis of rates one metric ton of reinforcement. Labor norms per MT skilled 12 no/m³/day, unskilled 12 no/m³/day. Assume suitable rates. [

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+

8. Prepare detailed estimate of the item of work form the building drawing (figure 1) attached herewith: [4×
   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: [1
   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+
    (i) RCC 1:2:4 in column
    (ii) Steel reinforcement work excluding formwork

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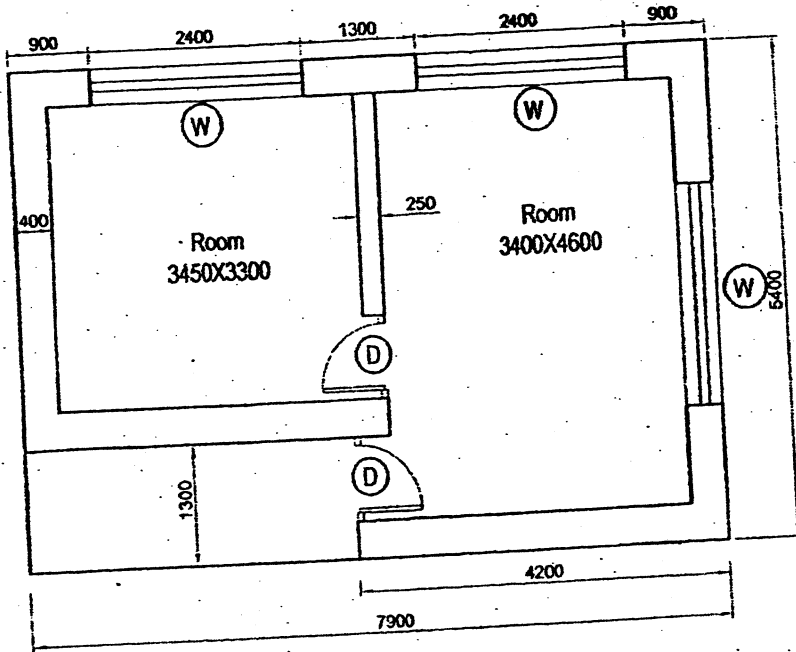
PLAN
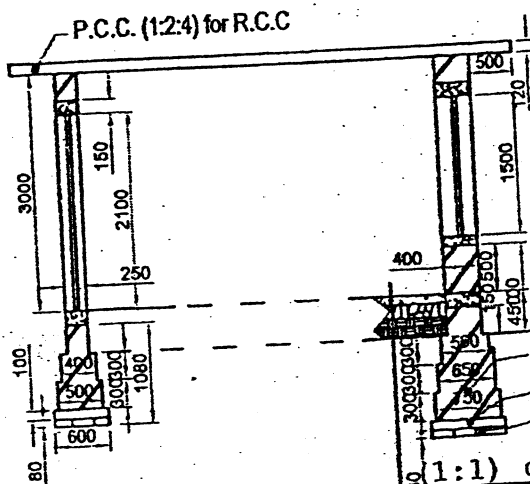
OPENINGS
D = 900X2100
W = 2400X1500

P.C.C. (1:2:4) for R.C.C

Brick work in (1:6) CM
p.c.c.(1:3:6)
Flat brick soling
(1:1) cement punning
100 Th.(1:3:6) P.C.C
150 Stone Soling
Rest Rammed Earth

SECTION OF
0.25m, WALL

SECTION OF
0.40m, WALL
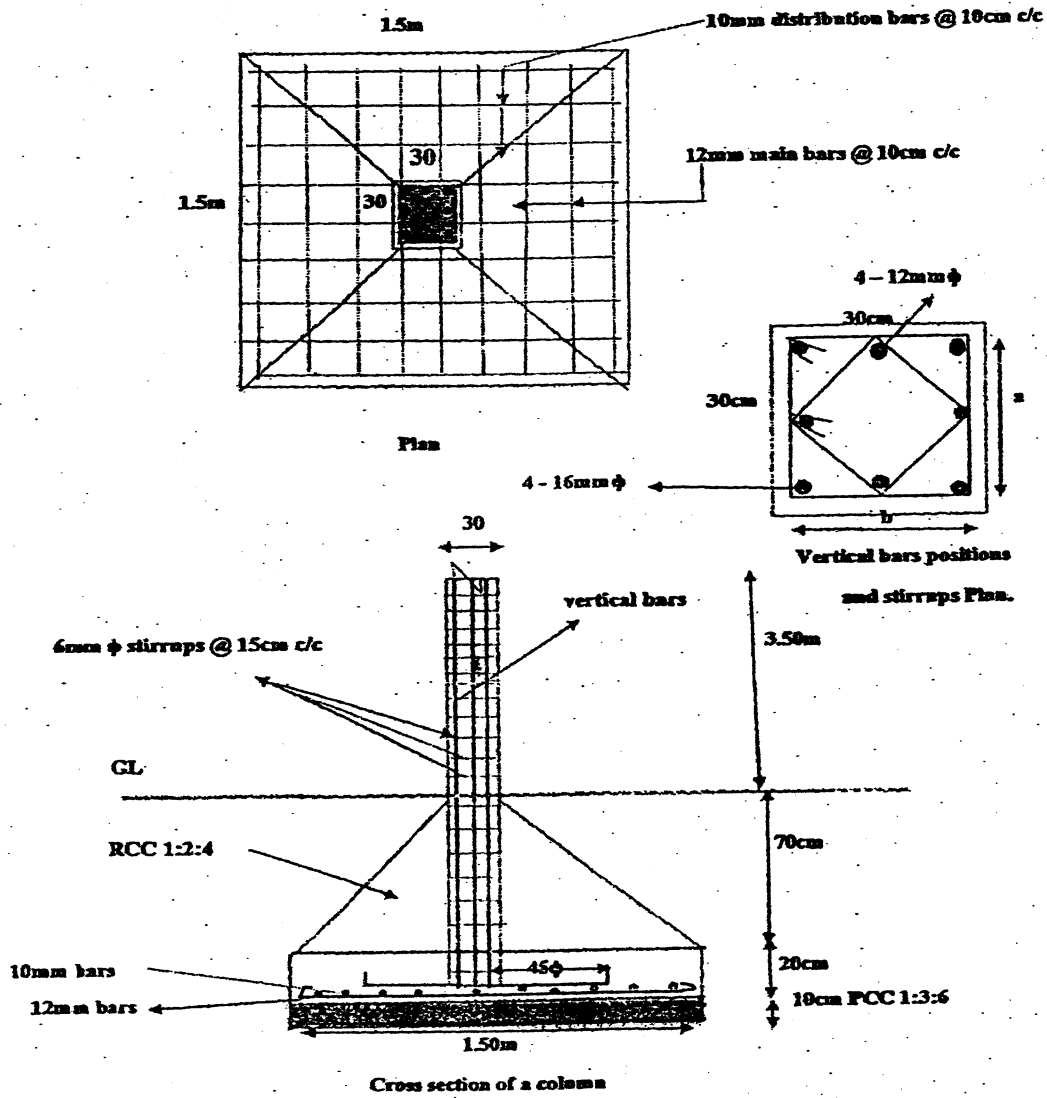
Fig-1
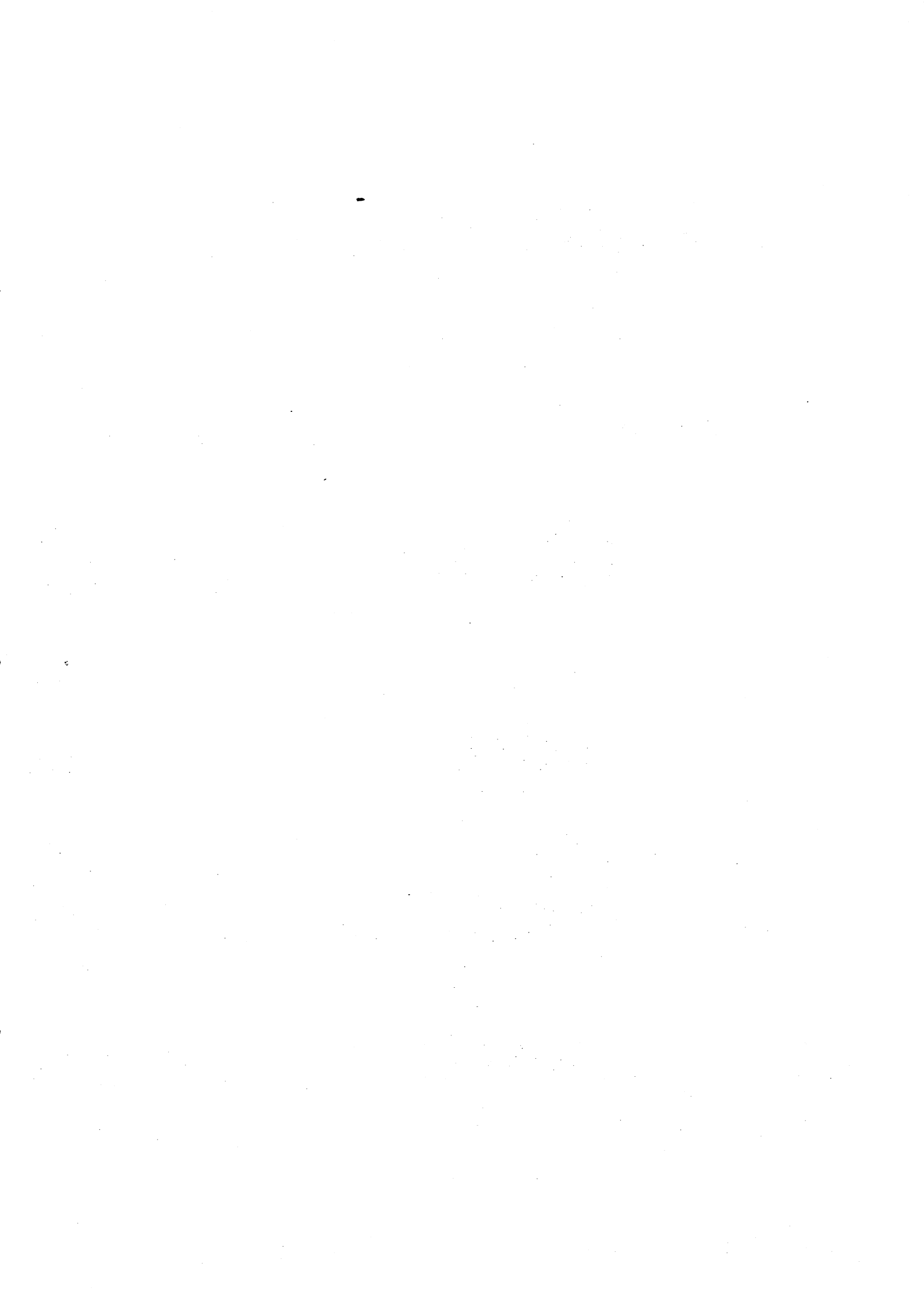
1.5m

10mm distribution bars @ 10cm c/c

12mm main bars @ 10cm c/c

1.5m

30

30

Plan

4 – 12mmφ

30cm

30cm

a

4 – 16mmφ

b

Vertical bars positions
and stirrups Plan.

30

vertical bars

3.50m

6mm φ stirrups @ 15cm c/c

GL

RCC 1:2:4

70cm

10mm bars

12mm bars

45φ

20cm

10cm PCC 1:3:6

1.50m

Cross section of a column

Figure 2

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 / 1	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	
1000	1314.90	1316.00 .
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

SECTION

REINFORCEMENT -
BEAM   — 2½%
SLAB AND POSTS 1%

***

18 SCREED OVER 2 LAYER OF TARFELT.

SECTION THROUGH X-X'

3 cement sand (1:1) punning
over 36 cement concrete (1:2:4)
75 thick brick bats soiling
150 sand filling

DPC
Bk Wk in 1:6 C.S.

P.L.
G.L.

PLAN

All dimension are in mm.
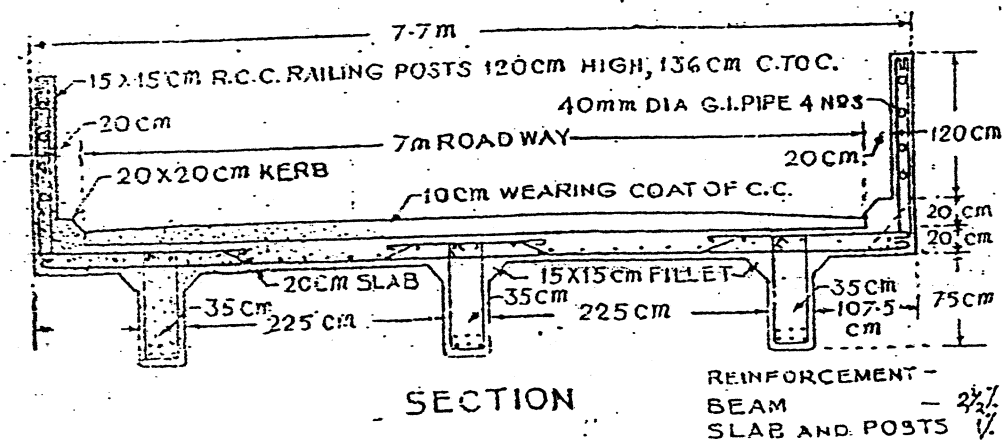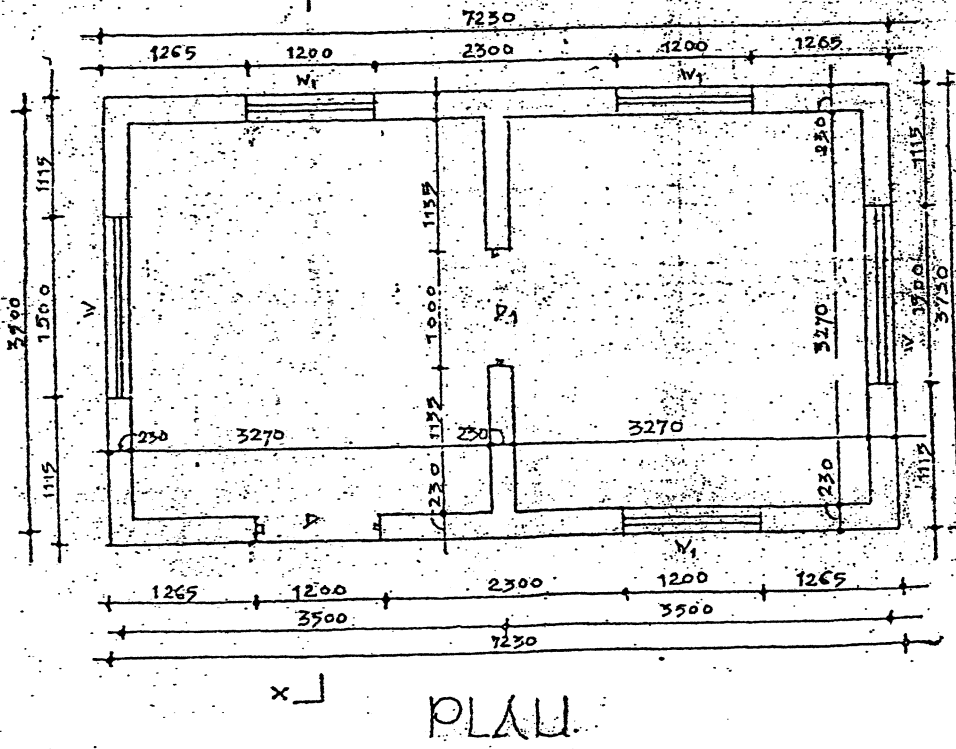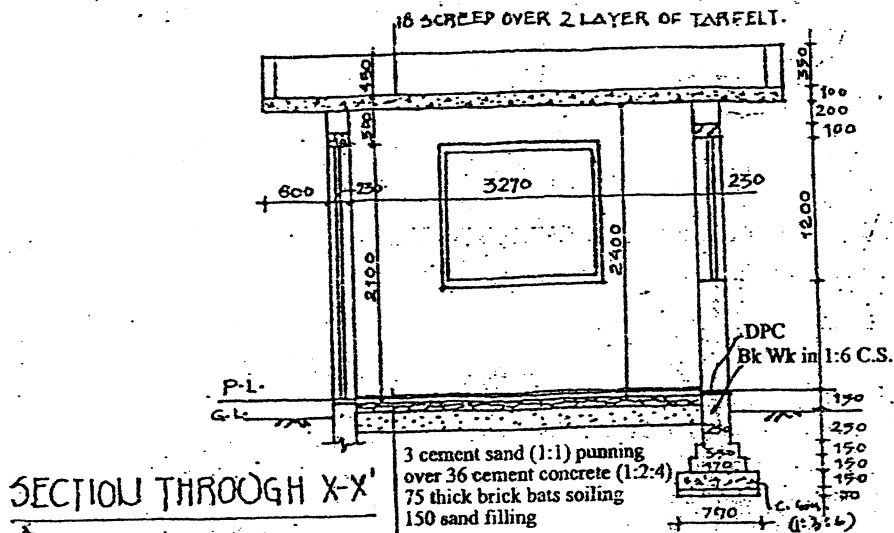
Doors and Windows Schedule
D - 1200 × 2100
D₁-1000 × 2100
W - 1500 × 1200
W₁- 1200 × 1200

Figure 1

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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 <u>building drawings</u>: [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 <u>RCC Slab Culvert</u> drawings: [10]

   a) Earthwork in excavation in foundation
   b) PCC (1:3:6) in foundation
   c) PCC (1:2:4) for RCC slab

***

Plan (a)

Doors : D = 1.20 × 2.10
Windows : W = 1.00 × 1.50
Shelves : S = 1.00 × 1.50

7.5 cm Lime Concrete

15 cm R.C.C. Slab

2.5 cm Cement Conc.
1 : 2 : 4

10 cm Cement
Conc. 1 : 5 : 10

2.5 cm D.P.C. 1 : 2 : 4
Cement conc.

G.L.

Sand Filling
10 cm
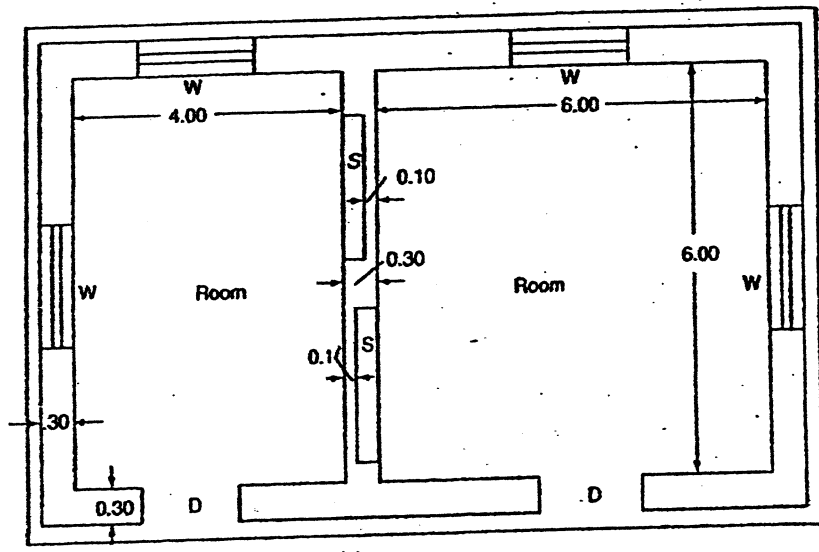
Lime Concrete
1 : 7 : 20
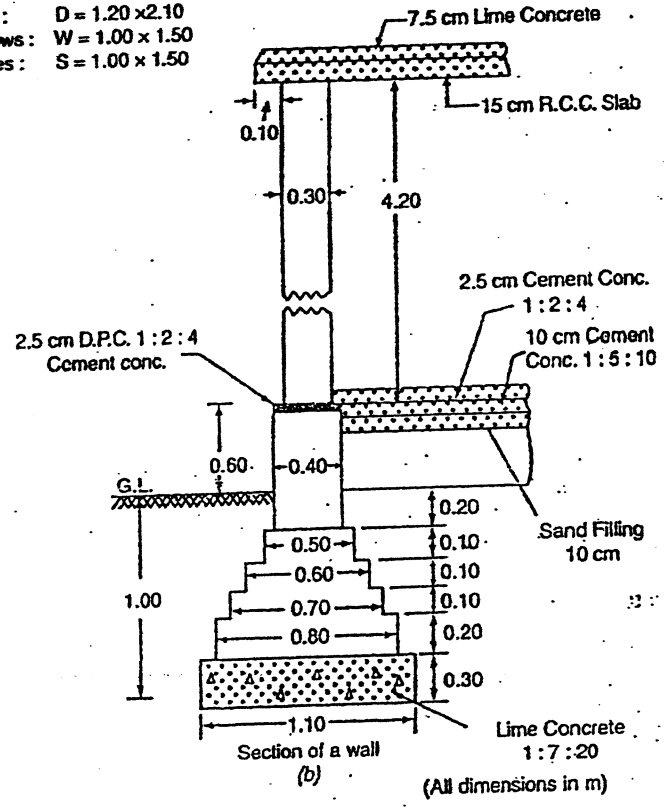
Section of a wall
(b)

(All dimensions in m)

R.C.C. SLAB CULVERT 1.50 m SPAN with standard modular bricks

HALF SECTIONAL ELEVATION ON ABCD

HALF LONGITUDINAL SECTION ON CBEF

SECTIONAL PLAN

TOP PLAN

HALF SECTIONAL PLAN

Fig.

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Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
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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.
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✓ 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	

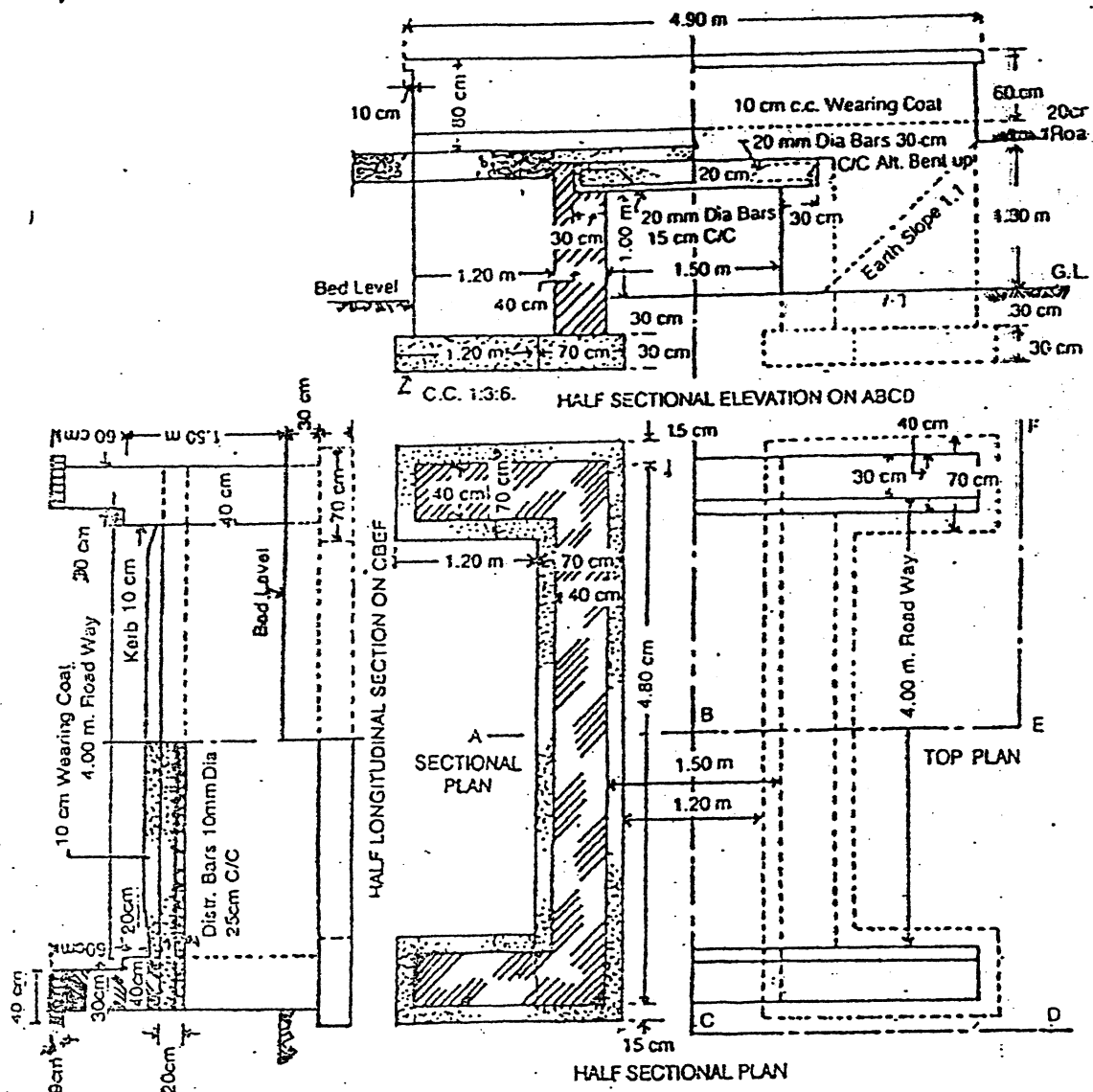9. Prepare detailed estimate of the following items of work for a building from the attached Fig.1. [4×3]

   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]
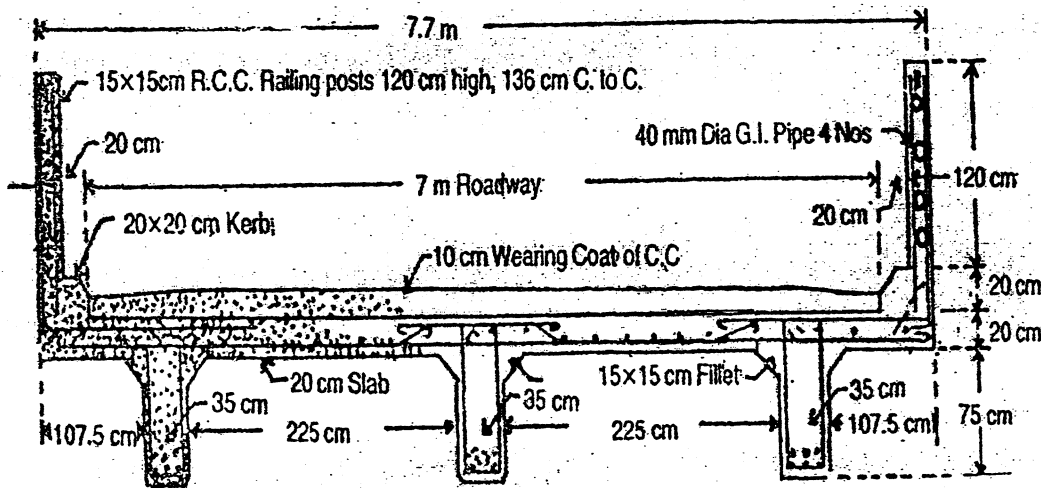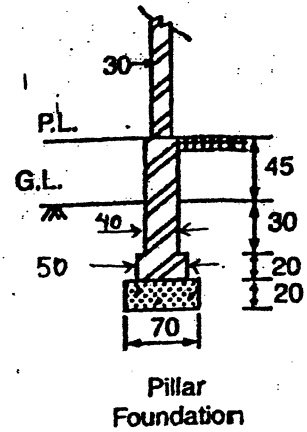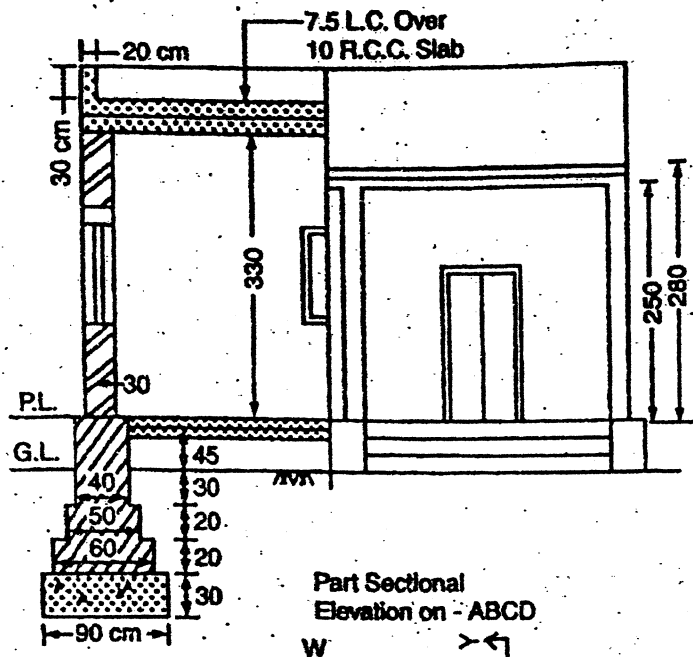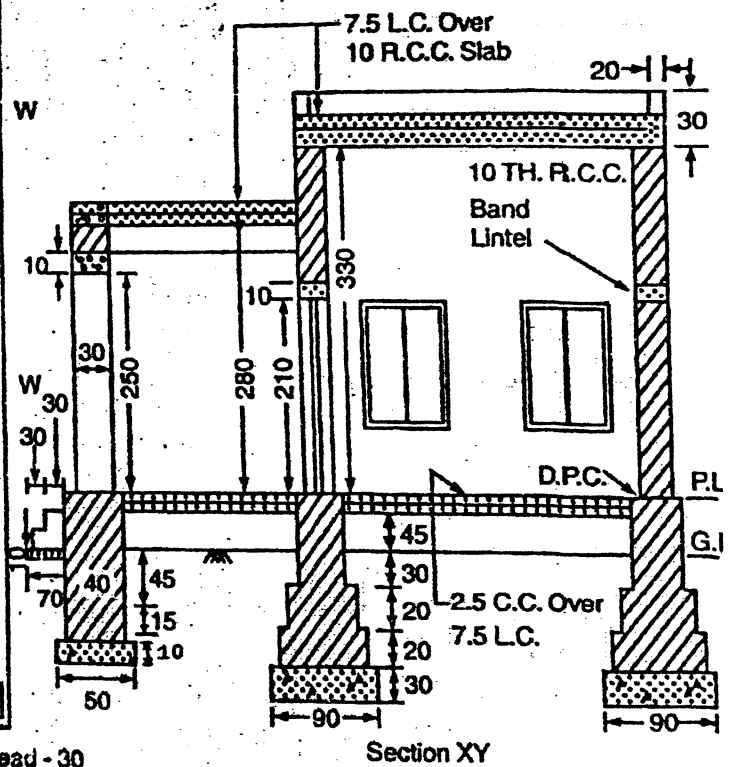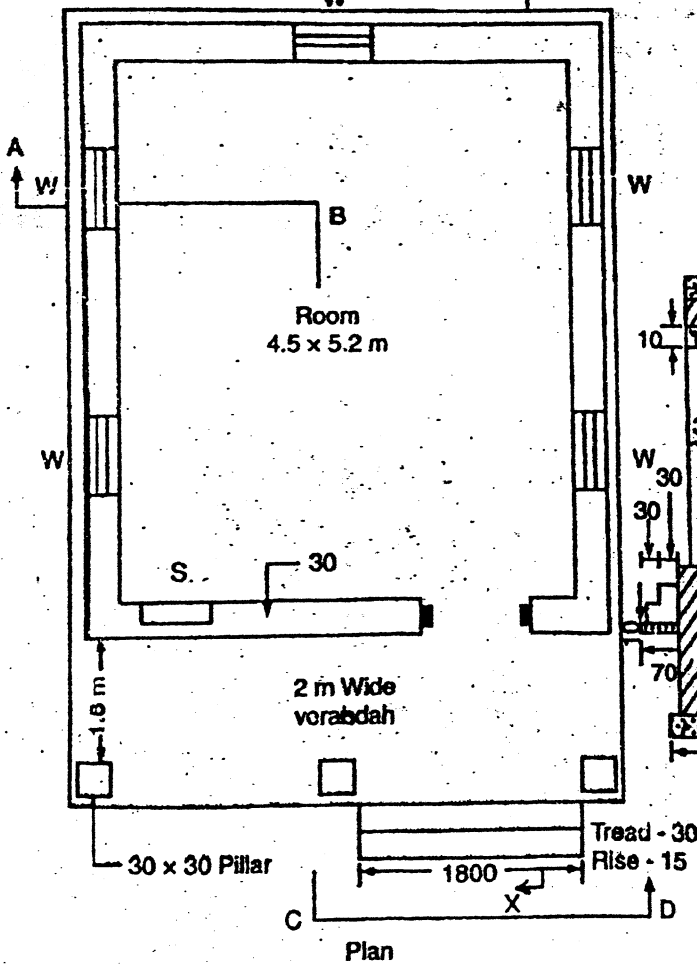
***

Part Sectional Elevation on - ABCD

7.5 L.C. Over 10 R.C.C. Slab

20 cm
30 cm
330
280
250
30
P.L.
G.L.
45
40
30
50
20
60
20
30
90 cm

Pillar Foundation

30
P.L.
G.L.
45
40
30
50
20
20
70

Schedule

Door   D = 110 × 210
Window   W = 90 × 150
Shelf   S = 90 × 150

Plan

W

A

W

B

Room
4.5 × 5.2 m

W

W

S.

30

1.8 m

2 m Wide
verandah

30 × 30 Pillar

Tread - 30
Rise - 15

1800

X

C   D

Section XY

7.5 L.C. Over
10 R.C.C. Slab

20

30

10 TH. R.C.C.
Band
Lintel

10

10

30

330

280

250

210

30

30

W

30

D.P.C.
P.L
G.I

45
30
20
20
30

2.5 C.C. Over
7.5 L.C.

70
40
45
15
10

50

90

90

(All dimensions in cm
except, otherwise mentioned)

Fig - 1

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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.**
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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]

***

SLAB CULVERT
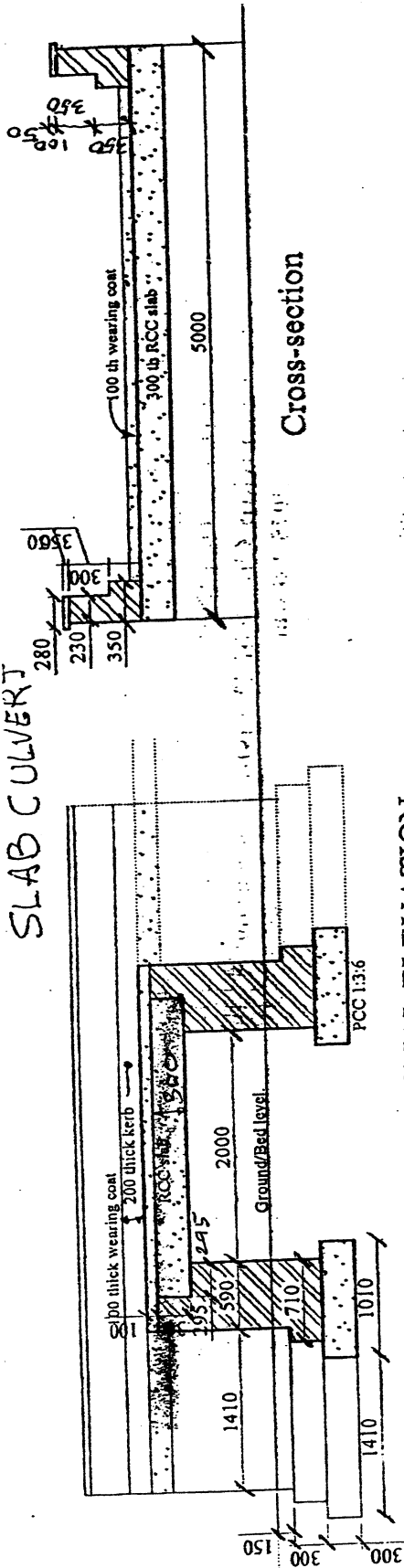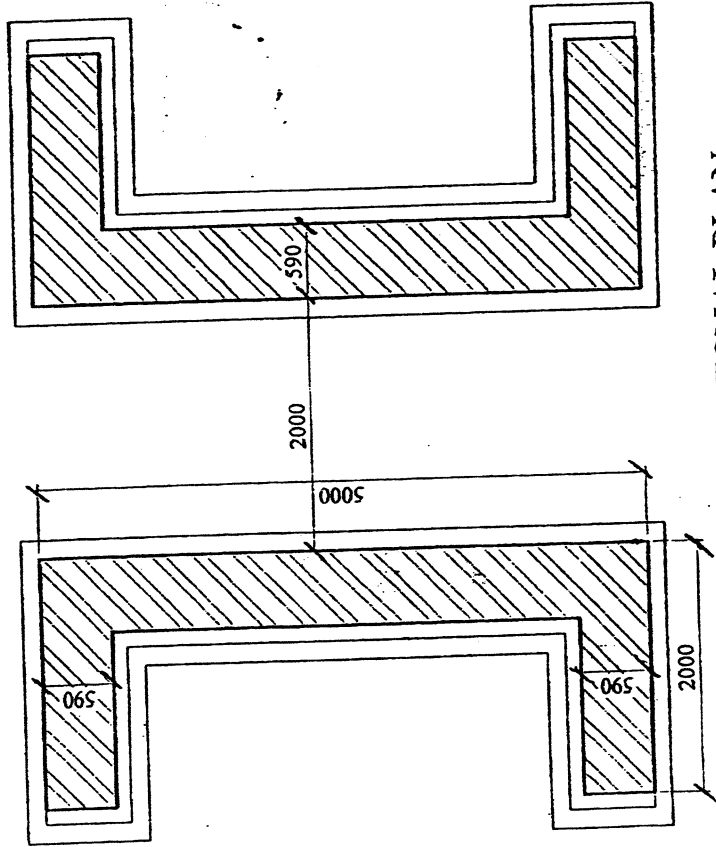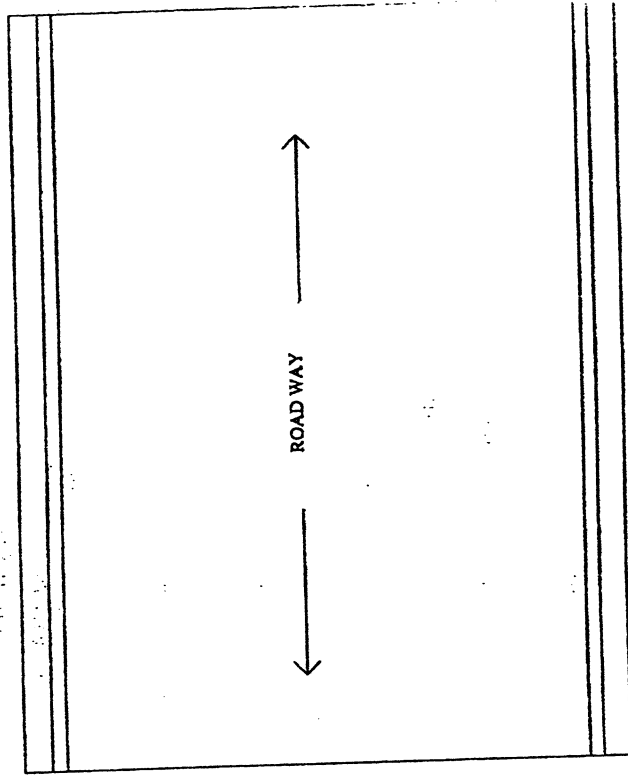
Cross-section

100 th wearing coat
300 th RCC slab
5000
350
280
230
350
3560
100
350
350

SECTIONAL ELEVATION

100 thick wearing coat
200 thick kerb
RCC slab
PCC 1:3:6
Ground/Bed level
2000
590
710
1010
1410
1410
1410
300
300
150

SECTIONAL PLAN

590
2000
5000
590
2000

PLAN

ROAD WAY

Fig:2

BUILDING

SECTION

PLAN

ROOM B

ROOM A

ENT

W₁ W₂ D₁ D₂

Foundation

3mm cement punning 1:1
40mm screed 1:4
75mm PCC 1:2:4
150mm sand filling
Earth filling

350 thick wall

230 thick wall

Fig: 1

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

Subject: - Estimating and Costing (CE705)

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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]

***

Two Room Building
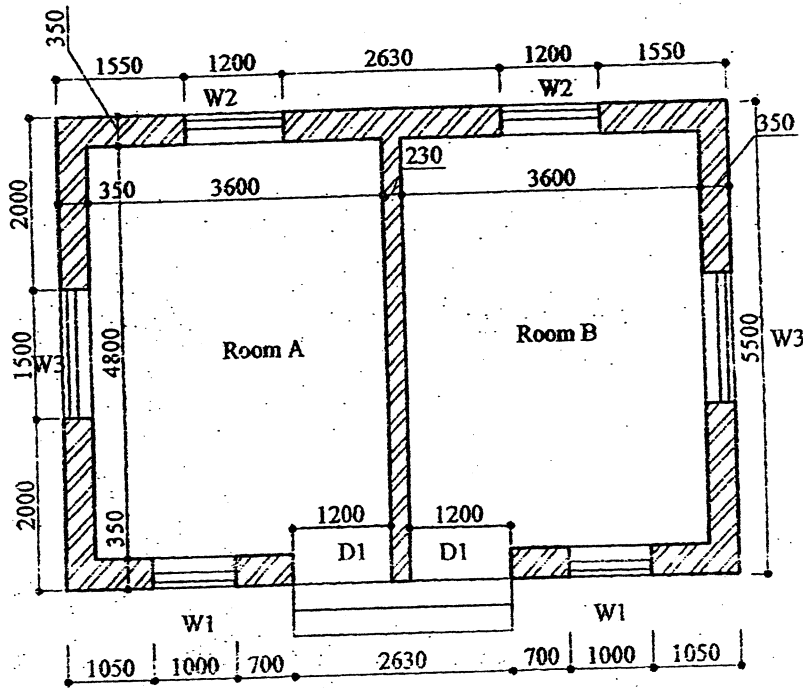
Note: All dimensions are in millimeter
Assume necessary dimensions

Foundation

External wall:	Internal wall:
Depth: 900	Depth: 750
Width: 900	Width: 750
Concrete depth:150	Concrete depth:130
Footings, width and depth:	Footing width and depth:
1st footing: 590 and 130	1st footing: 470 and 130
2nd footing: 470 and 130	2nd footing: 350 and 130
3nd footing and plinth: 350 th	3nd footing and plinth: 230
Plinth height: 450	Plinth height: 450
Sill height:750	Sill height : 750

Steps:

Tread: 300
Riser: 150
100 th. PCC

Roofs:

RCC Slab thickness: 100
Projection: 600
Parapet wall: 110 thick, 300 high at the end of roof projection

Superstructure

Floor to floor height: 2700

External wall: 350

Internal wall:230

Openings

Doors D: 1200x2100
Windows W1: 1000x1000

Windows W2: 1200x1200
Windows W3 1200x1200

Frame size: 75x100
Doors and windows shutter: 35 thick

SEPTIC TANNK

75 th RCC precast cover

350

150

300

230

230

50 th RCC bafle

1800

350

350

150

150

Slope 1:20

150

SECTION

450

50

2000

1000

230

230

PLAN

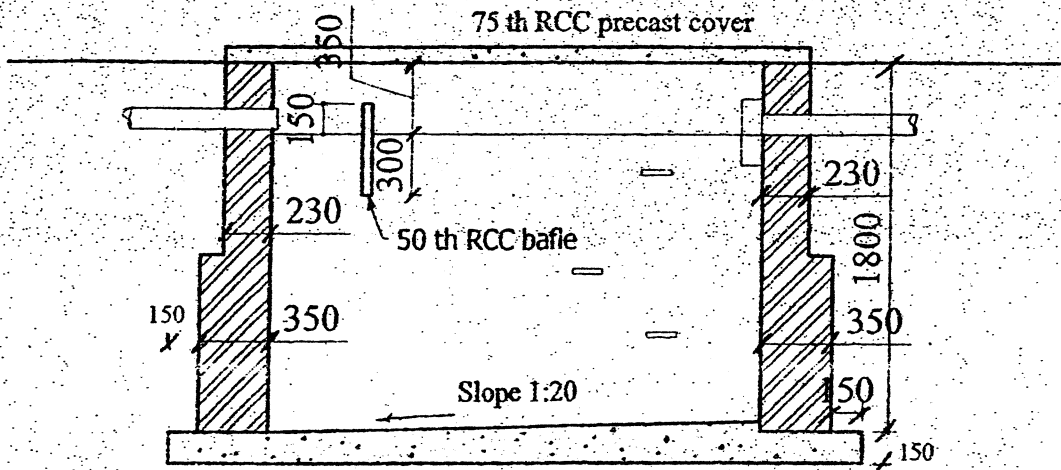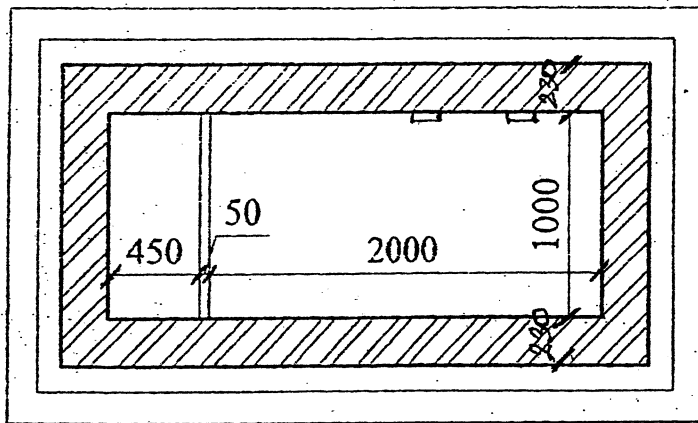| Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
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Subject: - Estimating and Costing (CE705)

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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

***

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
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✓ 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. [12]

      - 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.

***

6 a)

All the dimension are in cm. unless otherwise stated.

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]

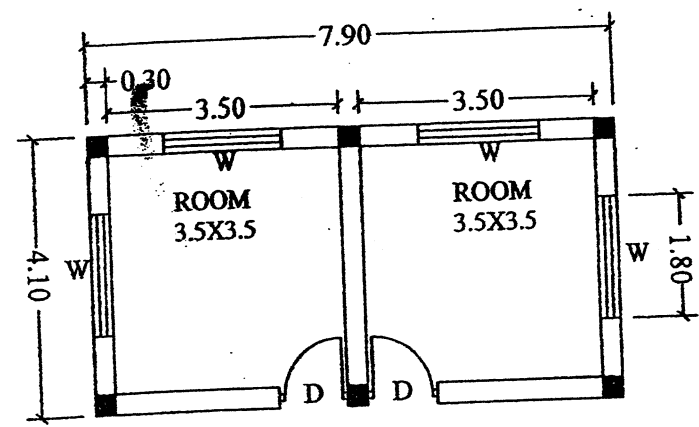   (ii) Prepare bill of quantities from the following data for the construction of RCC T-beam Decking bridge.

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

***

PLAN

7.90

0.30

3.50   3.50

W   W

ROOM
3.5X3.5

ROOM
3.5X3.5

W   W

4.10

1.80

D   D

NOTE
ALL DIMENSION ARE IN METRE
DRAWING IS NOT IN SCALE

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

WALL SECTION

0.35   0.30   0.30

0.45   0.35   0.30

0.25

10 CM PCC
15 CM STONE SOLING

10 CM PCC
15 CM STONE SOLING
30 CM SAND FILLING
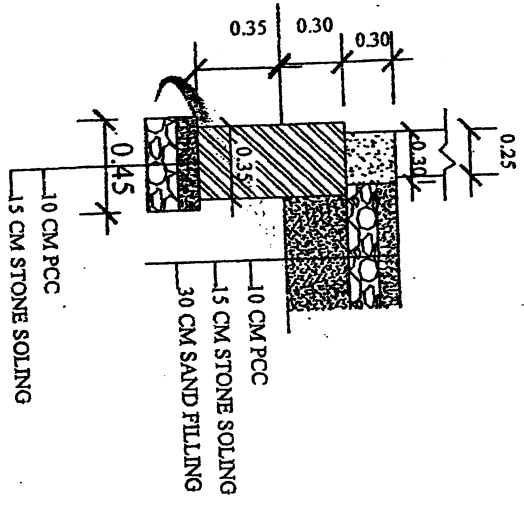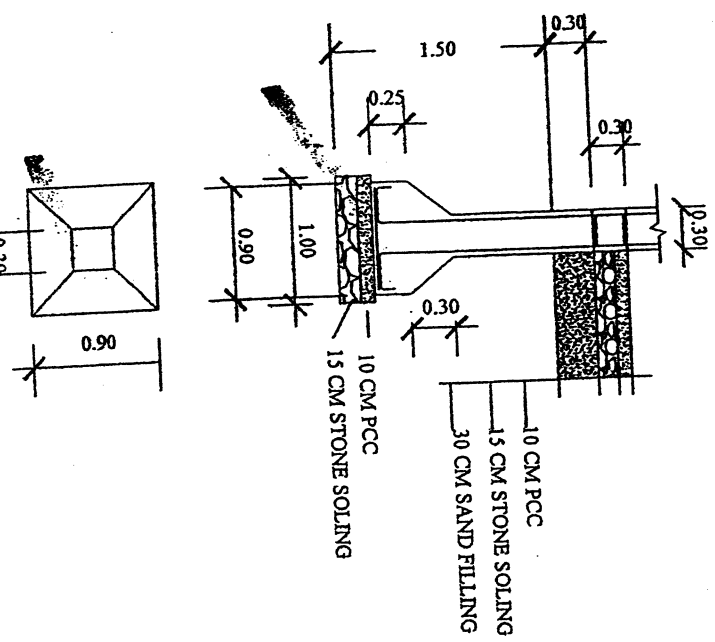
SECTION
COLUMN: 0.30x0.30
FOOTING: 0.90x0.90
PLINTH BEAM:0.30x0.30

COLUMN SECTION

0.30

0.90

1.50

0.25

0.30

0.30

0.90

1.00

0.30

0.30

10 CM PCC
15 CM STONE SOLING

10 CM PCC
15 CM STONE SOLING
30 CM SAND FILLING

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+

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

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

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

   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: [1(

      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: [{

      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: [{

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

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
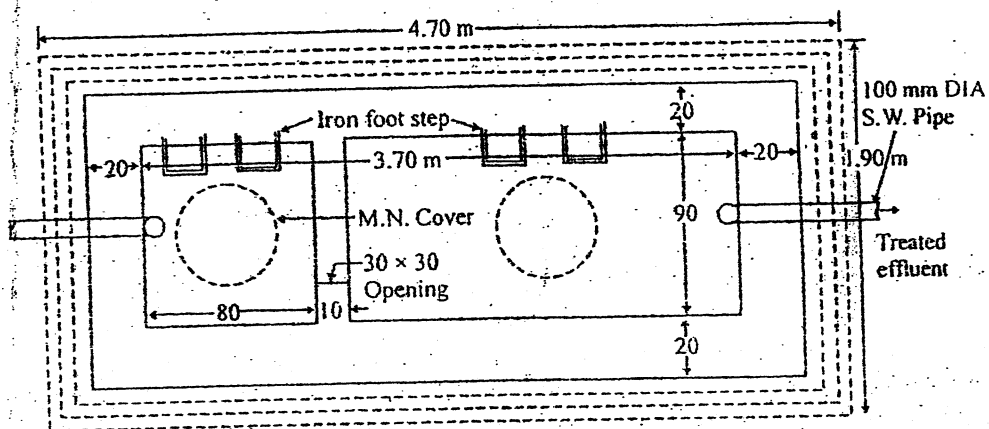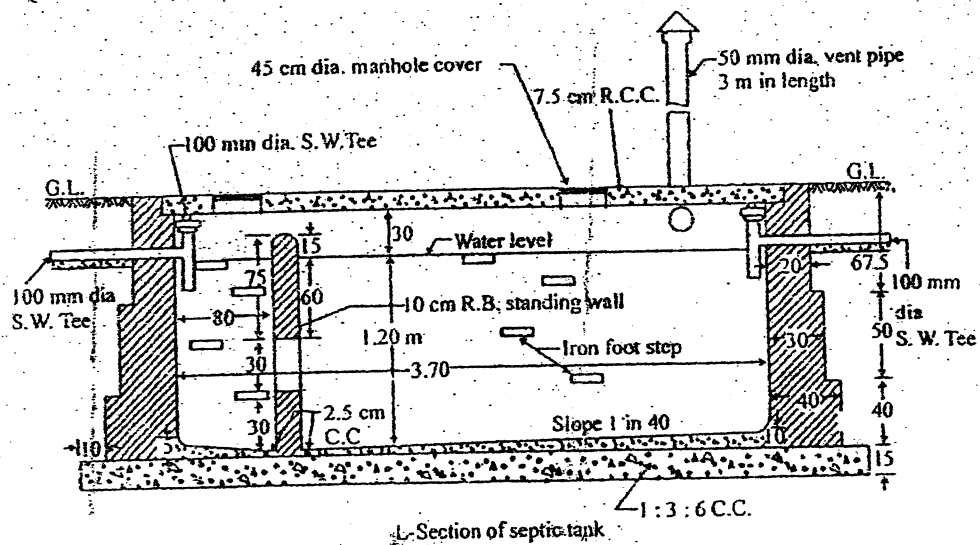Full supply depth = 1m, Top width of bank= 3 m (Left) 1.5 m Right
There is a 50 cm fall at 60 m distance

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

***

For Question No.3(b)

L-Section of septic tank

Plan of septic tank
(All dimensions in cm except otherwise mentioned)

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
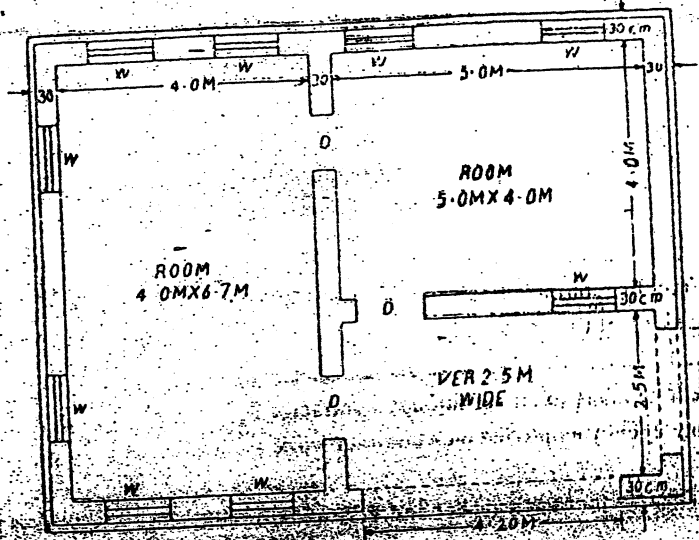
5. Calculate earthwork for a portion of hill road from the following data: [12]

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

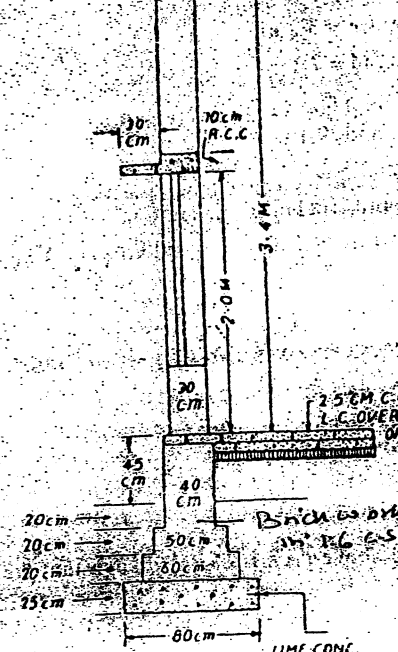   Formation width = 10 m, side slope in cutting = 1:1

   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

***

ROOM
5·0M X 4·0M

ROOM
4·0M X 6·7M

VER 2·5M
WIDE

4·0M

5·0M

30 cm

30

30

30 cm

2·5M

1·3M

10 cm

PLAN   DOORS 1·0X2·10M WINDOWS 1·0X1·5M

25

10 cm

20 cm

8·5cm C.C OVER
12·5cm R.C.C

30 cm

10 cm
R.C.C

3·4 M

2·0 M

20 cm

2·5 CM C.C. OVER 7·5cm
L.C. OVER ONE LAYER
OF BRICK

45 cm

40 cm

20 cm

20 cm

20 cm

15 cm

50 cm

80 cm

80 cm

Brick bat
in R.C.C.S

LIME CONC

SECTION MAIN
ROOM WALL

25

40 cm

20 cm

7·5cm L.C
OVER 10cm R.C.C

20 cm

40 cm

2·0M

2·8 M

2·5cm C.C. OVER
7·5cm L.C OVER
ONE LAYER OF
BRICKS

45 cm

40 cm

10 cm
10 cm
10 cm
20 cm

80 cm

70 cm

LIME CONC

SEC VER WALL

C. I. Cowl

50mm Dia. C. I. Ventilating pipe 2mm High

Inlet
100 mm
S. W. Pipe
.0 cm Long

G. L.

7.5cm R. C. C. Slab Precast

U. Bolt

4 cm R. C. C. Baffle

4cm R.C.C. Baffle

1:3:6 C.C.

Iron Foot Steps

Slope 1 in 20

140

15
30
30

40

100 mm Dia
S. W. Pipe

300

Outlet

Brick work with
1:6 Cement mortar

SOAK PIT
7.5cm R.C.C. Slab
U-Bolt
30×30cm Removal

G.L.

100cm
Dia

250

20
20

50

15cm Coarse Sand

Brick Work with
1:6 Cement mortar

15cm Coarse Sand

Dry Brick
Work

Brick Aggregate

20
60
10
20

15cm
Coarse Sand

200

90

20 30 40

20

Iron Foot Steps

Iron Foot Step

15cm Brick Aggregate

100cm Dia

20

A

B

PLAN
All Dimensions in Centimetre unless otherwise Specified.

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

Subject: - Estimating and costing (CE705)

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✓ 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 100m². [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]
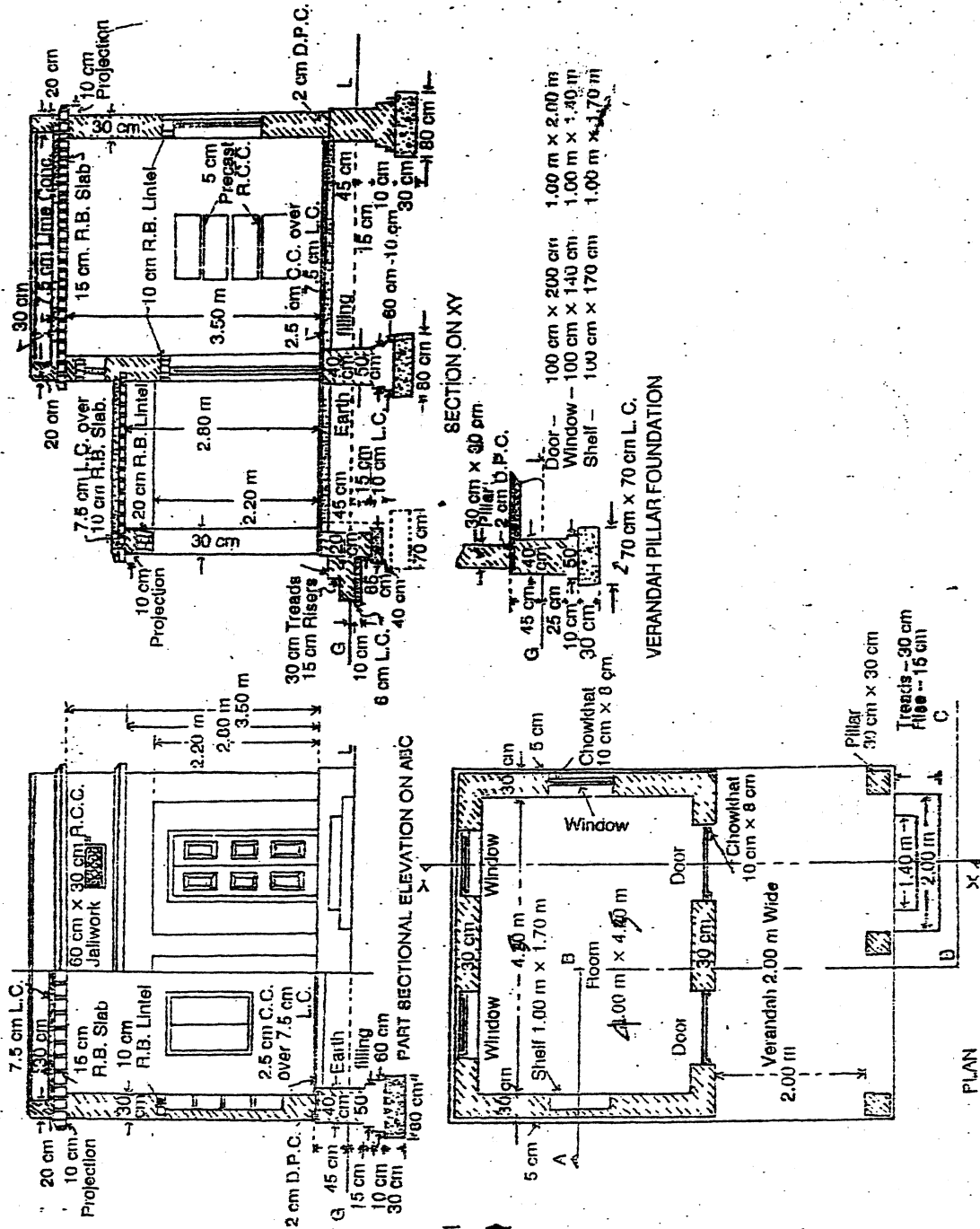
***

SECTION ON XY

Door — 100 cm × 200 cm   1.00 m × 2.00 m
Window — 100 cm × 140 cm   1.00 m × 1.40 m
Shelf — 100 cm × 170 cm   1.00 m × 1.70 m

VERANDAH PILLAR FOUNDATION

PART SECTIONAL ELEVATION ON ABC

PLAN

Fig.

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)

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✓ 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 m². [5]

   c) Find the quality of materials required for first class B/W in 1: 4 cement sand mortar per 150m³. (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:
100	-	1.20	6:1	Cutting = 1:1
200	-	0.50	5:1	Filling = 2:1

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

***

SEPTIC TANK PLAN

2580

150 120 120 230   1350   230 120 120 150

150 120 120 230

4650

4750

230 120 120 150

1150

40mm THK. RCC BAFFLE WALL

20mm THK. CEMENT PLASTER(1:4)
& 3mm THK. NEAT CEMENT PUNNING(1:1)

IRON FOOT STEP

X — X

SECTION AT X-X

600   450

55 170

150

100mm∅ S.W. PIPE
900mm LENGTH

C.I. COWL

40mm∅ C.I. VENTILATING PIPE 2m HIGH

20mm THK. CEMENT PLASTER(1:4)
& 3mm THK. NEAT CEMENT PUNNING(1:1)

40mm THK. RCC BAFFLE WALL

300 150

U-BOLT

IRON FOOT STEPS

100mm THK. PRECAST RCC SLAB

1400   300

SLOPE 1 IN 20

450

OUTLET

100mm∅ S.W. PIPE

BRICK WORK IN CEMENT MORTAR(1:3)

P.C.C (1:3:6)
FLAT BRICK SOLING

55 170 150

600   450

6000

SOAK PIT PLAN

150mm COARSE SAND

150mm BRICK AGGREGATE

150 150 230   1500   230 150 150

Y — Y

SECTION AT Y-Y

100mm∅ S.W. PIPE

76mm RCC SLAB

U-BOLT

150   230

BRICK WORK IN CEMENT MORTAR(1:3)

150

DRY BRICKWORK

1200

230

BRICK AGGREGATE

150mm COARSE SAND

230   2500   500

230

30mmx30mmt REMOVABLE MANHOLE

BRICK WORK IN CEMENT MORTAR(1:3)

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

Subject: - Estimating and Costing (CE705)

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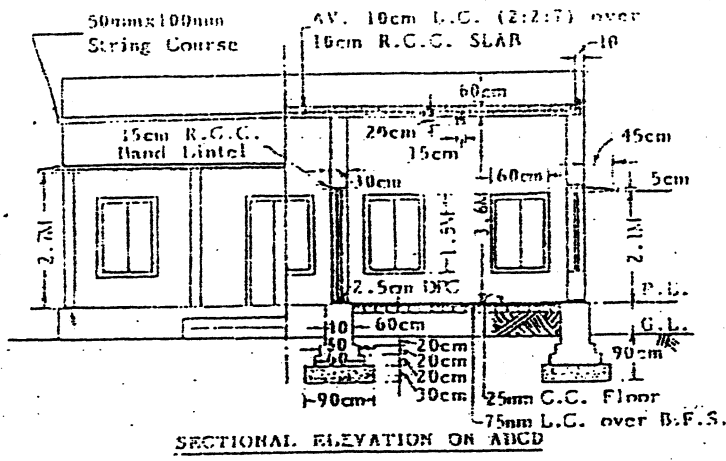✓ Necessary figures are attached herewith.
✓ Assume suitable data if necessary.

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)
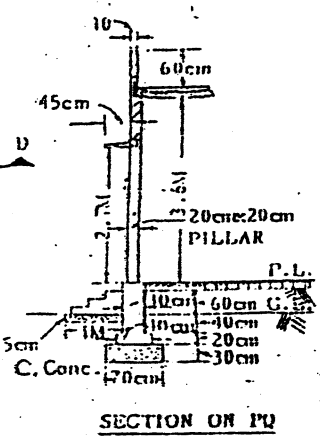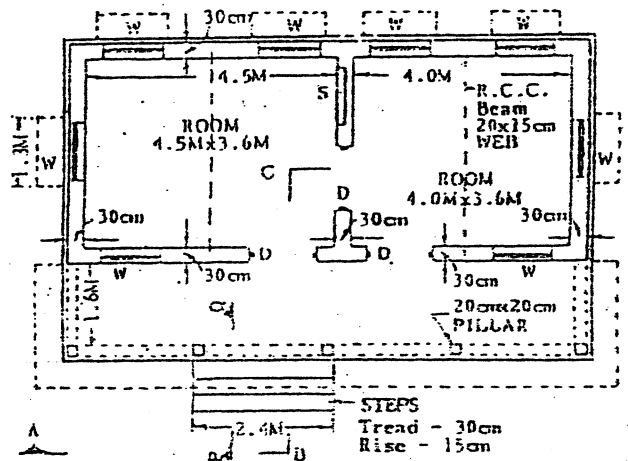   * Fully supply depth = 1 m
   * Top width of bank =1.5 m

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.

***

SECTIONAL ELEVATION ON ABCD

50mm×100mm String Course

AV. 10cm L.C. (2:2:7) over 16cm R.C.C. SLAB

15cm R.C.C. Band Lintel

60cm

20cm

15cm

30cm

45cm

5cm

2.7M

2.5cm DPC

10

60cm

G.L.

40

20cm

20cm

20cm

30cm

90cm

P.L.

90cm

25mm C.C. Floor

75mm L.C. over B.F.S.

Schedule

DOOR :
D = 1.2M × 2.1M

FRAME
= 10cm × 8.0cm

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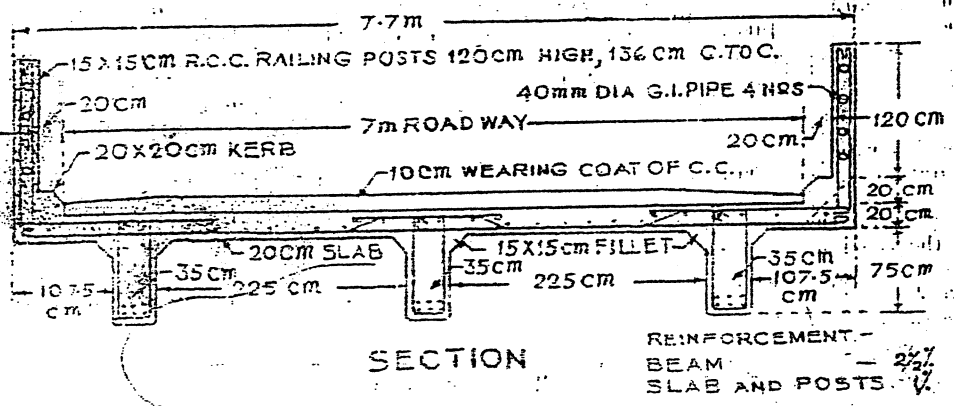
FRAME
= 10cm × 8.0cm

SHELF
S = 1.1M × 1.5M
20cm Deep

PLAN

30cm

W   W   W   W

4.5M   4.0M

R.C.C.
Beam
20×15cm
WEB

ROOM
4.5M×3.6M

S

ROOM
4.0M×3.6M

C

D

30cm

30cm

30cm

30cm

30cm

30cm

W

W

W

W

1.3M

1.8M

20cm×20cm
PILLAR

20cm×20cm
PILLAR

A

STEPS
2.4M   Tread - 30cm
Rise - 15cm

B

D

SECTION ON PQ

10

60cm

45cm

20cm×20cm
PILLAR

P.L.

10cm   60cm   G.L.
10cm   40cm
20cm
30cm

15cm

C. Conc.   70cm

R. C. C. T-BEAM DECKING

7.7m

15×15cm R.C.C. RAILING POSTS 120cm HIGH, 136 cm C.TO C.

20cm

7m ROAD WAY

40mm DIA G.I.PIPE 4 NOS

20cm

120 cm

20×20cm KERB

10cm WEARING COAT OF C.C.

20 cm
20 cm

20CM SLAB

15×15cm FILLET

35CM

35CM

225 cm

35cm

225 cm

107.5 cm

75cm

107.5 cm

35CM

225 cm

SECTION

REINFORCEMENT -
BEAM
SLAB AND POSTS

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

Subject: - Estimating & Valuation (EG726CE)

✓ 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) Prepare the approximate cost of a residential building when the prevailing plinth area rate is Rs. 80,000. per sq.m. the carpet area is 50 sq.m. The area of corridor and verandah is total taken 15% of the plinth area and 8% of plinth area is taken for wall. [4]

   b) What are the purpose of estimating? [4]

   c) What are the units of measurement of the following items work? [4]

   i) Surface dressing
   ii) Doors and windows shutters
   iii) Pointing works
   iv) Steel reinforcement for RCC works

2. a) What is 'rate analysis? What are the requirement of rate analysis? [4]

   b) Calculate the quantities of materials required for 15m³ brick masonry in (1:4) cement sand mortar. Assume the size of brick 230×110×55mm and thickness of mortar joint is 12mm. [4]

   c) Prepare an analysis of rate for 12mm thick cement sand plaster (1:6) in wall per 100m². [4]

3. A town planning authority has to acquire an area of 250,000 sq.m. for the development of a new colony. After developing the area it is proposed to be sold at Rs. 10,000 per sq.m workout the maximum compensation which can be given to the owners whose land is to be acquired for the development of the colony. Assume: [10]

   i)   The authorities establishment charge is 15% of sale price.
   ii) 40% area is to be provided for road, parks and other ammenities.
   iii) Colony improvement expenditure is Rs. 10 per sq.m.
   iv) Charge of engineer and architect is 5% of sale price.

   Work out the valuation of under developed property from the above data.

   b) Mention the various data required to prepare a valuation report of a piece of land with building for the purpose of selling. [10]

4. a) Calculate the quantity of earth work for the road in plain area if the formation with is 7m, side slope in cutting 1:1 and side slope in filling 2:1. The road has a rising gradient of 1 in 90. The formation level at 100m chainage is 950.60m. The R.L. of the ground points for the various chainages are as follows: [8]

Draw. No. 2

Slab Culvert

HALF SEC. ELEVATION ON ABCD

HALF SECTIONAL PLAN

HALF SEC. ELEVATION ON BCEF

All dimensions in centimetre scale 1:75

P.59

Chainage/Distance	100m	200	250	350	400
R.L. of ground	952.0m	952.5m	953.95	955.0	954.0

b) Calculate the earth work of a hill road from the following data: [3]

Distance	Central depth		Cross slope of the ground (H:V)
	Cutting (m)	Filling (m)	
0	0.80	-	12:1
50	1.20	-	10:1
100	-	1.40	8:1

Width of road = 8m
Side slope in filling = 2:1
Side slope in cutting = 1:1

5. Estimate the quantities of the following items of work from the accompanying drawing of slab culvert.
.[5×4]

    a) Earth work in excavation
    b) Cement concrete (1:3:6)
    c) Brick work in cement sand mortar
    d) R.C.C. work

The general specification are as follows:

Foundation shall be of cement concrete 1:3:6. Brick work shall be of first class in cement mortar 1:4. Exposed surfaces of brick masonry shall be cement pointed 1:3 carried upto 15cm below G.L. The exposed surfaces of R.C.C. shall be given a smooth finish during centring and no plastering shall be allowed. The string cources shall be 8cm deep and 12mm thick with cement mortar 1:3 finished with neat cement (wt. of 16mm and 10mm dia bars are 1.58 kg and 0.62kg respectively per r.m)

All dimensions are in cm.

620

22 thick road met...

8 c.c wearing coat.

ALTERNATE BARS CRANK...

16mmφ @22 C/C

16mmφ @10 C/C

120 45 30

1:0

30 50 80

90 45 30 210

G.L.

45°

Half sec. elevation ABCD

F   E   D

80   50   50   80

15   500   15

B   A

4M Road way

40 50 80

HALF SEC. ELEVATION ON BCEF

80

30 45 90

BED LEVEL

G.L.

40 12 8 22

50 40

8 C.C. wearing coat.

10mm φ ROD @ 22 C/C

4m Road way.

50 40

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / 1	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 is an estimate? Briefly describe the data required for preparation of an estimate. [2+3]

   b) What is a detailed estimate? When and where the following estimates are prepared? [2+2+2]
      i) Revised estimate
      ii) Cube rate estimate

2. a) What do you understand by contigencies? How the following items of work are measured? Write with units of measurement and payments. [2+2+2]
      i) Damp proof course
      ii) Bending and binding of reinforcement

   b) Explain two popular methods to calculate quantities of a building. [4]

3. a) Why is rate analysis prepared? Prepare an analysis of rate for PCC (1:2:4) for RCC work in a floor slab. [2+6]

   b) Calculate the quantities of materials required for the following item of works. [4+4]
      i) 500 sq.m.15mm thick Cement sand plastering (1:4) in wall
      ii) 20 cu.m. of brick work in cement sand mortar (1:5) in foundation (Assume size of brick 240×120×60 mm and 12 mm thickness of mortar joint)

4. Write short notes on: (any two) [4+4]
   i) Small water supply project estimate
   ii) Importance of rate analysis and requirements for rate analysis
   iii) Bill of quantities

5. Calculate the quantities of the following items of work from the attached building drawing No.1. [4+4+2+2]
   i) Earth work in excavation in foundation
   ii) Brick work in cement mortar (1:4) in foundation and plinth
   iii) Wood work in door shutters
   iv) PCC in foundation

6. Estimate the quantities required for PCC in foundation and brick work as shown in attached drawing No.2 of slab culvert. [4+6]

7. a) Prepare an estimate of a Earthwork in cutting and filling of a portion of a road from the given data: [8]
      Road width : 10 m
      Side slopes in cutting 1.5:1 and in banking 2:1
      Downward grading 1 in 150

Chainage / Distance	0	30	60	90m
Ground level (m).	102	104	103	99
Formation level (m).	100	95	90	85

   b) Write down the formula for calculates of cross sectional area and area of permanent land for a portion of an irrigation canal in full embankment with clear sketch. [5]
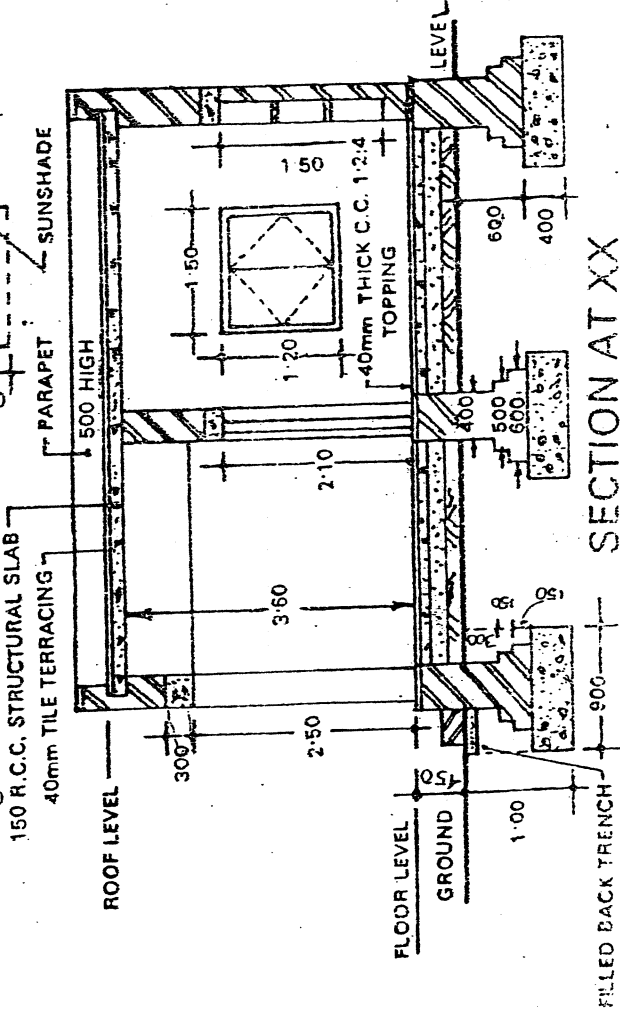
      OR

      Calculate the quantities of earth work and brick work of a soak pit with 1.5 m external diameter, 20 cm wall thickness and 3.5 m depth from ground level.

***

PLAN
SCALE 1:75

- 4·0
- 300
- A¹/₁
- ROOM 4·0 × 3·0
- 3·0
- W¹/₂
- W¹/₁
- O 1
- 300
- D¹/₁
- 450
- VER. 2·5m WIDE
- 2·50
- 300
- 300
- 1·50
- PILLAR 300 × 300
- STEP 300
- X

SECTION AT XX

- LEVEL
- 1·50
- 1·50
- 1·20
- 40mm THICK C.C. 1:2:4 TOPPING
- 600
- 400
- SUNSHADE
- PARAPET
- 500 HIGH
- 150 R.C.C. STRUCTURAL SLAB
- 40mm TILE TERRACING
- 2·10
- 400
- 500
- 600
- ROOF LEVEL
- 3·60
- 300
- 150
- 150
- 300
- 2·50
- FLOOR LEVEL
- GROUND
- 450
- 1·00
- 900
- FILLED BACK TRENCH
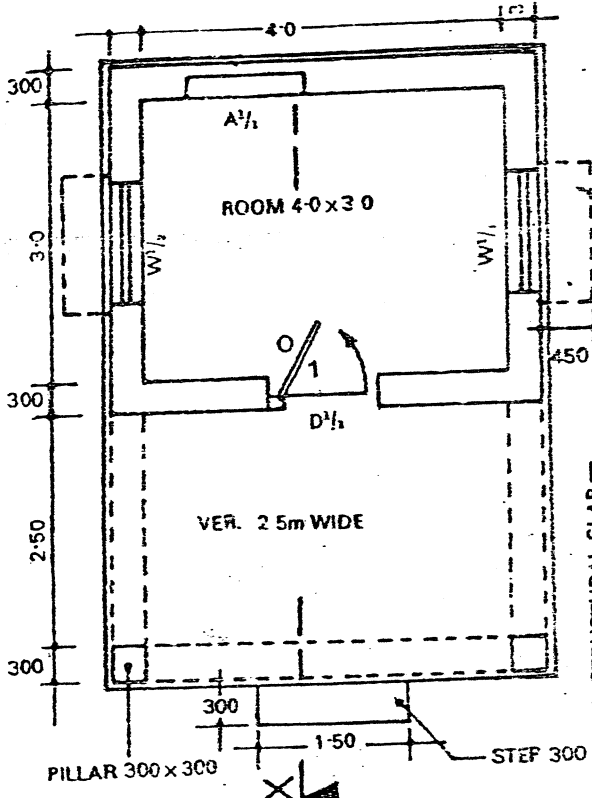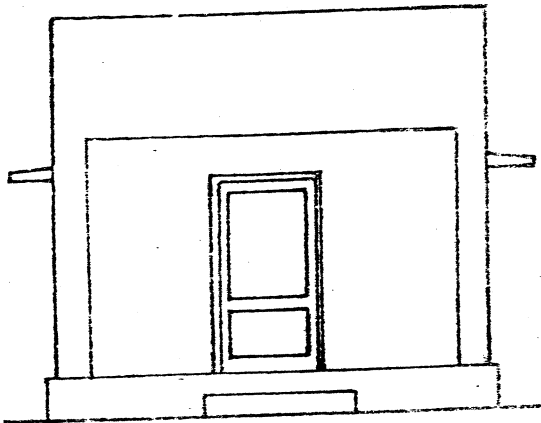
ELEVATION
SCALE 1:75

REFERENCE

S.NO.	SIZE	DESIGNATION	NUMBERING
1.	1·10 × 2·10	11 DS 21	D¹/₁
2.	1·50 × 1·20	15 WT 12	W¹/₁ W¹/₂
3.	1·5 × 1·5	15 AT 15	A¹/₁

Drawing No 1.

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

Subject: - Estimating and Valuation

✓ 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. Explain how you prepare preliminary estimate of a building project for the administrative approval. [2+5]

   b) What are the types of estimates? Explain with conditions when they are used. [9]

2. a) Discuss briefly the factors which affect the unit price of an item of work. [4]

   b) Work out the number of bricks, cement and sand required for 115m³ of brick masonry in (1:3) cement mortar in superstructure. The size of brick is 240×120×60mm and the thickness of mortar joint is 12mm. [4]

   c) Prepare an analysis of rate for 50mm thick PCC (1:1 ½:3) in floor. [4]

   d) Prepare an analysis of rate for W.C. commode with low level cistern [4]

3. a) Estimate the quantity of earthwork between 20m chainage and 100m chainage at equal interval of 20m. (Plain road) [8]

Distance in chainage (m)	20m	40m	60m	80m	100m	120m	140m
RL of ground(m)	77.74	77.80	78.20 80.40	80.25	80.00	79.60	79.80

   Formation level at 20m chainage is 78.70m.
   Formation width of the road = 12m
   Side slope in cutting = 1:1
   Side slope in filling = 2:1
   Formation has a rising gradient of 1 in 100.

   b) A road is to be constructed in hilly area with formation width of 10m, side slope in banking 2:1 and cutting 1:1. The height of banking and depth of cutting at center line of the road is given below. The cross slopes of the ground are also given at different sections. Calculate the quantities of earth work. [8]

Chainage/distance	cutting	filling	Cross slopes of ground
0	0.60	-	10:1
30	-	0.40	15:1
60	-	0.60	12:1

4. a) Estimate the quantities of the following items of work from the accompanying building drawing. (assume missing data) [8]

   i) Earth work in excavation
   ii) RCC work
   iii) Brick work in foundation and plinth
   iv) Wood work for doors and window frame.

   b) Estimate the quantity of the following item of work from the accompanying RCC T-beam decking beam for a bridge of one span of 6.50 metre. The bearing of the beams on either side of the abutment = 50cm. The steel reinforcement in beam may be assumed as 2.50 percent and in the slab, Post, fillet, kerb as 1.50 percent of the volume of PCC. [8]

   i) PCC M20 (1:1½:3) for RCC works.
   ii) Steel reinforcement

RCC T-beam decking
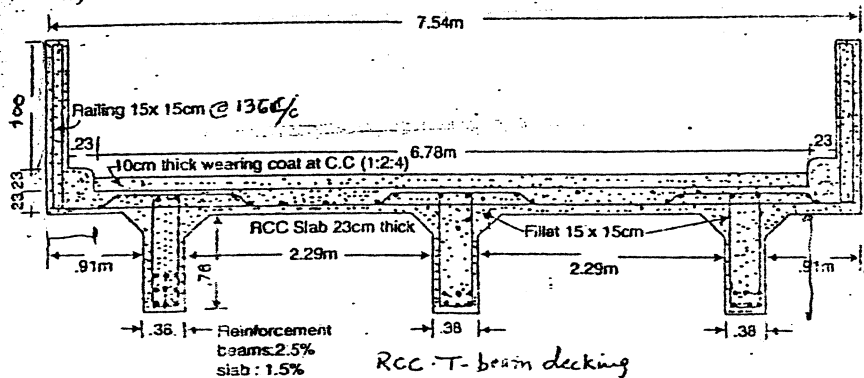
5. a) A 25 years old property is fetching an annual rent of Rs.1,45,000/-. The life of the building was expected to be 70 years. The rate for interest for sinking fund is 5% and that for capitalization is 7%. The estimated cost of land at present is Rs.25,00,000/- and at the end of life of building, its scrap value will be Rs.5,00 000/-. The owner is paying the other expenses annually at 35% of income. Determine the value of the property. [8]

   b) Write short notes on: (any two) [4+4]

   i) Sinking fund
   ii) Capitalized value
   iii) Salvage value

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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]

***

Traffic classes

Traffic classes	Range (10⁶ 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
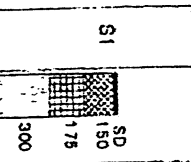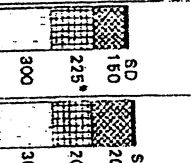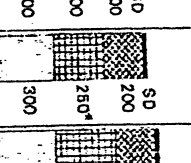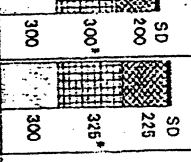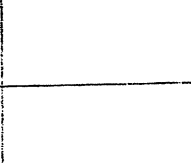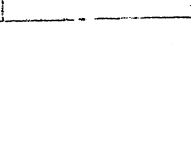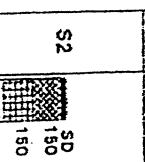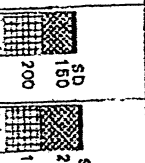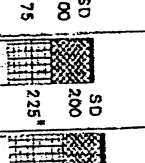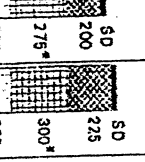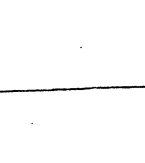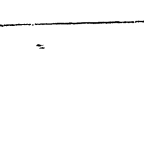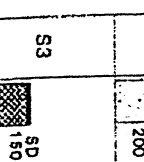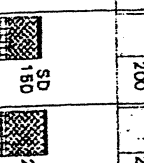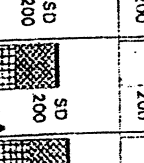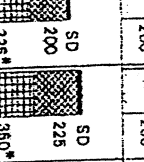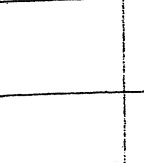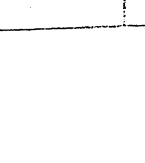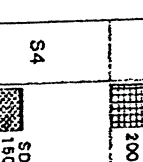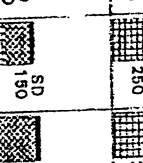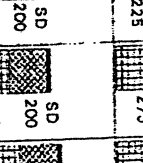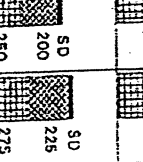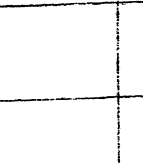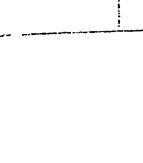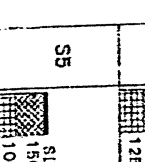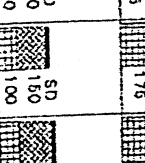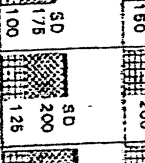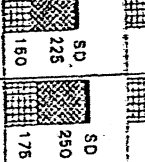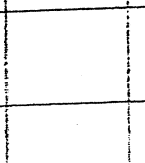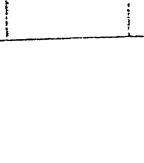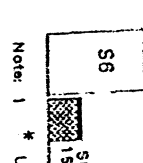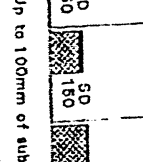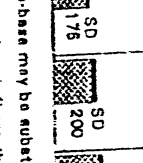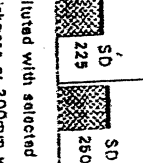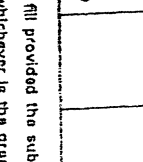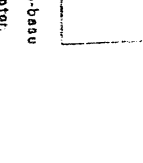
Subgrade strength classes

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

Pavement design chart (layer thicknesses in mm; SD = surface dressing):

	T1	T2	T3	T4	T5	T6	T7	T8
S1	SD 150 / 300	SD 150 / 300	SD 150 / 300	SD 200 / 300*	SD 200 / 325*	SD 225 / 300		
S2	SD 150 / 150 / 200	SD 150 / 200	SD 175 / 200	SD 200 / 225* / 200	SD 200 / 275* / 200	SD 200 / 300* / 200		
S3	SD 150 / 200	SD 150 / 250	SD 200 / 225	SD 200 / 275*	SD 200 / 325*	SD 225 / 360*		
S4	SD 150 / 125	SD 150 / 175	SD 200 / 160	SD 200 / 200	SD 200 / 250	SD 225 / 275		
S5	SD 150 / 100	SD 150 / 100	SD 175 / 100	SD 200 / 125	SD 225 / 160	SD 250 / 175		
S6	SD 150	SD 150	SD 175	SD 200	SD 225	SD 260		

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

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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:

   $$P_f = \frac{2d^3 F_f}{L_d + 8.8\delta}; \quad P_s = 0.785 d^2 F_s; \quad P_b = \frac{F_b L_d^2 d}{12.5(L_d + 1.5\delta)}$$

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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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	
20	730	40	110	
30	750	40	130	base = 250 subbase = 330
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	
20	690	40	100	
30	710	40	120	base = 250 subbase = 300
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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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
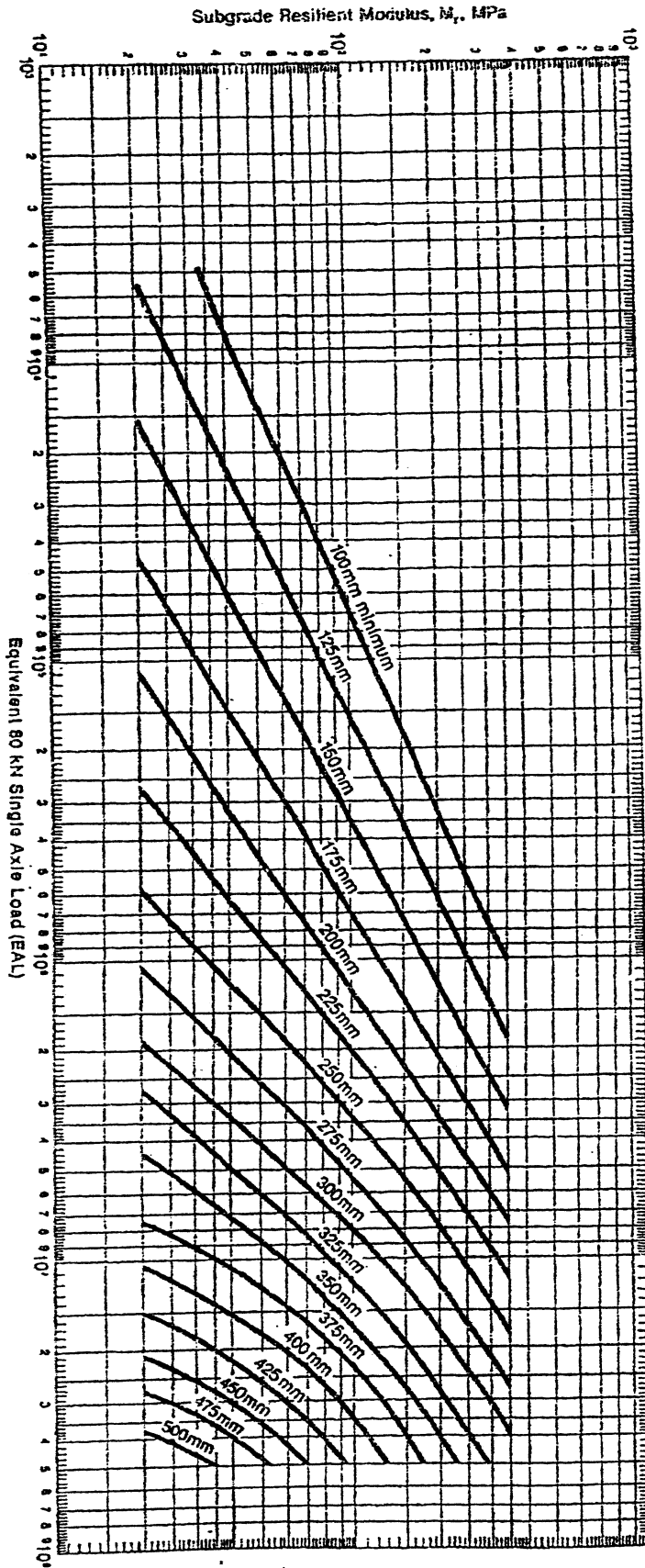
Subgrade Resilient Modulus, M_r, MPa

Equivalent 80 kN Single Axle Load (EAL)

100mm minimum
125mm
150mm
175mm
200mm
225mm
250mm
275mm
300mm
325mm
350mm
375mm
400 mm
425mm
450mm
475mm
500mm

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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 All questions.
✓ All questions carry equal marks.
✓ Necessary charts and tables are attached herewith.
✓ 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

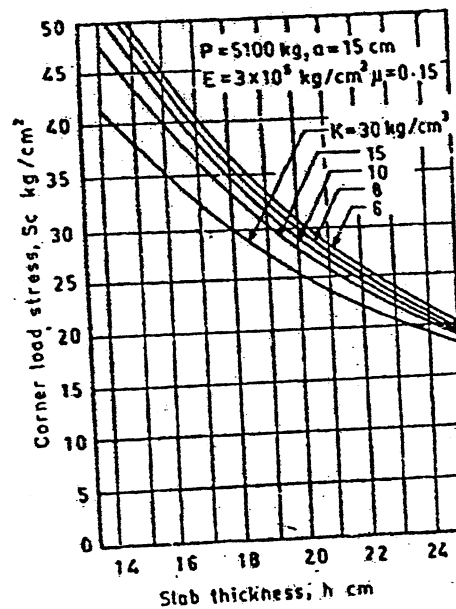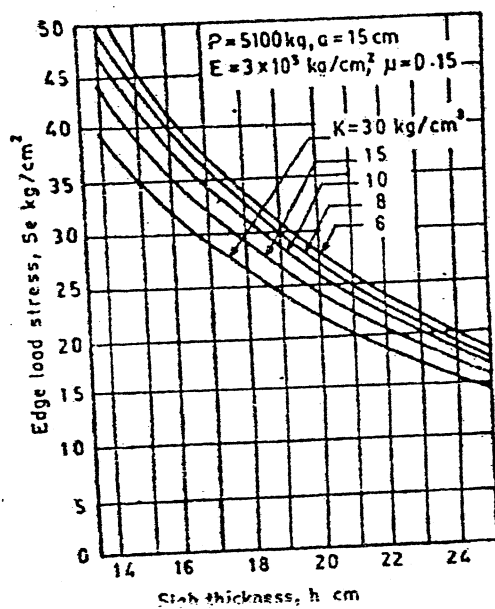| Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

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?

***

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

Subject: - Transportation Engineering II (CE703)

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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.

***

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / 1	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.
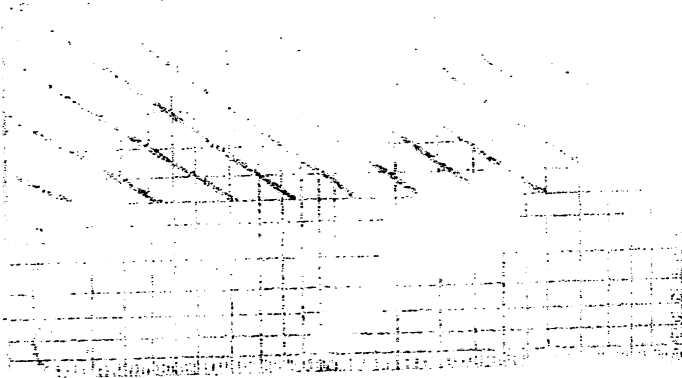
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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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.

***

Traffic classes
(10⁶ 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
(CBR%)

S1 =	2
S2 =	3 , 4
S3 =	5 - 7
S4 =	8 - 14
S5 =	15 - 29
S6 =	30+

CHART 1   GRANULAR ROADBASE / SURFACE DRESSING
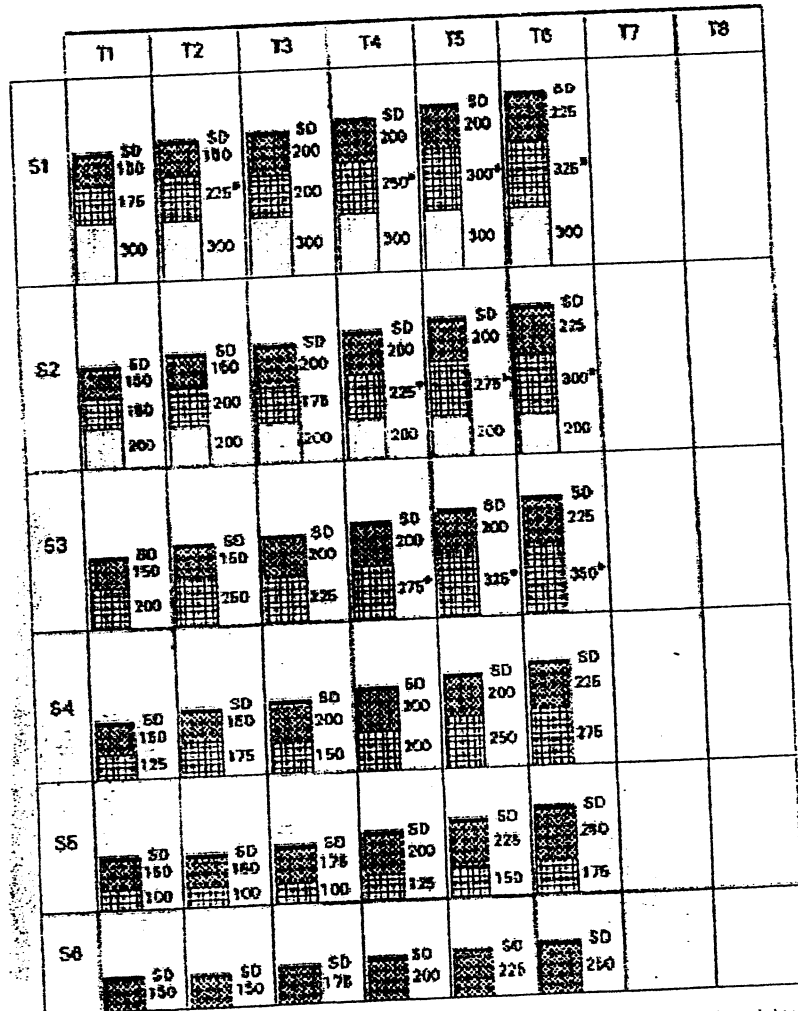
Note: 1   * Up to 100mm of sub-base may be substituted with selected fill provided the sub-base
is not reduced to less than the roadbase thickness or 300mm whichever is the greater.
The substitution ratio of sub-base to selected fill is 25mm : 32mm

2   A cement or lime-stabilised sub-base may also be used.

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 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?

***

Full-Depth Asphalt Concrete
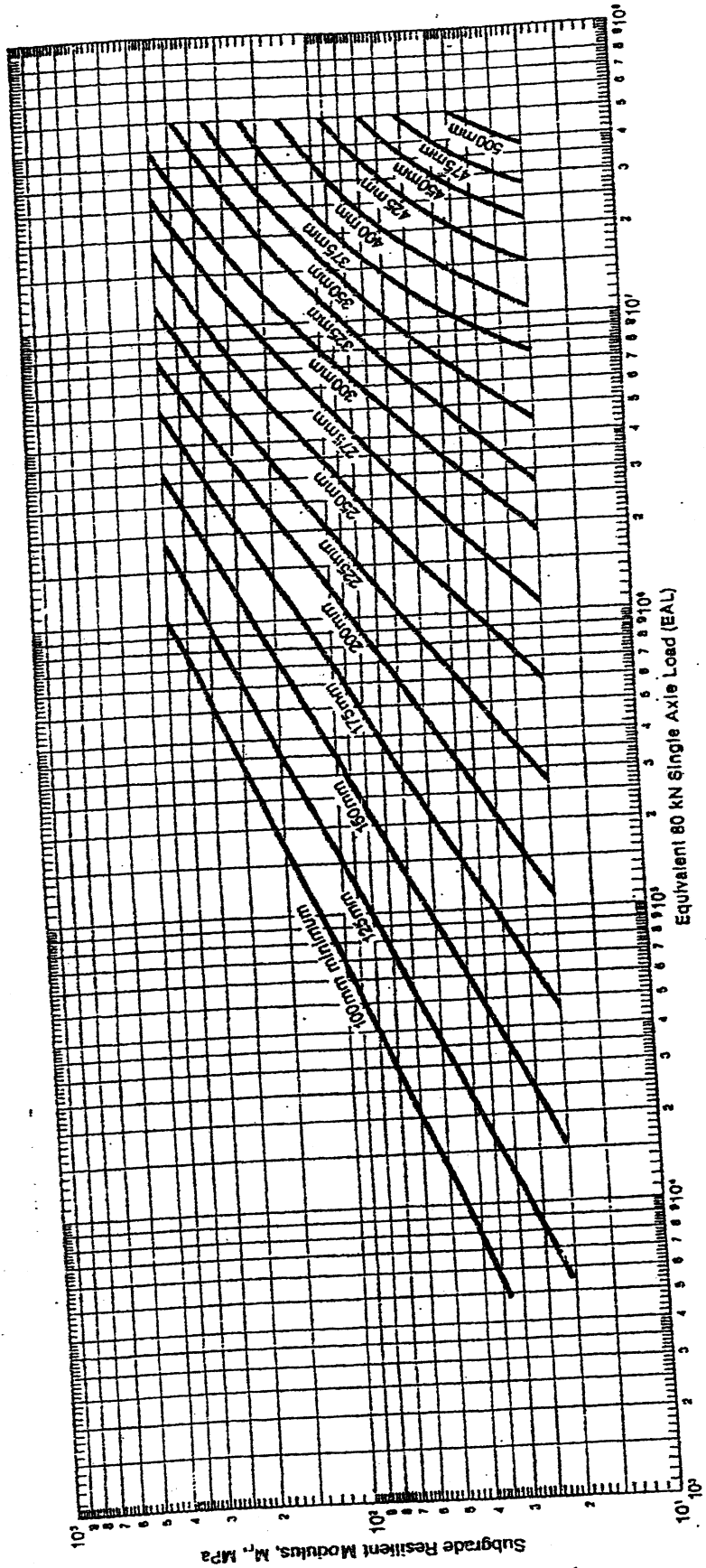
Axes (rotated):
- Vertical axis: Subgrade Resilient Modulus, M_r, MPa
- Horizontal axis: Equivalent 80 kN Single Axle Load (EAL)

Curve labels: 500mm, 475mm, 450mm, 425mm, 400mm, 375mm, 350mm, 325mm, 300mm, 275mm, 250mm, 225mm, 200mm, 175mm, 160mm, 125mm, 100mm minimum

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

Subject: - Transportation Engineering II *(CE703)*

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✓ *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.

***

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)*

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✓ *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.

***

Cumulative Traffic, msa	Total Pavement Thickness, mm	Pavement Composition		Granular Base, mm	Granular Sub-base, mm
		Bituminous Surfacing			
		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

(Table title: CBR 6%)

CBR 6%

Chart — Thickness & Composition (mm) vs Design Traffic (msa)

Legend:
- Premix Carpet
- Granular base
- Granular Sub-base
- Dense Bituminous Macadam (DBM)
- Bituminous Concrete

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

Subject: - Transportation Engineering II (CE703)
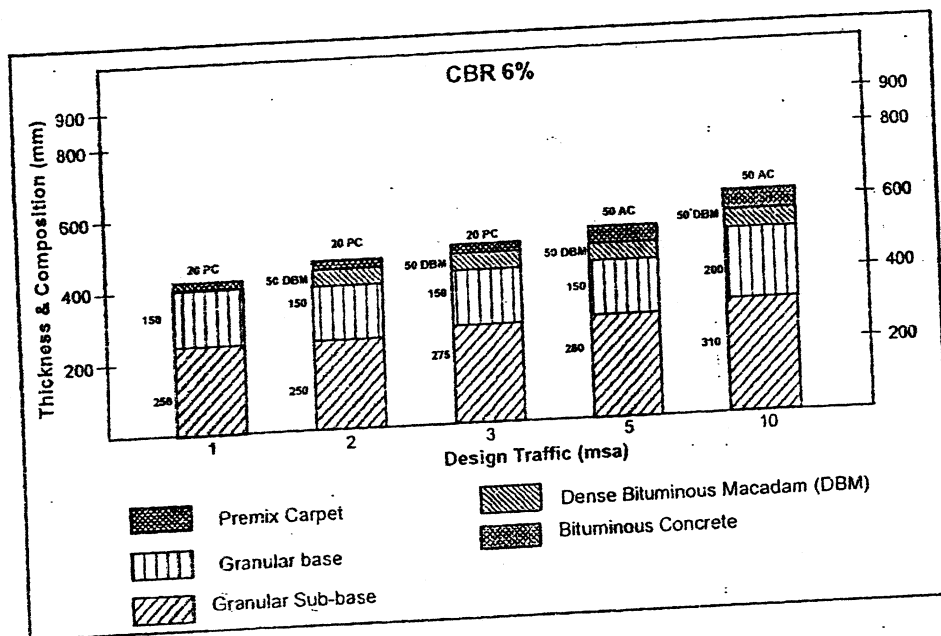
✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt All questions.*
✓ *All questions carry equal marks.*
✓ *Normal graph paper should be provided.*
✓ *Necessary figures are attached herewith.*
✓ *Assume suitable data if necessary.*

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.

$E_1 = 450,000$ psi	$a_1 = 0.44$	D_1
$E_2 = 25,000$ psi	$m_2 = 1.2$	D_2
$E_3 = 15,000$ psi	$m_3 = 1.2$	D_3

$M_R = 5000$ psi
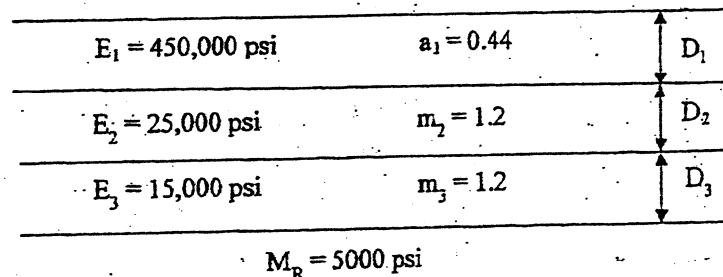
7. Draw a neat sketch of typical pavement structures. Explain in detail the construction methodology of Otta Seal.

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.

***

AAHSTO Flexible Pavement Nomograph

Reliability, R(%)

Overall
standard
deviation, S_0

99.9

99

90

80
70
60
50

.6
.4
.2

T_L

Estimated total 18-kip equivalent
single-axle load applications, W_{18} (millions)

50

10
5.0

1.0

.5

.1
.05

T_L

Effective roadbed soil
Resilient modulus, M_R (ksi)

40
20
10
5

1

Design serviceability loss, ΔPSI

0.5

1.0

1.5

2.0

2.5

3.0

9 8 7 6 5 4 3 2

6.5 5.5 4.5 3.5 2.5 1.5

Design structural number, SN

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]

***

Full-Depth Asphalt Concrete

Subgrade Resilient Modulus, M$_r$, MPa

Equivalent 80 kN Single Axle Load (EAL)

100mm minimum
125mm
150mm
175mm
200mm
225mm
250mm
275mm
300mm
325mm
350mm
375mm
400 mm
425 mm
450mm
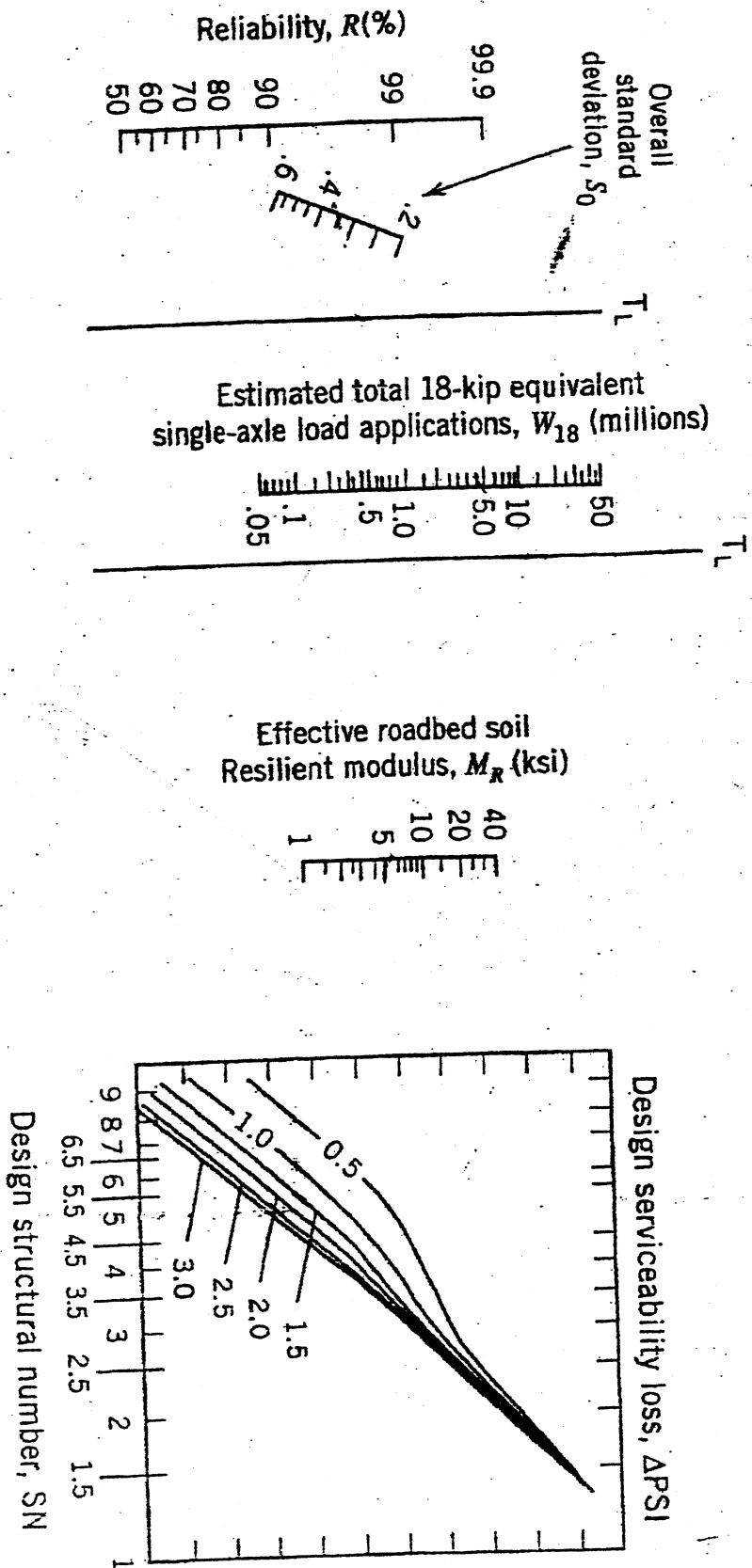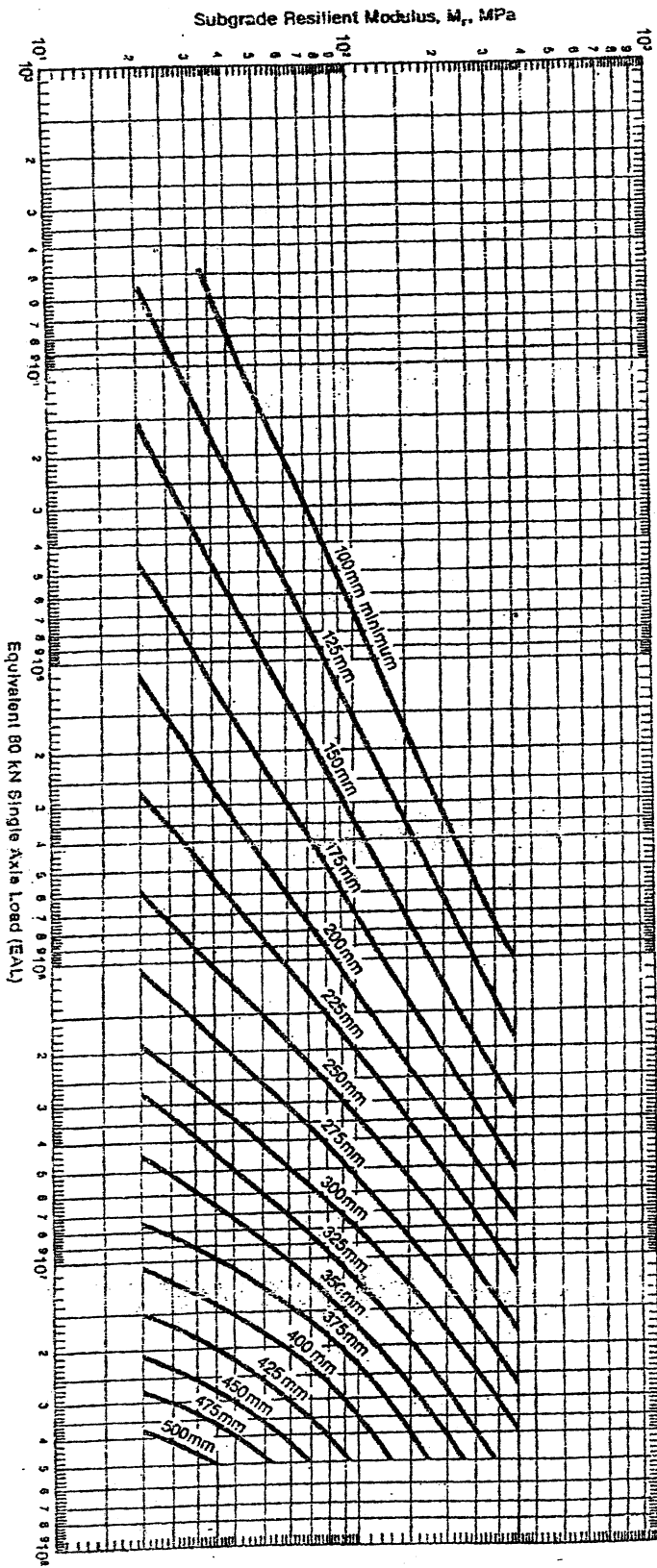475mm
500mm

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. 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?

***

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	
20	640	40	90	base = 250 subbase = 260
30	655	40	105	
50	675	40	125	
100	700	50	140	
150	720	50	160	

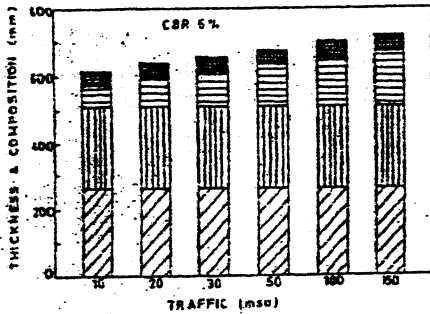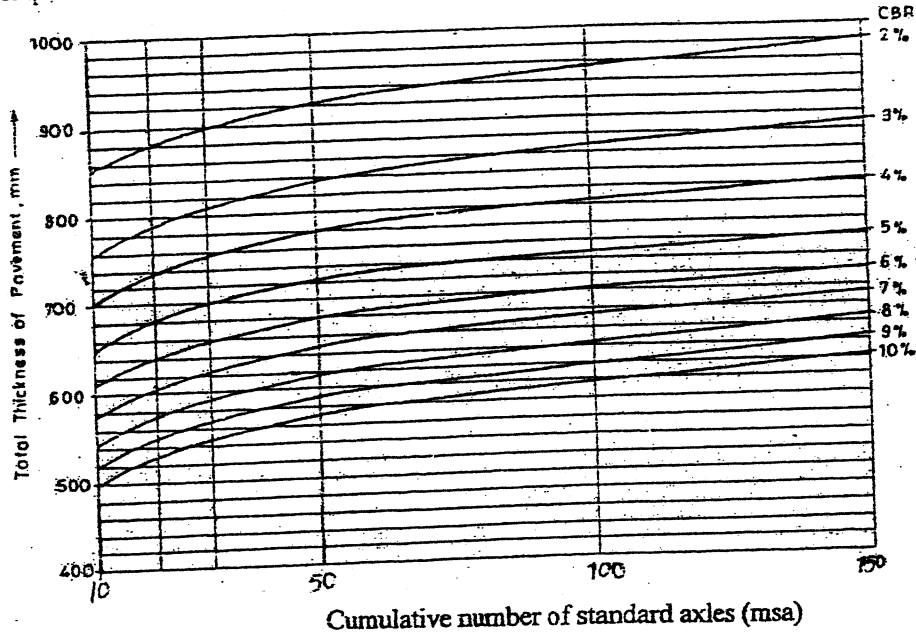| Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

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
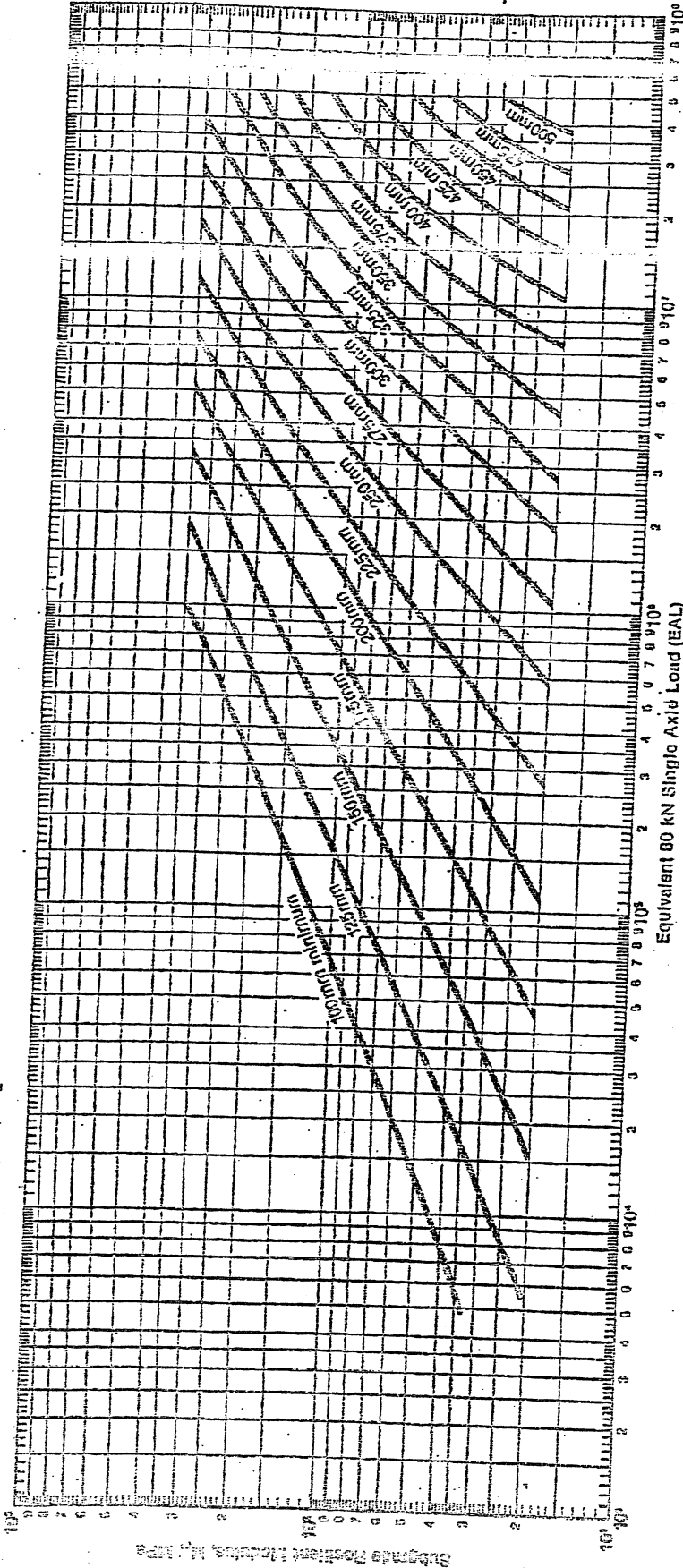
Equivalent 80 kN Single Axle Load (EAL)

Subgrade Resilient Modulus, M_r, MPa

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
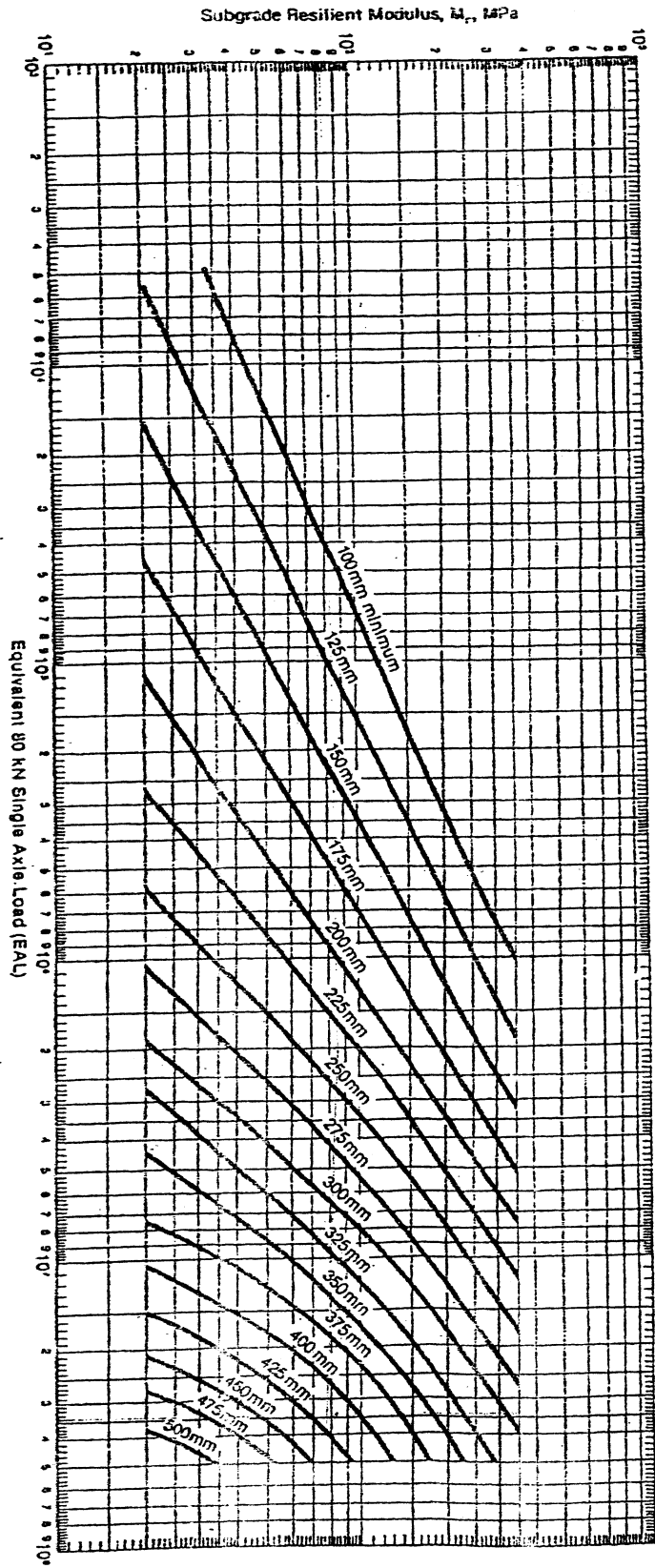
Subgrade Resilient Modulus, M_r, MPa

Equivalent 80 kN Single Axle Load (EAL)

100mm minimum
125mm
150mm
175mm
200mm
225mm
250mm
275mm
300mm
325mm
350mm
375mm
400 mm
425 mm
450mm
475 mm
500mm

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: - Transportation Engineering II

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

1. a) Describe traffic characteristics. [8]

   b) Two trucks A and B weight 7 tonne and 12 tonne approaching from west and south direction applied brakes and skid through distances 3.2cm and 1.9 m respectively before collision. After collison truck A was thrown making an angle of 50° from West to North ands skid through a distance of 2.8 m. Truck B skids along a distance of 3.8 m from North to East making an angle of 60°. Calculate the initial speeds of approaching vehicles. [8]

2. a) What is street lighting? Write the importance of street lighting and factors influencing night visibility. [8]

   b) Twenty spot speed observations were taken in kmph were as under: [8]

      45, 50, 42, 41, 60, 72, 65, 46, 62, 45, 56, 54, 49, 60, 70, 62, 43, 47, 42 and 40. Calculate: (i) Time mean speed (ii) Space mean speed (iii) Verify the relation between two.

3. a) Describe the different factors affecting pavement design. [8]

   b) Design a flexible pavement by using Asphalt Institute Method for a two lane two way pavement carrying traffic of 1500 cv/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 2500 MPa, 1200 MPa and 125 MPa respectively. Assume construction period of 18 months. Draw a net sketch of pavement layers. [8]

4. a) What are the different tools, equipment and plants used in road construction? [8]

   b) What is surface dressing? Write the construction procedure of double bituminous surface dressing. [8]

5. a) Write the importance of road maintenance. Describe the maintenance of rigid pavement. [8]

   b) Write the methods of bridge classification. [8]

6. Write short notes on: [4×4]

   a) On - street and off-street parking
   b) Prime coat and tack coat
   c) Fixed delay and operational delay
   d) Radius of relative stiffness
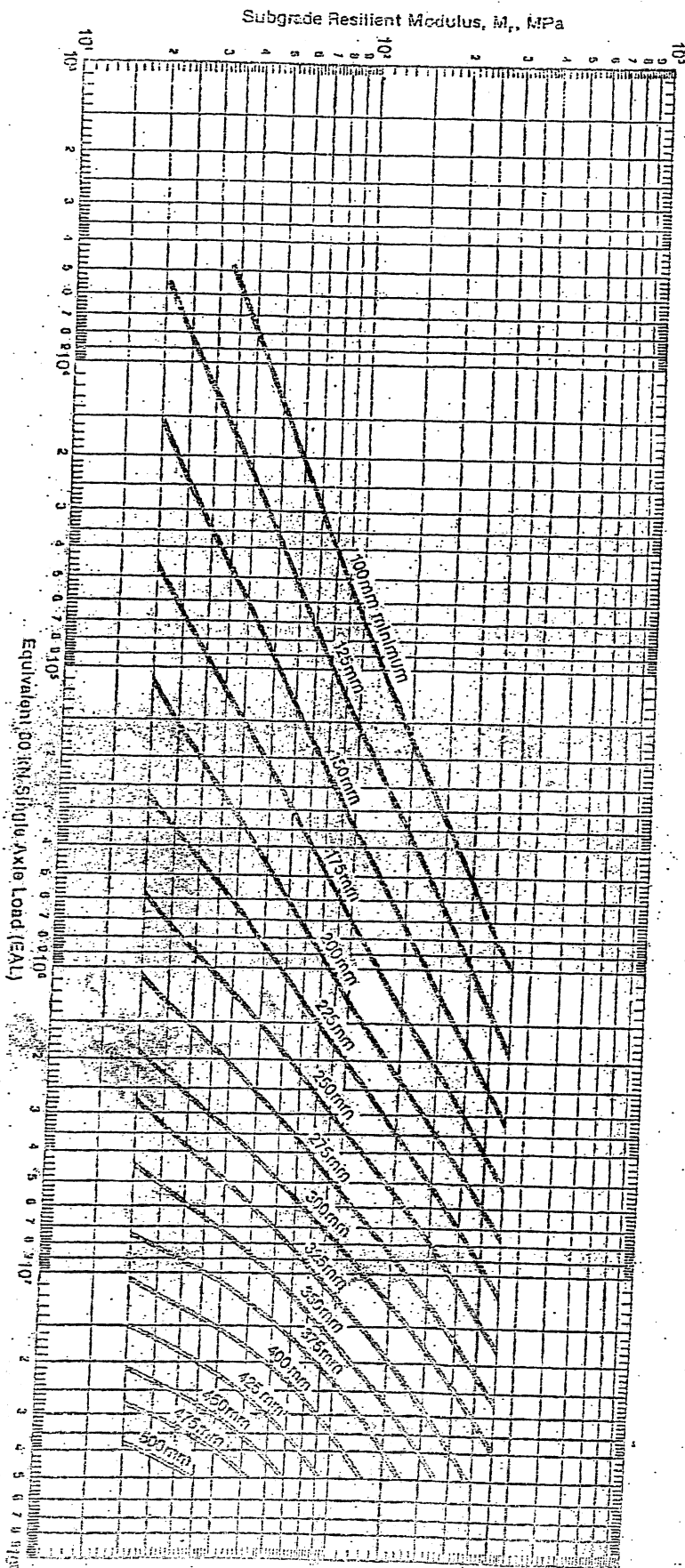
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Subgrade Resilient Modulus, M$_r$, MPa

Full-Depth Asphalt Concrete

Equivalent 80 kN Single Axle Load (EAL)

100mm minimum
125mm
150mm
175mm
200mm
225mm
250mm
275mm
300mm
325mm
350mm
375mm
400mm
425mm
450mm
475mm
500mm

P.46

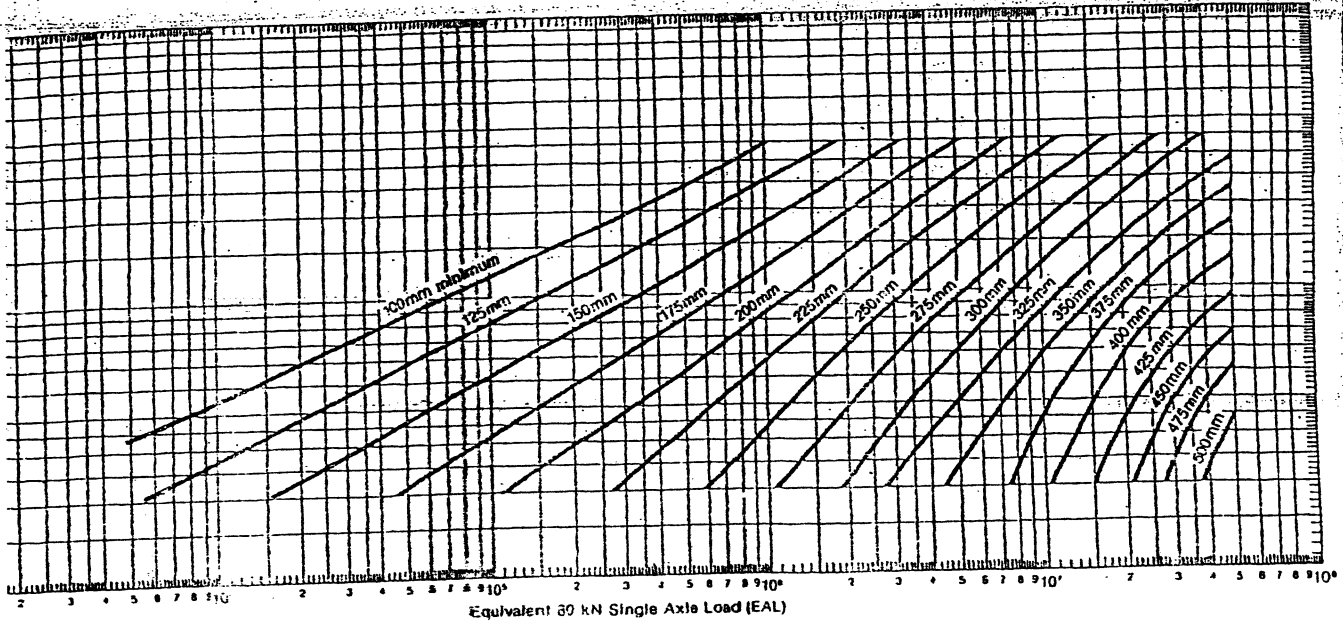| Exam.		Regular / Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Transportation Engineering

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** question.
✓ The figures in the margin indicate **Full Marks**.
✓ **Necessary figures are attached herewith.**
✓ Assume suitable data if necessary.
✓ Provide normal graph.

1. a) What are the basic requirements of intersection at grade? Describe channelized intersections with their advantages. [8]

   b) A driver of a car applied brakes and avoided hitting the parked vehicle on the roadway. The car left the skid marks of 37m. Assuming f = 0.62 and braking efficiency of 90%, determine whether the driver was violating the 50 kmph speed limit at that location if the driver is travelling (i) up hill on 3.5°slope (ii) downhill on 2.45° slope (iii) on the level roadway [8]

2. a) Explain human-vehicle-environment operating system. [8]

   b) The spot speeds at a particular location are normally distributed with a mean of 51.7 kmph and standard deviation of 8.3 kmph. What is the probability that [8]
   i) The speed exceeds 65 kmph?
   ii) The speed lies between 40 kmph and 70 kmph?
   iii) What is the 98th percentile speed?

3. a) Differentiate between flexible and rigid pavements. How the load is transferred to the layer underneath in flexible and rigid pavaments? [8]

   b) Design the flexible parament using CBR curve with the help of following data: [8]
   i) Subgrade soil (soaked) CBR = 5%
   ii) Laterite sub-base (soacked) CBR = 15%
   iii) Water bound macadam base CBR = 95%
   iv) Number of heavy traffic per day in may 2003 = 150
   v) Design life = 15 years
   vi) Annual rate of increase in heavy vehicle = 5%

   The road is purposed to be completed in may 2008. (Use CBR curve for design).

4. a) Draw a mass haul diagram with neat sketch and explain the properties of the diagram. [8]

   b) Distinguish between prime coat and tack coat. Write down the construction procedure of surface dressing. [8]

5. a) Explain the factors that should be considered in selecting the bridge site. What are different method available for protecting river bank? [8]

   b) Define road maintenance. Explain the causes of flexible pavement failure with sketches. [8]

6. Write short notes on : (any four) [4×4]
   a) On street and off street parking
   b) Pavement evaluation
   c) Define with neat sketch
      i) Pot holes in flexible pavement   ii) Mud pumping
   d) Road construction equipments and plants
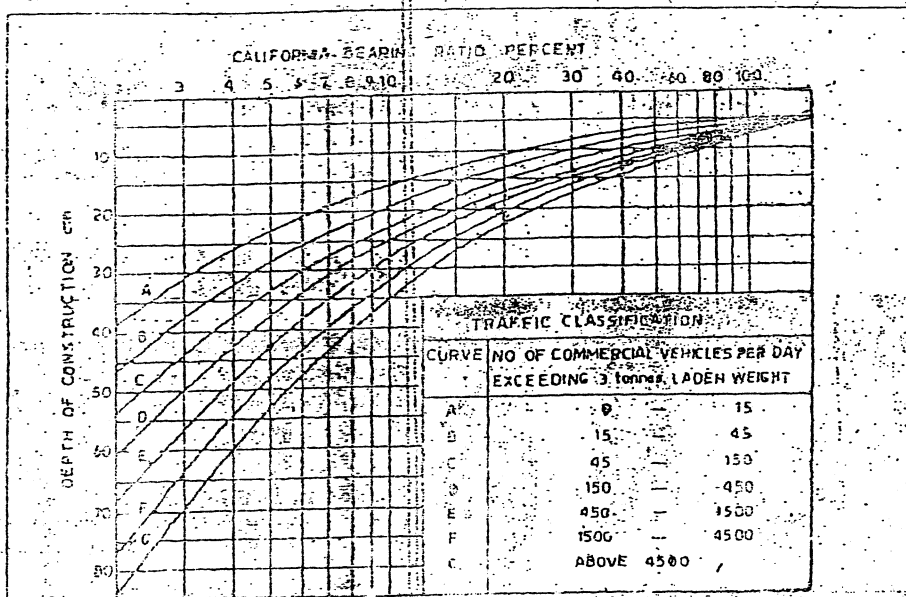   e) Types of maintenances

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Full-Depth Asphalt Concrete

Equivalent 80 kN Single Axle Load (EAL)

Qno 3(b)

Figure   C.B.R. Design Chart (Recommended by RC)

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 / 1	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

***

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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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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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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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) Define Project. Describe Joint Venture Project and Possibility of Technology Transfer through it. [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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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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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BGE, B.Agri.	Pass Marks	32
Year / Part	IV / 1	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:

   o 5 hours to make a total of 1000 bricks
   o Budgeted cost per brick is $ 0.05
   o 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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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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Exam.	New Back (2066 & 1		
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_0	t_1	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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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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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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INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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 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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Exam.			
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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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

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

Subject: - Project Engineering

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

1. a) Define a project and classify it? Name the characteristics of a project and describe what you mean by temporary team/organization in a project. [8]

   b) Name project life cycle and explain how you set goals in a project by giving example of one goal and verifying the same with the criteria of goal setting. [8]

2. For a project, following durations are given: [16]

SN	Activity	Durations	Precedence	Successor
1	A	5	–	E
2	B	6	–	F
3	C	7	–	G
4	D	8	–	H
5	E	9	A	I, J
6	F	7	B	I, J
7	G	5	C	I, J
8	H	3	D	I, J
9	I	4	E, F, G, H	–
10	J	5	E, F, G, H	–

   Find EST, EFT, LST, LFT, TF, FF. Show critical path and find duration.

3. a) Define PERT and discuss its uses. Project A and B have t_0, t_m and t_p as 5, 8, 12 and 6, 8, 11 respectively. Find Mean and Standard Deviation. Which project is better and more certain? [8]

   b) What are Gantt chart and discuss about resource allocation and smoothing. [8]

4. a) Differentiate Monitoring and Controlling by explaining Project Control Cycle. Explain the concept of Earned Value Analysis used for controlling cost. [8]

   b) Define Work Breakdown Structure? Write its importance and use. [8]

5. a) Explain the importances of Budgeting. Name different types of budgets and explain Capital Budgeting decision and Budgeting process. [8]

   b) Describe Socio Economic survey and also social and ordinary cost benefit analysis. [8]

6. Write short notes on: (any two) [8+8]

   a) Environmental problems and type of impacts
   b) Project Management Information System (PMIS)
   c) Linear Programming
   d) Goal setting in a project

7. Write short notes on: [4×4]

   a) WBS and its uses
   b) Feedback Control System
   c) Manpower Levelling
   d) Cashflowability and Capital Structure

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

Subject: - Project Engineering

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

1. a) Explain project family tree with suitable example. Explain also criteria of goal setting in any project. [4+4]

   b) List out different phases of project life cycle. Explain in details what are the activities to be done in implementation phase of project life cycle. [8]

2. Define forward and backward pass in the network analysis. Draw the network diagram and compute EST, EFT, LST, LFT, TF, FF, IF and interferring floats for each activities of the project having precedence relationship as shown below. Also find out critical path. [4+12]

Activity	A	B	C	D	E	F	G	H	I	J	K	L
Duration (days)	10	9	7	9	8	5	11	6	9	12	10	8
Predecessors	—	—	A	A	B	B	D,E	C,G	H	G	G,F	K

3. a) Explain with examples closed system and open system of control. Justify the statement "Quality costs more, but lack of quality costs even more". [8]

   b) Define Project Management Information System (PMIS), stating objectives of PMIS. Explain the various choice of information channel in a project. [8]

4. a) Why project planning is necessary in any project? List out the planning tools used in project management. Write down the limitations of conventional bar chart showing suitable example of a bar chart. [4+4]

   b) Explain earned value analysis graphically showing favourable and unfavourable cases of variance. For a particular project, budgeted cost of work schedule was 9,50,000 and budgeted value of the work actually completed or earned value was 8,00,000 at a point of reporting date i.e. at 20 weeks from starting date. The completion time of project is 45 weeks. Based on above details, draw features of that project and comment on the schedule performance. [4+4]

5. a) List out various errors in drawing a network diagram. Find out the expected time of each engineer mentioned below. Which engineer you will choose and why? Who is more certain in completing the job? [4+4]

Types	t_o	t_m	t_p
NTC Engineer	5	9	12
NCell Engineer	4	5	9

   b) Describe environmental impact analysis. Explain in brief about shadow pricing, market externalities, market imperfection and social cost benefit analysis [8]

6. a) Define budgeting? List out different types of budget. Explain the essential and purpose of budgeting for a new project. [8]

   b) Define capital structure planning. Explain in brief cash flowability, leverage ratio, flexibility and marketability of the company. [8]

7. Write short notes on: (any four) [4×4]
   a) Environmental problems in Nepal
   b) WBS with example specifying level
   c) Material scheduling
   d) Linear programming
   e) Resource allocation and smoothing
   f) Budgetary control

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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 Planning and Engineering (*Elective I*)(*CE72509*)

✓ 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 the decision-making process in transportation planning. [8]

2. Enlist the types of transportation survey. Differentiate between regional planning and urban planning. Describe road side interview survey method. [8]

3. Explain four step models for urban transportation planning with example in each step. [8]

4. A simple work-mode-choice model is estimated from data in a small urban area to determine the probabilities of individual travelers selecting various modes. The mode choices include automobile driver-alone (DL), automobile shared-ride (SR) and bus (B), and the utility functions are estimated as:
   $U_{DL} = 2.2 - 0.2$ (cost) $_{DL} - 0.03$ (travel time) $_{DL}$
   $U_{SR} = 0.8 - 0.2$ (cost) $_{SR} - 0.03$ (travel time) $_{SR}$
   $U_B = -0.2$(cost)$_B - 0.01$ (travel time)$_B$
   Where cost is in dollars and time is in minutes. Between a residential area and an industrial complex, 4000 workers (generating vehicle based trips) depth for work during the peak hour. For all workers, the cost of driving an automobile is $6.00 with a travel time of 20 minutes, and the bus fare is $1.00 with a travel time of 25 minutes. If the shared-ride option always consists of two travelers sharing costs equally, how many workers will take each mode? [8]

5. Mention with examples 'impact trade off in evaluation. Write down the project evaluation criteria. [8]

6. What are the factors affecting the selection of airport sites? Explain the aircraft characteristics that affect the runway length. [8]

7. Determine the length of runway using general correction factor for an airport in Eastern Nepal using the data given. Runway length required for landing at sea level in standard atmospheric conditions 2200 m, runway length required for take-off at a level at sea level in standard atmospheric condition 1800 m, aerodrome elevation 200 m, aerodrome reference temperature 25°C, temperature in the standard atmosphere for 200 m is 14.5°C. The construction plan includes the following data. [8]

End to end of runway, m	Grade (%)
0 - 500	+1.00
500 - 1000	- 0.20
1000 - 1500	+ 0.50
1500 - 2000	+ 1.00
2000 - 2500	- 0.30

8. Describe the functions of ballast and the depth requirement. Explain different types of railway stations. [8]

9. Calculate the super-elevation, maximum permissible speed and transition length for a 2.5° curve on a high-speed BG section with a maximum sanctioned speed of 100 kmph, equilibrium speed of 80 kmph and booked speed of the goods train as 50 kmph. The permissible equilibrium cant, cant deficiency and cant excess are 165 mm, 100 mm and 75 mm respectively. [8]

10. Justify the importance of gravity goods ropeway in the present context of Nepal. Write down its features and limitations. [8]

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 Planning and Engineering *(Elective I) (CE72509)*

✓ 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 scope of transportation planning and draw a flow chart depicting steps of transportation system analysis. [5+3]

2. Describe about multimodal transport planning approach. List various types of transport survey and highlight the importance of public transport survey. [4+2+2]

3. What is trip? Classify the different types of trips. [2+6]

4. A mode choice model was developed from a journey to work data from an urban area. The car and bus modes are available for travelers. The utility functions $U_i = -A_i - 0.4 IT_i - 0.1 OT_i - 0.008 C_i$. Where A = Modal constant, IT = In Vehicle Travel time, OT = Out Vehicle travel Time, C = Travel Cost [8]

Mode	Modal Constant	In Vehicle Travel Time (min)	Out Vehicle Travel Time (min)	Travel Cost (Rs)
Car	0.7	30	5	100
Bus	0.08	50	15	30

Determine the percentage of travel by Car and Bus for the existing condition. Suppose that rising fuel price lead to a cost increase by a Rs 50 for Car and Rs 10 for bus. How will mode shares be affected?

5. Briefly discuss several characteristics of evaluation for effective decision oriented planning process. [8]

6. Explain any two methods of sir travel demand forecasting method. What are the factors that affect airport site selection? [4+4]

7. The length of runway under standard conditions is 2000 m. The airport site has an elevation of 400 m. The mean of maximum and mean of average daily temperature of the hottest month are 44.8 and 26.2 degrees respectively. The maximum elevation difference along the proposed profile of runway is 6.0 m. Determine the actual length to be provided. [8]

8. Write the functions of rails and sleeper in railway track. How does negative superelevation affect geometric design of railway tracks? [4+4]

9. A 600 m radius curve is introduced between two tangent portions of a BG line intersecting to form a deviation angle of 70°. The booked speed for good train in the section is 50 kmph and the maximum sanctioned speed is 110 kmph. Calculate the equilibrium cant, maximum permissible speed, length of transition curve and cant gradient. Limits for maximum cant and cant deficiency are 165 mm and 100 mm respectively. [8]

10. Explain the main features of gravity goods ropeway. Describe its limitation. [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: - Transport Planning and Engineering *(Elective I) (CE 72509)*

✓ 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.*
✓ *Windrose diagram will be provided.*
✓ *Assume suitable data if necessary.*

1. Explain the four basic questions to be answered during transport planning. Differentiate between short term transport planning and long term transport planning with examples. [4+4]

2. What is multimodal transportation planning? What are the differences between planning of goods and people? [2+6]

3. Describe the use of linear regression models in estimating trip production. What is meant by logit model? Where is it used? [4+2+2]

4. Calculate the future trip distribution based on the average growth factor model using the existing trip matrix shown in table below upto 2 iterations. The set of future trip productions and attraction for zone A, B and C are (170,150), (170,180) and (160,170) respectively. [8]

Zone	A	B	C
A	24	30	27
B	21	15	18
C	15	21	27

5. What is evaluation? Explain the issues that form the basis of evaluation. [1+7]

6. How is wind rose diagram utilized in airport design? Enumerate several factors affecting airport site selection. [4+4]

7. Explain wind rose diagram method II for determining the runway orientation. Find the runway orientation using Wind Rose Diagram Method I for the following data. [4+4]

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
7.2	9.7	5.9	3.8	3.3	2.9	3.1	3.8	6.6	10.3	11.1	9.2	8.7	5.9	4.7	3.8

(The Windrose diagram must be return back with the answer sheet)

8. What are the different component parts of railway track? Explain the different requirement of ideal railway track. [4+4]

9. The maximum sanctioned speed on a BG track for a circular curve is 100km/hr, speed of goods train is 50 km/hr and equilibrium speed is 80km/hr. Design super elevation to be provided. If length of transition curve to be provided is 100m what will be the permissible speed for the railway. The permissible equilibrium cant, cant deficiency and cant excess are 165, 100 and 75 mm respectively. The degree of curve is 3 degrees. [8]

10. Describe the operating mechanism of gravity goods ropeway with a sketch. Why such ropeways have limited applications for economic benefit? [4+4]
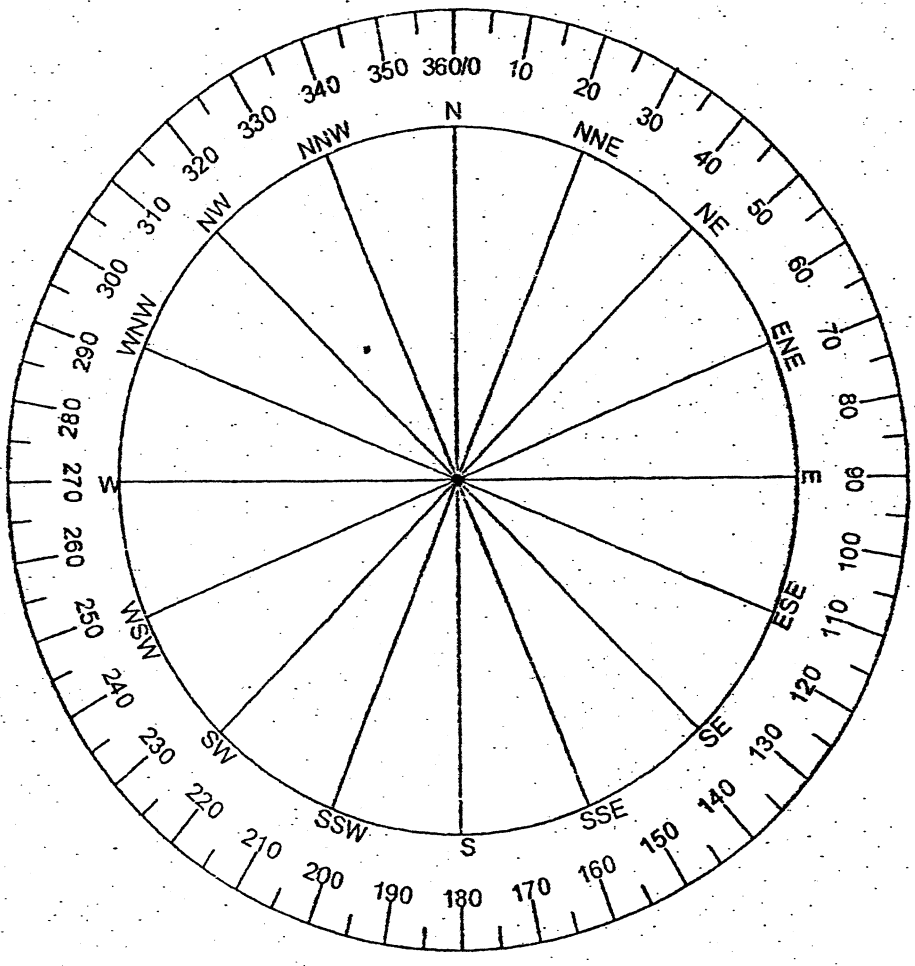
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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Transportation Planning and Engineering (Elective I) (CE72509)

✓ 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. What are advantages and disadvantages of Simulation Techniques in Transportation Planning? Explain stepwise method of simulation modeling for studying traffic problem.

2. Write down difference between urban and regional transport planning. Explain method of tag on vehicle survey and post card survey to collect transport data.

3. A small town has been divided into three traffic zones. The number of trips produced and attracted in each zone is shown in the table below.

Zone	1	2	3
Trip Produced	710	890	340
Trip Attracted	670	770	500

Intra-zonal average trip distance is 5 km, distance between zone 1 and 2 is 10 km, zone 2 and 3 is 15 km and zone 1 and 3 is 15 km. Develop the trip distribution matrix by gravity model at least up to 2 iterations. Assume Socio-economic factor = 1, and friction factor (F_{ij}) is related to travel distance (d_{ij}) as $F_{ij} = 120 - 4\,d_{ij}$ Where, d_{ij} in km.

4. There are three alternative roads between two district A and B. Average travel time along these three roads are 21, 28 and 37 minutes. The Trip interchanges between these two districts are 4,636 veh/day. Assign traffic among three routes by using (i) All or Nothing method, and (ii) Multipath assignment method.

5. Define Evaluation of alternative, its purpose and its characteristics.

6. Explain about the factors affecting airport site selection. Explain the process of determining the orientation of runway using Wind rose diagram I.

7. Yearly temperature variation of the proposed airport area has been shown below. The basic length of runway to be constructed in a airport is 2500 m. The differences in elevation between two points along the runway will be 5 mm per meter. The airport is situated at the elevation of 1200 m from mean sea level. Find out actual runway length to be provided by applying necessary corrections.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Mean daily Temperature (°C)	10	15	17	18	19	16	15	14	14	12	10	10
Mean of Max. daily Temperature (°C)	26	27	26	26	32	31	23	20	19	19	20	22

8. Define switch and crossing. Explain about different parts of switch and crossing in the railway with neat sketch.

9. Calculate super elevation and maximum permissible speed for Railway with BG track. The minimum radius of the alignment is 580 m. the maximum sanctioned speed and booked speed of goods train is 110 kmph and 45 kmph respectively.

10. Write down advantage of gravity rope way in the context of Nepal. Explain in brief the operating mechanism of gravity ropeway.

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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 / 1	Time	3 hrs.

Subject: - Transportation Planning and Engineering *(Elective I) (CE72509)*

✓ 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 model and model developing process in brief. List the responsible agencies for planning in Nepal. [4+4]

2. Distinguish urban and Regional Planning. Why origin and destination study is essential for the transport planning. [4+4]

3. Total trips produced and attracted to the 3 zones A, B, C of a survey area in the design year are:

Zones	Trips produced	Trips attracted
A	2500	2000
B	2500	3000
C	3000	2500

It is known that the trips between two zones are inversely proportion to the second power of the travel time between zones which are shown in table below. If the trip interchange between zones A and B is 900, calculate the interchange between zones A and C, B and C, B and A, C and A, C and B. [8]

Trip between	A and B	B and C	C and A
Travel time (min)	10	15	20

4. A mode choice model for a city includes following modes: Autos (A), Light rail (L), buses (B) and Rapid rail (R) with the utility function (U) as shown in tables.

Function:	Cost (C)	Time (T)
$U(A) = 3.2 - 0.3*C - 0.03*T$	5	30
$U(L) = 1 - 0.2*C - 0.04*T$	3	25
$U(B) = 0 - 0.1*C - 0.01*T$	2.5	40
$U(R) = 1.5 - 0.3*C - 0.05*T$	6	20

where C is cost in dollars and T is time in minute.

i) Based on estimate that 10,000 workers will head for downtown each morning, how many workers will choose to take a particular mode?

ii) If government subsides light rail by 40%, buses by 30%, and Rapid rail by 20% and the same time increases automobile cost by 25%, what will be the new modal distribution? [4+4]

5. Mention the principle facilities that should be considered in an airport plan with neat sketch. Write down the procedure of demand analysis in airport planning. [4+4]

6. Basic Length of runway is 1500m. The airport site has elevation of 1000m. Its reference temperature is 30 degree celcius. The maximum RL difference between highest and lowest point in the runway is 5m. Find the corrected runway length. Assume standard temperature at 1000m is 15 degree celcius. [8]

7. Calculate the super elevation, maximum permissible speed, and transition length for a 3° curve on a BG section with a maximum sanctioned speed of 120 km/h. Assume the equilibrium speed to be 80 km/h and the booked speed of the goods train to be 50 km/h. [8]

8. Explain the components of railway track with neat sketch. Mention the types of railway station with their functions. [4+4]

9. "Gravity goods ropeways are the indispensable for the economic development of Nepal, especially for hill terrain" elaborate the statement. Explain the features of gravity ropeway. [4+4]

10. Write short notes on: (Any two) [4+4]

    a) Intelligent Transportation System
    b) Rolling Stock of railway
    c) Wind Rose Diagram
    d) Principle of developing set of Alternative

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

Subject: - Transportation Planning and Engineering *(Elective I) (CE72509)*

✓ 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. List the various agencies involved in the planning stage in context of Nepal. Describe the decision making process in transportation planning.

2. Why the identification of freight transport and NMT demand is very important in planning. List the various types of transportation surveys.

3. Total trips produced and attracted to the 3 zones A,B,C of survey area in the design year is shown in table below. It is known that the trips between two zones are inversely proportion to the second power of the travel time between zones, which is uniformly 20 min. If the trip interchange between zones B and C is 850, calculate the interchange between zones A and B, A and C, B and A, C and B.

Zones	Trips Produced	Trips attracted
A	3500	2000
B	2000	2500
C	1500	2500

4. Trip rate corresponding to Household (HH) size are as shown in given table. Develop the trip generation model and compute the trip rate corresponding to household size of 3.25. Also check for statistical significance based on goodness of fit.

HH size	Trips per day		
1	1	3	3
2	3	4	5
3	4	5	7
4	5	8	8

5. Define stop way and clear way. Explain the aircraft characteristics that affect the runway length.

6. At an airport site at sea-level with standard atmospheric conditions, the runway length requires for take-off and landing are 2000 m and 2400 m respectively. The proposed airport is situated at an altitude of 150 m. If he airport reference is temperature 25°C and if the effective runway gradient is 0.35 percent, calculate the length of runway to be provided.

7. Discuss the components of railway track with neat sketch. make a neat sketch of left hand turn-out.

8. Calculate the superelevation and maximum permissible speed for 3 degree curve on high speed BG track with the following data:

   i) Maximum sanctioned speed = 130 Kmph
   ii) Equilibrium speed = 85 Kmph
   iii) Booked speed for goods train = 50 Kmph

9. Write down the steps in transport system analysis. What are the principles of developing a set of alternatives?

10. Why gravity goods ropeway is considered to be a viable option in context of rural areas of Nepal. Explain about the pros and cons of the gravity good ropeway.

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06H   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 Planning and Engineering *(Elective I) (CE72509)*

✓ 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. "Transportation planning is a continuous process, elaborate this statement". Explain land-use transportation cycle.

2. Enlist the types of transportation surveys. Mention difference between the planning for movement of people and goods.

3. Discuss about the Four Step modeling and mention the drawback of growth factor method of trip distribution.

4. A study represents the following characteristics:

Average HH size	2	3	4	5	6
Average total trips per day	5	7	8	10	10

   Derive the trip generation equation and Calculate R^2 value (coefficient of determination)

5. Define Effective Gradient. Find corrected runway length for Dang Airport, laying at 200 m elevation and having basic runway length of 1200 m. The Aerodrome reference temperature is 28 degree and Standard temperature at given elevation being 13.5 degree. Take the difference between Maximum elevation and minimum elevation as 20m.

6. What is Wind Rose diagram? Discuss its importance. What are the factors to be considered while selecting the airport sites?

7. Calculate the super elevation, maximum permissible speed and transition length for a 3° curve on a high-speed BG section with a maximum sanctioned speed of 100 km/h. Assume the equilibrium speed to be 80 km/h and the booked speed of the goods train to be 50 km/h.

8. What are the superior aspects of Railway over Roadway? Discuss about various component of railway track with neat diagram.

9. What are the principles for developing a set of alternatives in transportation system analysis?

10. Explain operating mechanism of Gravity goods Ropeway. Discuss the characteristics features of gravity goods ropeway.

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6 H   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 Planning and Engineering *(Elective I) (CE72509)*

✓ 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. Transportation planning is necessary at national, regional and urban level. Give reasons why such level wise planning is required. Describe in detail elements of urban transport planning process. [8]

2. Discuss the need of identification of NMT demand. List the various types of transportation survey. Explain about Household Questionnaire Survey in brief. [2+3+3]

3. Why is project evaluation necessary? Discuss various aspects of evaluation of alternatives. [8]

4. Describe the factors that are to be considered for selecting suitable airport site. What is stop way? [8]

5. What are the superior aspect of Railway over Roadway? Discuss about various component of railway track with neat diagram. [2+6]

6. A 2 degree BG transitioned curve on a high speed route has a maximum sanctioned speed of 100 kmph. For computing the equilibrium super elevation the speed has been given as 75 kmph and the booked speed for goods traffic is 50 kmph. Determine the field super elevation and maximum speed that can be allowed. [8]

7. Calculate the modal split based on the calibrated cost function for one of the city of India as:

Mode	Auto	Micro	Bus
A	0.3	0.35	0.4
Y	20	32	40
X	26	18	15

   $C = A + 0.01*X + 0.04*Y$
   Where, A = Constant, X = travel cost (Rs.) and Y = travel time (min)
   In order to reduce congestion, government tries to increase the patronage of public transportation by reducing fare of bus. What would be the changed modal split, if the travel cost (fare) of bus is subsidized to 60% of initial? [5+3]

8. Define effective gradient. Calculate corrected runway length for: Aerodrome elevation 1250m, mean of maximum and average temperature of hottest month of the year as 42°C and 20°C, maximum elevation difference 20m and basic runway length 1500m. [8]

9. What do you understand by trip production and trip attraction? What are the advantages and disadvantages of Growth factors trip distribution models. [3+5]

10. Describe the operations of gravity goods ropeways and mention why such rope-ways are beneficial. [8]

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061   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 Planning and Engineering *(CE72509) (Elective I)*

✓ 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. Describe the basic elements in the transportation planning process. State, why this process in not intended to furnish a single result.

2. What are the key factors which make planning for movement of people different from planning of goods movement ? Highlight some indicators used.

3. Define trip production and attraction. Discuss the characteristics of urban travel.

4. Clearly state the objectives of conducting project evaluation. List the basic criteria for evaluating transportation projects.

5. Discuss the characteristics of aircraft which have influence on aerodrome planning design and operation.

6. What are the components of railway track structure? Identify the functions of each component.

7. What are the specific advantages of gravity goods ropeway as compared to other modes of transportation? Include relevant variables to support your answer in the Nepalese context.

8. Distribute the total 500 work trip productions from zone 1 to zones 1, 2,3,4,5. The details are given in table. Assume socio-economic factor as unity.

From	To	Attraction	Friction
1	1	80	45
1	2	500	30
1	3	1000	8
1	4	40	15
1	5	90	5

9. Determine the length of a runway using general correction factor, for the data given. Runway length required for landing at sea level in standard atmospheric conditions 2200 m, runway length required for take-off at a level site at sea level in standard atmospheric conditions 1800 m, aerodrome elevation 200 m, aerodrome reference temperature 25°C, temperature in the standard atmosphere for 200 m 14.5°C, runway slope 0.7%

10. Calculate the super elevation and maximum permissible speed for a 2° BG track with the maximum sanctioned speed = 130 kmph, equilibrium speed = 80 kmph and booked speed for goods train = 50 kmph.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
EXAMINATION CONTROL DIVISION
2070 ASHAD

Exam	NEW BACK (2066 & LATER BATCH)		
Level	BE	Full Marks	80
Programm	BCE	Pass Marks	32
Year/Part	IV/I	Time	3hrs

Subject : *Transportation Planning and Engineering (Elective I)(CE 72509)*

➢ Candidates are required to give answers in their own words as far as practicable
➢ All questions carry equal marks.
➢ Assume suitable data if necessary.
➢ Attempt all questions.

1. What are the purpose of planning? Give an example of impact trade-off decision making. Explain land use transportation cycle.

2. What are the types of transportation survey? Why origin and destination study is essential for planning the transportation network?

3. The trip rate and corresponding household size for a sample are given below. Compute the trip rate if average household size is 3.5.

Trips per day	Household size			
	1	2	3	4
	2	4	5	6
	4	5	6	9
	4	6	8	9

4. Classify the trips. Explain the four step modeling process of urban transportation planning.

5. Define cross wind component and wind coverage Discuss the importance of wind rose diagram.

6. The basic runway length of an airport is 2200 m and the elevation of the site is 200m. The airport reference temperature is 25°C and effective gradient is 0.38%. Find the corrected runway length.

7. Explain the functions of component parts of railway track.

8. Find out the superelevation to be provided and the maximum speed for a 3° BG transition curve on a high speed route having a maximum sanctioned speed of 120 kmph. The equilibrium speed is 80 kmph and booked speed for goods traffic is 55 kmph

9. Justify the statement 'Gravity goods ropeway can be the promising alternative to address remote life'. Discuss the limitations of such ropeway.

10. What is an evaluation? Discuss the principles for generating a set of alternatives.

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
EXAMINATION CONTROL DIVISION
CHAITRA 2069

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

Subject : *Transportation Planning and Engineering (Elective I)*

➢ *Candidates are required to give answers in their own words as far as practicable*
➢ *All questions carry equal marks.*
➢ *Assume suitable data if necessary.*
➢ *Attempt all questions.*

4. Describe the decision making process in transportation planning.
5. What are the methods of transport survey? Why origin and destination study is essential for transportation planning.

6. Total trips produced in and attracted to the three zones A,B,C of a survey area in the design year tabulated as:

Zones	Trips produced	Trips attracted
A	1200	1500
B	1800	2000
C	3000	2500

It is known that the trips between two zones are inversely proportion to the second power of the travel time between zones which is uniformly 30 minutes. If the trip interchange between zones B and C is known to be 330, calculate the trip interchange between zones A and B, A and C, B and A and C and B.

4. Write down the steps for urban transportation planning process. Where logit model is used in urban transport modeling.
5. What are the characteristics of an ideal airport layout? Discuss the importance of wind rose diagram.

6. Basic runway length is 1280 m. The airport site has an elevation of 1200 m. Its reference temperature is 18°C. If the runway is to be constructed with an effective gradient of 0.5%, determine the corrected runway length.
   List out the methods of transport survey. Explain the home interview method.
7. Explain the components of railway track. Why grade compensation is done on curves of railway track?
8. Calculate the super elevation and maximum permissible speed for a 2° curve on a high speed BG track with the maximum sanctioned speed = 120 kmph, equilibrium speed = 85 kmph and booked speed for goods train = 50 kmph
9. What are the principles of developing set of alternatives?

10. What is ropeway? Explain briefly the components of gravity goods ropeway.

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

Subject : *Transportation Planning and Engineering (Elective I)*

➢ Candidates are required to give answers in their own words as far as practicable
➢ The figures in the margin indicate **Full marks**.
➢ Assume missing data if necessary. Necessary charts and tables attached.
➢ Attempt any five questions.

8. a) What is the scope of transportation planning? Define accessibility and mobility. [8]

b) Basic length of runway is 1200 m. The airport site has an elevation of 700 m. Its reference temperature is 18°C. If the runway is to be constructed with an effective gradient of 0.15%, determine the corrected length of runway. [8]

2. a) What is the travel demand? Describe the steps of travel demand forecasting model for urban transportation planning. [8]

b) What is the importance of O-D survey? Describe the use of O-D data in the transportation planning. Describe the data to be collected by home interview method . [8]

3. a) What is evaluation of alternatives? Mention the principles for generating alternatives during transportation planning. [8]

b) What are the organizations involved in planning in Nepal? Describe the role of department of roads as an implementing agency. [8]

4. a) What are the factors to be considered during site selection of an airport? [8]

b) Total trips produced in and attracted to the 3 zones A,B,C of a survey area in the design year is tabulated as: [8]

Zones	Trips produced	Trips attracted
A	1200	1400
B	1500	1200
C	1400	1500

It is known that the trips between two zones are inversely proportion to the second power of the travel time between zones which is uniformly 15 minutes. If the trips interchange between zones B and C is known to be 900, calculate the trip interchange between zones A and B, A and C, B and A and C and B. [8]

5. a) Calculate the superelevation and maximum permissible speed for a 3° curve on a high speed BG track: [8]
   - maximum sanctioned speed = 130 kmph
   - equilibrium speed = 85 kmph
   - booked speed for goods train = 50 kmph

b) What are the component parts of rolling stock of railway? Calculate the material requirements for one km of BG railway track. [8]

6. Write short notes on: (any four) [4x4]
   a) Right hand turn out
   b) Railway stations: functions and types
   c) Advantages of air transportation
   d) Jet Engine
   e) Gravity model

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

Subject : *Transportation Planning and Engineering (Elective I)*

➢ Candidates are required to give answers in their own words as far as practicable
➢ The figures in the margin indicate **Full marks**.
➢ Assume missing data if necessary. Necessary charts and tables attached.
➢ Attempt any five questions.

1. a) List out the responsible agencies for planning in Nepal and mention their roles for planning. [2+6]

   b) Describe the scope of transportation planning in brief. [2+6]

2. a) What is difference between urban and regional planning? Describe the economic location theory and factors affecting the relative desirability of a location. [2+6]

   b) List out the methods of transport survey. Explain the home interview method. [2+6]

3. a) Total trips produced in and attracted to the three zones A,B,C of a survey area in the design year tabulated as: [8]

Zones	Trips produced	Trips attracted
A	4000	2000
B	3000	4000
C	2000	3000

   It is known that the trips between two zones are inversely proportion to the second power of the travel time between zones which is uniformly 20 minutes. If the trips interchange between zones B and C is known to be 900, calculate the trip interchange between zones A and B, A and C, B and A and C and B.

   b) Make a flow chart of urban transportation planning process. Describe the application of logit model in urban transport modeling system. [4+4]

4. a) What are the components of an aircraft? Make a neat sketch of an aircraft. [8]

   b) make a layout plan of an airport. Calculate the corrected length of runway for the given conditions:[8]
   - reference temperature for the airport site is 20°C
   - basic length of runway is 1280 m
   - altitude above mean sea level is 900 m
   - runway gradient is 0.25%

5. a) what are the components of rolling stock of railway? Make a sketch of right hand turn out of railway track. [4+4]

   b) Calculate the superelevation and maximum permissible speed for a 2° curve on a high speed BG track with the following data: [8]
   - maximum sanctioned speed = 150 kmph
   - equilibrium speed = 80 kmph
   - booked speed for goods train = 55 kmph

6. Write short notes on: (any four) [4x4]
   a) Factors affecting trip generation
   b) Cross wind component, wind coverage and wind rose
   c) Equivalent criteria of transportation projects
   d) Types of railway stations
   e) Transportation systems in Nepal

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: - Rock Engineering (Elective I)(CE72508)

✓ 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 Steronet are attached herewith.__
✓ __A4 size tracing paper will be provided if necessary.__
✓ Assume suitable data if necessary.

1. Why rock engineering is important in hydropower development? Is there any reason delay of hydropower related to the rock engineering? Discuss briefly, problem caused by water in designing underground structures. [8]

2. What are your observation about the intact rock and rock masses? Are you agree with the term there are different kind of properties in rock? If so list them and explain them showing characteristics and engineering uses of any four. [8]

3. What do you mean by rock stress? Explain about the origin and magnitude of rock stress situation surrounding underground opening. What are the stability problem due to stresses? Calculate the magnitude of tangential stress by the Hoek and Bray practical method at the roof and wall of an unlined pressure shaft having Roof factor = 3.8; Wall factor = 2.4 and vertical stress = 30 MPa. [8]

4. Estimated the water flow into tunnel by the Tokheim and Janbu method from the following data: [8]

   Length of tunnel = 1845 m; Active head = 0.75 MPa; Distance between length axis and groundwater table = 66 m; Unit weight of water = 10 kNmm^3; Equivalent radius = 3.6 m; Hydraulic conductivity = 10^{-13} m/s.

5. Describe in detail stages and substages of geological investigation for underground hydropower plants. Write contents of engineering geological report from the define plan study investigations. [8]

6. Describe the Q-method for quality rating of rock mass and support estimation for a tunnel. Briefly discuss support methods which are commonly used in the hydropower tunnels. [8]

7. Write difference between shallow seated and deep seated opening for underground opening. From the study of these two types opening how you locate the tunnel in the field give examples. What type of the main slope failure occurs in Nepal? What are the assumption of plane failure? [8]

8. a) What are the major points to be considered in designing low cost hydropower plants? Explain briefly. Draw the distribution of tangential stress surrounding the circular opening of tunnel for the following conditions and critically discuss the influence of rock stress anisotropy for above planned structure. [8]

   i) Major principal stress/Minor principal stress = 12/12 (MPa)
   ii) Major principal stress/Minor principal stress = 12/8 (MPa)
   iii) Major principal stress/Minor principal stress = 12/3 (MPa)

   b) Find the potential mode of failure, direction of failure and angle of failure of a rock slope having with following input data: [16]
   Joint Set 1: 50/340 degrees (dip/dip direction)
   Joint Set 2: 58/280 degrees (dip/dip direction)
   Joint Set 3: 15/080 degrees (dip/dip direction)
   Slope angle: 60/320 degree (dip/dip direction)
   Friction angle: 25 degree

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: - Rock Engineering *(Elective I) (CE72508)*

✓ 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**.
✓ **Equal area net and tracing paper are attached herewith.**
✓ Assume suitable data if necessary.

1. Why do you think rock engineering is important for Nepal? List the elements of hydropower plant. [4]

2. Describe term: Rock and Rock Mass. What are the physical and mechanical properties of rocks? [6]

3. Explain in brief Empirical method for estimation of shear strength of rock joints. [4]

4. The results from the joint survey are given below (dip, dip direction in degrees). Present the results in a joint rosette and show the possible orientation of a tunnel. [8]

45, 020	70, 300
70, 290	65, 020
45, 025	75, 290
43, 175	65, 310
25, 127	65, 020
45, 050	34, 125
74, 085	50, 115
30, 040	40, 330
65, 030	20, 160
65, 040	60, 325
55, 025	28, 132
30, 140	

5. Discuss about origin of rock stress in underground excavation. Show the distribution of tangential stress surrounding the circular profile of a tunnel for the following conditions. (The value of stress are in MPa). [4+6]

$\sigma_1/\sigma_3 = 12/12$
$\sigma_1/\sigma_3 = 12/9$
$\sigma_1/\sigma_3 = 12/6$

6. Discuss Hydraulic Conductivity and Permeability of rock mass. Explain Louis-equation to estimate the hydraulic conductivity of single joints. [4]

7. Calculate water flow (m³/s) into a tunnel having following input data: [8]

Length of tunnel = 5.5 Km
Potential active head = 0.8 MPa
Distance between length axis and groundwater table = 25 m
Dynamic viscosity of water = 0.0013 kg/ (m.s)
Equivalent radius = 2.5 m
Specific Permeability = 10^{-15} m²

8. What are the main goals of geological investigation for underground hydropower plants? Describe investigations which are carried out during construction phase. [6]

9. Describe the RMR-method for quality rating of rock mass and support estimation for a tunnel. [6]

10. Discuss in detail the various stages of design procedure for Shallow and Deep seated underground structures. [6]

11. Write main objectives of rock slope stability analysis. Describe plane failure with suitable sketch. [4]

12. The three discontinuity sets represents an area (ref. Table below). Find the mode of failure and angle of potential failure plane if angle of slope face is 62 degrees in the dip direction of 150 degrees. The fiction angle is 26 degrees. [10]

Joint set number	Dip/dip direction (deg.)
1 Joint set (J_1)	20/290
2 Joint set (J_2)	85/165
3 Joint set (J_3)	78/200

13. Describe briefly the rock support methods. Explain about important of the support system. [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: - Rock Engineering (Elective I) (CE 72508)

✓ 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 Steronet are attached herewith.
✓ A4 size tracing paper will be provided if necessary.
✓ Assume suitable data if necessary.

1. Describe the important of rock engineering in hydropower development. Explain the factors that are related to rock engineering causes the delay of hydropower. [4]

2. Explain the intact rock and rock masses. List the physical, index and engineering characteristics of rock and explain any three with suitable example. [8]

3. What do you mean by rock stress? What are the different type of stress associated to the rock list them? Discuss origin and magnitude of rock stress situation surrounding underground openings. Estimate the magnitude of tangential stress at the roof and wall of an unlined pressure shaft having roof factor = 3.9; wall factor = 2.6 and vertical stress = 24MPa. [5+4]

4. Calculate the water flow into tunnel for following conditions: [8]

   Length of tunnel = 1455m

   Active head = 0.65 MPa

   Distance between length axis and groundwater table = 65m

   Unit weight of water = $10 kN/mm^3$

   Equivalent radius = 3.4m

   Hydraulic conductivity = $10^{-13} m/s$

5. What are the problems associated with water in designing underground structures? Discuss briefly, problems caused by water in designing hydropower tunnels. [4]

6. What are the objectives of engineering geological investigation? List the activities that should be carried out during preconstruction and construction phase investigation. Write the contents of engineering geological report from the definite plan study investigations. [8]

7. What are the objectives of rock mass classification and its application? Explain classification system on the basis of support system. "The effect of the defects in a rock mass that reduces the strength of rock mass". Do you agree with this statement? If so which one classification system address this statement? [6]

8. Write difference between shallow seated and deep seated opening for underground opening. From the study of these two types opening how you locate the tunnel in the field give examples. [6]

9. Describe briefly the rock support methods that are commonly used in underground structure. Why support and lining are necessary during underground excavation. [5]

10. What types of the main slope failure occurs in Nepal? Describe the importance of stability analysis of rock slope for engineers. Describe toppling failure with suitable sketch. [6]

11. Why hydropower construction is being costly and time consuming in Nepal? Discuss the major hydropower of Nepal which cost is nearly double the estimated cost also give your opinion why became so. [4]

12. The three discontinuity sets represent an area (ref. table below). Find mode of failure, direction of failure and angle of potential failure plane if angle of slope face is 66 degree in the dip direction of 334 degree. [12]

Table: Discontinuity sets.

Joint set number	Dip/Dip direction (degree)	Joint Spacing (cm)	Roughness
Foliation (J₁)	66/185	1-2	Planner to undulating
Joint (J₂)	80/355	18-40	Undulating
Joint (J₂)	75/280	8-30	Undulating

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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: - Rock Engineering *(Elective I) (CE72508)*

✓ 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**.
✓ **Sterionet and tracing paper are attached herewith.**
✓ Assume suitable data if necessary.

1. What are the important of rock engineering in hydropower development? Draw a layout of hydropower plant with its main element. [4]
2. Define joint set. What do you mean by joint mapping? List the physical characteristics of rock and explain any three with example. [8]
3. What do you mean by rock stress? Discuss the origin and magnitude of rock stress situation surrounding underground openings. [4]
4. Calculate the water flow into tunnel for following conditions: [8]
   Length of tunnel = 1230 m
   Active head = 0.65 MPa
   Distance between length axis and groundwater table = 65m.
   Unit weight of water = 10 kNmm^3
   Equivalent radius = 3.25m
   Hydraulic conductivity = 10^{-13} m/s
5. Discuss briefly, problems caused by water in designing underground structures. Do you think it is important part for design of underground structures? [4]
6. What are the objectives of engineering geological investigation? List the activities that should be carried out during preconstruction and construction phase investigation. [8]
7. Define rock mass classification and its objectives. What are commonly used methods in rock classification describe them? [8]
8. Write difference between shallow seated and deep seated opening for underground opening. Also mention the main goals of design consideration for underground openings. [6]
9. Why support and lining are necessary during underground excavation? Describe briefly the rock support methods that are commonly used in underground structure. [6]
10. What are the factors affecting slope stability? What type of the main slope failure occurs in Nepal? Describe them with neat sketches. [6]
11. What are the major points to be considered in designing low cost hydropower plants? [6]
12. The three discontinuity sets represents an area (ref. table below). Find mode of failure direction of failure and angle of potential failure plane if angle of slope face is 66 degree in the dip direction of 342 degree. [12]

Table: Discontinuity sets.

Joint set number	Dip/Dip direction (Degree)	Joint Spacing (cm)	Roughness
1. Foliation (J₁)	65/185	1-2	Planner to undulating
2. Joint (J₂)	72/355	18-40	Undulating
3. Joint (J₂)	75/280	8-30	Undulating

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04G   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: - Rock Engineering *(Elective I) (CE72508)*

✓ 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 Equal Area Net and Tracing Paper (A4 size)are attached herewith.__
✓ Assume suitable data if necessary.

1. Define rock mass. Why it is important to know the physical properties of the rock mass? Explain in brief the different physical properties associated with rock mass. [8]

2. Define in-situ and induced rock stresses. Explain the origin of in-situ rock stresses and stress around circular opening with neat sketch. [3+5]

3. What are the different discontinuities present in the rock mass? Categorizes the discontinuity with its distinguishing features. [8]

4. From the parameter given, find the magnitude of stresses surrounding the underground opening (tangential) at the roof and the wall of an unlined pressure shaft using roof factor as 3.9, wall factor as 2.8 and vertical stress of 20MPa. Assume Poisson's ratio of 0.25. [6]

5. What is the potential mode of failure, direction of failure and angle of potential failure plane using stereopolt for the given following discontinuity sets if angle of slope face is 60 degree with dip direction of 325 degree? [10]

Features	Dip/ Dip direction in degree
Sheet joint	55/280
Joint set 1	55/335
Joint set 2	80/050
Joint set 3	70/330

6. What is Q-system in quality rating and support system estimation? Write down the RMI-support method in brief. [6+4]

7. Explain the characteristic of shallow – seated and deep – seated underground openings. What are the problems associated with shallow seated underground opening? Also explain the solution to such problems. [10]

8. Describe briefly the rock support methods that are commonly used in underground structure. [6]

9. What are the objectives of engineering geological investigation? List the activities that should be carried out during preconstruction and construction phase investigation. [4+6]

10. Why hydropower construction is being costly in Nepal. [4]

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

Subject: - Rock Engineering I *(CE72505) (Elective I)*

✓ 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.
✓ Provide A-4 size Tracing paper and copy of stereonet.

1. Define shallow seated and deep seated opening for underground structure? Describe the main engineering design procedure for underground opening. (8)

2. Estimate the magnitude of tangential stress at a roof and wall of an unlined pressure shaft using following input parameters (6)

    Roof factor = 3

    Wall factor = 2.5

    Vertical stress = 18 MPa

3. a) Recently you completed an engineering geological survey of an area. Write down contents that should be incorporated in the report. (4)

    b) What are the comments the classification system for rock support estimates. (4)

4. Calculate the water flow into a tunnel in lit/minute for following situations. (8)

    Length of tunnel = 350 m

    Specific permeability = $10^{-15} m^2$

    Active head = 3 MPa

    Equivalent radius = 4.0 m

    Distance between the length axis of excavation and ground water table = 20m

5. Write the main goals of engineering geological investigation. List the activities which should be carried out during preconstruction and construction phase investigation. (8)

6. Explain stress surrounding circular underground opening. (6)

7. Discuss support methods which are commonly used in underground structures (6)

8. Write short notes on: (6*2)

    a) Q- method for rating of the rock mass quality

    b) Design criteria for unlined high pressure tunnel and shaft (two rules of thumb).

9. The three discontinuity sets represents an area (ref. table 1). Find mode of failure and angle of potential failure plane if angle of slope face is 65^0 in the dip direction of 185^0

Table 1 Discontinuity sets   (10)

Joint set number	Dip/Dip direction	Joint spacing (cm)	Roughness
Foliation (J₁)	58/168	1-2	Planar to undulating
Joint (J₂)	52/342	18-40	undulating
Joint (J₃)	58/276	8-30	undulating

10. Plot the joint Rosette with following dip/dip direction (degrees) of discontinuities (ref table 2)

(8)

Dip/dip direction

40/300	55/07	15/290
25/025	70/075	78/340
20/29	15/330	65/08
75/165	25/280	22/285
10/280	12/280	83/09
80/100	70/08	75/140
65/07	75/200	75/190
80/190	30/290	80/340
80/200	20/330	20/320
75/060	68/070	78/060
75/240	25/290	78/200
15/290	82/160	22/280
78/090	30/290	80/110

Table 2

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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: - Bio-Engineering (*Elective I*)(CE72504)

✓ 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 justify the use of Bio-Engineering techniques? What are the fundamental issues related to Bio-Engineering slopes? Define RAR and show its general trend. Estimated root reinforcement effect using the fiber-break model. [2+2+2+2]

2. What are the main factors affecting slope stability? Discuss stability of slope based on mineral types. [8]

3. Define small scale Civil engineering system. Discuss about Wire Bolster Cylinder. [8]

4. What do mean by plant community and what are the factors that need to be considered while selecting the plant species for Bio-engineering techniques? [8]

5. Estimate the effect of vegetation on the factor of safety on a slope using the infinite slope method. The basic expression of factor of safety in case of slope without vegetation cover is given below. Follow the notation and data accordingly to estimate the factor of safety in a slope. [8]

$$F = \frac{C' + (YZ - Y_w h_w)\cos^2\beta \tan\phi}{YZ \sin\beta\cos\beta}$$

Effective soil cohesion within the soil = $10 kN/m^2$
Unit weight of the soil = $18 kN/m^3$
Yielding soil depth = 1m
Slope angle = 35 degree
Angle of internal friction of soil = 35 degree
Water table position above the yielding surface = 0.5 m

6. Enlist different vegetative stabilization techniques which are used as bio-engineering practices in our country and explain about Brush Layering Technique. [8]

7. Describe how hydrological components effect on instability of slope. List out the Mechanical functions of plants. [8]

8. a) Performance-based evaluation method is applicable in Bio-engineered slopes. How do you do with the following instruments? (i) piezometer, (ii) inclinometer, (iii) extensometer, and (iv) Pressure cells and strain gauges. [4]

   b) What would be the probable lab tests for the following root properties? (i) root-soil interaction, (ii) shear reinforcement, (iii) slope reinforcement, and (iv) root reinforcement. [4]

9. What are the factors that have to be considered while establishing a Nursery? Draw the typical section of the Grass Bed in a nursery and mention its general requirements. [8]

10. Write short notes on: (Any Two) [2×4]

    a) Basic requirement of plants
    b) Merits and demerits of Asexual plant Propagation
    c) Guidelines for selecting of Optimal Bioengineering techniques
    d) Bioengineering norms and specification

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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: - Bio-Engineering *(Elective I) (CE72504)*

✓ 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 bio-Engineering. Briefly explain about the different hydrological and engineering functions of bio-Engineering with some examples. [8]

2. Write briefly about the geology of Nepal and problems of slopes seen in Siwalik regions of Nepal. [8]

3. Explain about the major factors that govern the distribution of plant ecology in Siwalik regions of Nepal. List out the major problems that are seen in this region in the field of plant diversity. [8]

4. Define nursery. Explain the environmental and technical aspects of the nursery management. [8]

5. Mass movement events can likely be avoided by employing engineering techniques for making the slope more stable. Explain four major preventive engineering techniques to control the mass movement. [8]

6. What are the different purposes of cuttings that are used in vegetative systems of bio-engineering? [8]

7. "Properly designed vegetative cover or revegetation plays a significant role in preventing surface erosion and shallow mass failure". Explain the statement with the help of some vegetative structures with their functions. [8]

8. List out all the small civil engineering structures that are used in bio-engineering techniques. State about the design criteria, applications and engineering functions of check dam and gabion walls. [8]

9. After 6 years of tree plantation, it was found that following root system was developed. Calculate amount of increase in shear strength, if angle of internal friction of slope material is 32 degree and root were observed in C/S of 3 m². [8]

No. of roots	Dia. of roots (cm)	Tensile strength of root fiber (MPa)	Angle of shear distortion in shear zone
10	8	12	15
22	5	20	16
18	16	23	20
24	6	18	30

10. Write short notes on: (Any Two) [2×4]
    a) Grass Plantation and its types
    b) Planning the bioengineering maintenance works
    c) Plant species selection wrt drought factors
    d) Landslides treatment

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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: - Bio-Engineering *(Elective I)(CE 72504)*

✓ 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. Describe scope and Fields of application of bio-engineering with suitable examples you visited in field.

2. How slope stability is analyzed with different aspect? Explain anyone in brief with related examples.

3. What do you mean by plant community? How plant community helps for the sustainability of bio-engineering practice?

4. What are the roles of vegetation? Briefly explain the mechanical effect of vegetation with soil interaction.

5. Enlist the major problems caused by land slide. Draw the typical landslide map showing all components.

6. How can you select the plant species for bio-engineering in road side at mountainous region? Describe briefly.

7. Briefly explain the relationship between vegetative and civil engineering system. Describe functional use of retaining wall in bio-engineering.

8. What do you mean by optimal technique? Write down the procedure for the construction of brush layering and palisade.

9. Define bio-engineering nursery. What are the factors that must be considered when establishing a nursery? Explain with suitable examples.

10. Write short notes on: (Any Two)
    a) Hydrological function of plant
    b) Live checkdam
    c) Disadvantages of bio-engineering

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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: - Bio-Engineering (Elective I) (CE72504)

✓ 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. Define bioengineering. Briefly explain about the engineering and hydrological functions of vegetative structures that are used in bioengineering techniques.
2. Explain about the major causes and mechanism of slope failure in hilly regions of our country.
3. Define plant ecology. What are the major factors that govern the distribution of plant ecology in different geological regions of Nepal? Explain them.
4. What are the major objectives for establishing the nursery in mega projects? Describe the different criteria for the establishment of nursery for a highway project in lesser Himalaya zone of Nepal?
5. Fill in the blank boxes given below:

S.N	Structures	Functions	Applications	Advantages	limitations
1	Revetment wall				
2	Stone pitching				
3	Check dams				
4	cascade				

6. Mention at least 4 different differences between horizontal and vertical line of grass planation with figures.
7. Describe about the functions, installation process and limitations of turfing and brush layering.
8. After 6 years of tree plantation, it was found that following root system was developed. Calculate amount of increase in shear strength, if angle of internal friction of slope material is 24 degree and root were observed in C/S of 3 m^2.

No. of roots	Dia. of roots (cm)	Tensile strength of root fiber (MPa)	Angle of shear distortion in shear zone
14	10	13	22
17	11	22	19
14	14	15	21
22	09	16	24

9. Explain how the civil engineering structures interacts with the vegetative structures in respects to time and relative shear strength. Draw different graphs for different interacting structures.
10. Write short notes on: (any two)
   a. Effect of vegetation on factor of safety on a slope
   b. Land slide mapping
   c. Palisade
   d. Application of bioengineering

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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: - Bio-Engineering *(Elective I) (CE72504)*

✓ 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. What is Bio-Engineering? What are the advantages and limitations of Bio-engineering?

2. Write down the causes and Mechanisms of Landslide. Enlist the steps for preliminary and detail landslide mapping in site.

3. What are the major component parts of a landslide? How can the slope failures be categorized based on the effectiveness of bioengineering applications?

4. Define Nursery. What are the factors that have to be considered while establishing a nursery?

5. A site has been treated with tree plantation with the root characteristics given as below. Estimate the increase in the shear strength of the slope materials by perpendicular root area method-if the angle of internal friction of the slope material is 25° and the area of root coverage is 2m².

Dia or roots, mm	No. of roots	Tensile strength of root fibre, Mpa	Average Angle of shear distortion in the shear zone
7	10	20	17
11	20	10	18
15	18	18	15
19	24	12	22

6. Define Small Scale Civil engineering system. How they are interacting with vegetative engineering system? Explain with examples.

7. What are the basic criteria for plant species selection in Bio-engineering? Explain the process of Final Choice of Plant Type.

8. Enlist different vegetative stabilization techniques which are commonly used in bio-engineering practice and write down the procedures for the construction of Fascines.

9. Describe how hydrological components effect on instability of slopes. List out the engineering functions of Plants.

10. Write short notes on: (Any two)

    a) Maintenance activities in bio-engineering works
    b) Basic Requirements of Plants
    c) Plant propagation
    d) Guidelines for applying the Bio-engineering works

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06D 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: - Bio-Engineering *(Elective I) (CE72504)*

✓ 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. Define bio-engineering. Briefly explain about the different functions and applications of bio-engineering.

2. Explain about the mass movement and its classification indicating factor contributing to increase in shear stress.

3. Define nursery. What are the main components of nursery? Explain about the factors to be considered to select the nursery site.

4. Explain about the causes and mechanisms of slope failure during highway construction in Nepal.

5. What are the different factors that govern the distribution of vegetation in Nepal?

6. List out all the small civil engineering structures that are used in bio-engineering techniques. Explain about the different walls with their engineering functions.

7. Write short notes on:
   i) Relative strength of structures over time
   ii) Plant ecology of Nepal
   iii) Palisades and mulching
   iv) Maintenance activities in bio-engineering works

8. Check dams are simple physical constructions to prevent the down cutting of runoff water in gullies. Explain about the practical features of check dams.

9. Differentiate between horizontal and vertical line of grass plantation with figure.

10. After 6 years of tree plantation, it was found that following root system was developed. Calculate amount of increase in shear strength, if angle of internal friction of slope material is 25 degree and root were observed in C/S of 2 m^2.

No. of roots	Dia. of roots (cm)	Tensile strength of root fiber (MPa)	Angle of shear distortion in shear zone
10	8	12	15
20	5	20	18
18	9	10	20
24	6	18	22

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

Subject: - Bio-Engineering *(Elective I) (CE72504)*

✓ 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 scope and fields of application of bio-engineering. [8]

2. How slope stability is analyzed with different aspect? Explain any one in brief. [8]

3. What do you mean by plant community? How plant community helps for the switching of bio-engineering practice? [8]

4. What is the cause of failure? Draw typical landslide map showing all components. [8]

5. Describe how soil strength and stability analysis is important for vegetation. [8]

6. What is drought factor? Describe plant species selection based on drought factor. [8]

7. List out small scale civil engineering structures use in bio-engineering. Describe functional use of retaining wall in bio-engineering. [8]

8. Explain any three vegetative stabilization techniques with major function and design criteria. [8]

9. Define bio-engineering nursery. What are the factors that must be considered when establishing a nursery? [8]

10. Write short notes on: (any two) [4×2]

    i) Optimal technique
    ii) Engineering function of plant
    iii) Basic requirement of plant

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

Subject: - Bio-Engineering *(Elective I) (CE72504)*

✓ 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. Define bio-Engineering. Briefly explain about the different functions and applications of bio-Engineering.

2. Explain about the mass movement and its classification indicating factor contributing to increase in shear stress.

3. Define nursery. What are the main components of nursery? Explain about the factors to be considered to select the nursery site.

4. Explain about the causes and mechanisms of slope failure during highway construction in Nepal.

5. List out the basic sixteen steps of landslide mapping technique that are used in Nepal.

6. What are the different purposes of cuttings that are used in vegetative systems of bio-engineering?

7. What are the different factors that govern the distribution of vegetation in Nepal?

8. List out all the small civil engineering structures that are used in bio-engineering techniques. Explain about the different walls with their engineering functions.

9. Write short notes on: (Any two)
   a) Relative strength of structures over time
   b) Plant ecology of Nepal
   c) Palisades and mulching

10. After 6 years of tree plantation, it was found that following root system was developed. Calculate amount of increase in shear strength, if angle of internal friction of slope material is 30 degree and root were observed in C/S of 4m^2.

No. of roots	Dia. of roots (cm)	Tensile strength of root fiber (MPa)	Angle of shear distortion in shear zone
10	8	12	15
20	5	20	18
18	9	10	20
24	6	18	22

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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: - Structural Dynamics (Elective I)(CE72501)

✓ 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 D' Alembert's principle and principle of conservation of energy? Explain. [3]

   b) Differentiate harmonic load from periodic load with examples. [4]

   c) Derive equation for response of SDOF system for un-damped free vibration and explain natural frequency, time period and amplitude of vibration. [9]

2. a) The SDOF system having viscous damping has a spring stiffness 500 N/m, when the weight is displaced and released, the period of vibration is 2.0 sec and ratio of successive amplitude is 4 to 1. Determine the amplitude of the motion, transmissibility ratio (TR) when a force F (t) = 4 sin 4t is applied to the system. [8]

   b) For the steel frame as shown below which is subjected to a horizontal force applied at the girder level BC. The force decreases linearly from 25 kN at time t = 0 to zero at t = 0.6 sec. Determine (i) The horizontal deflection at t = 0.5 secs (ii) The maximum horizontal deflection. Assume the columns to be massless and the girder is rigid. Neglect damping. [8]
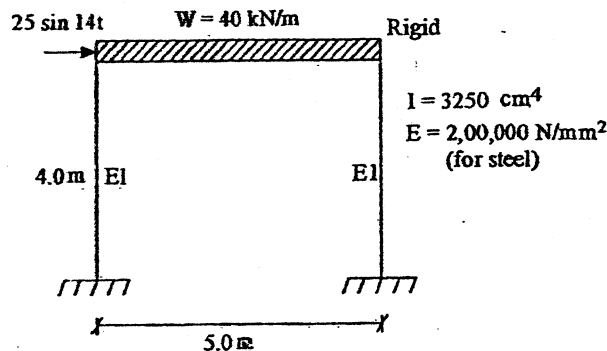
3. a) Determine the natural frequencies and modes shapes for the shear frame building as shown in the figure below. [12]
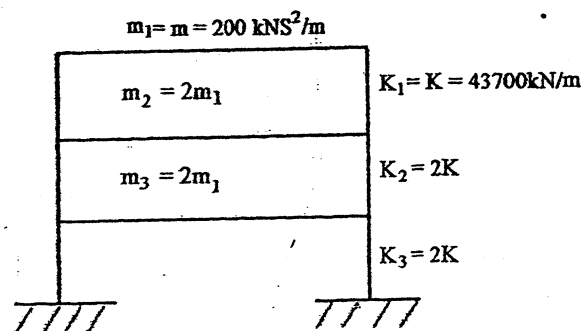
   b) Demonstrate numerically that the computed mode shape from above satisfies the orthogonality condition. [4]

4. a) Using matrix holzer method, find the fundamental period of vibration and fundamental mode shape of the three storey shear building as given. [10]

$M_1 = 2.0$ kN- sec^2/m

K_1 $M_2 = 2.5$ kN-sec^2/m   → V_1

K_2 $M_3 = 3.0$ kN-sec^2/m   → V_2

K_3 → V_3

Where

$K_1 = 700$ kN/m
$K_2 = 1100$ kN/m
$K_3 = 1700$ kN/m
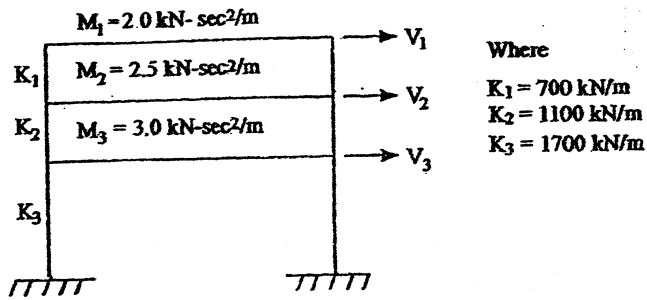
b) Derive the expression for equation of motion for transverse vibration of a beam. [6]

5. Write short notes on: (Any Four) [4×4]

   a) Time domain analysis for general dynamic loading
   b) Rectangular impulse
   c) Axial vibration of the bar
   d) Uncouple equation of motion
   e) Periodic loading

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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: - Structural Dynamics *(Elective I) (CE72501)*

✓ 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 do you mean by critically damped system, under-critically damped system and over damped system? Explain with response diagrams. [9]

   b) Demonstrate that the equation of motion expressed with reference to static equilibrium position of the dynamic system is not affected by gravitational force. [7]

2. a) A centrifugal fan weighs 50 kg and has a rotating unbalance of 25 kg.cm. When dampers having damping factor $\xi = 0.2$ are used, specify the springs for mounting such that only 10% of the unbalanced force is transmitted to the floor. Also determine the magnitude of the transmitted force. The fan is running at a constant speed of 1000 rpm. [6]

   b) Determine the response of SDOF system subjected to the rectangular impulse as shown in figure below. [10]
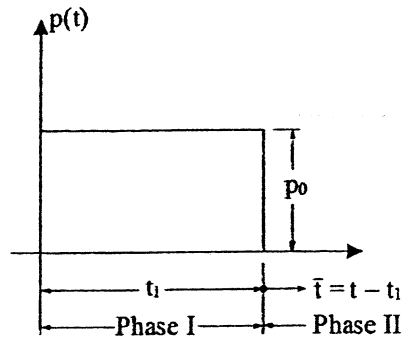
3. Find the frequency vector and mode shape matrix of the system as shown in figure below. [16]
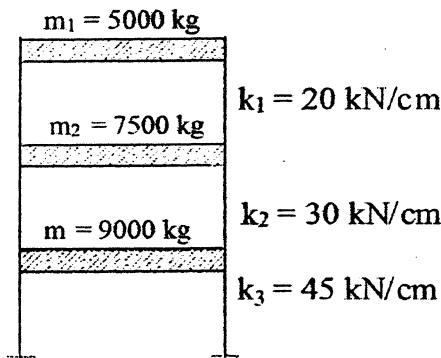
4. a) Using partial differential equations of motion for a continuous system (beam) evaluate frequencies and draw mode shapes of the beam shown in figure. [8]

p(t)

m, EI

L
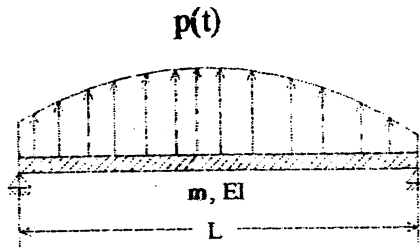
b) The mass and stiffness properties of a two storey shear building are shown in figure below. The structure is set into free vibration by displacing the floor by $v_1 = 1$ mm, $v_2 = 3$ mm and releasing them suddenly at time t = 0 sec. Find the deformed shape at time t = 2 sec. Assume undamped vibration. [8]

$m_1 = 5000$ kg
v_1
$m_2 = 6000$ kg $k_1 = 15$ kN/cm
v_2
$k_2 = 25$ kN/cm
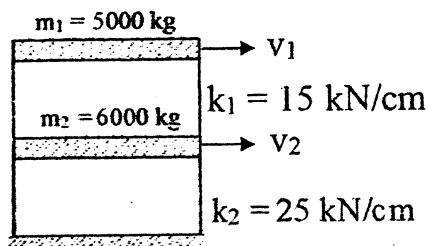
5. Write short notes on: [4×4]

   a) Logarithmic Decrement
   b) Duhamel integral
   c) Mode superposition method
   d) Rayleigh's Improved method for vibration frequency

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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: - Structural Dynamics *(Elective I) (CE 72501)*

✓ 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) Derive the expression of damped free vibration response for SDOF system. [6]

   b) A free vibration test is conducted on an empty elevated water tank. A cable attached to the tank applied a horizontal force of 20kN and pulled the tank horizontally by 7cm. The cable is suddenly cut and the resulting free vibration is recorded. The time taken for 10 complete cycle is 4sec and the amplitude recorded at the end of 10 complete cycle is 2cm. From the data, compute the following: [10]
      (i) Damping ratio
      (ii) Natural period of undamped vibration
      (iii) Stiffness coefficient
      (iv) Effective weight
      (v) Damping coefficient
      (vi) No. of cycle required for the displacement amplitude to decrease to 0.2m.

2. a) Derive the expression for the response of the structure to the harmonic loading of the undamped system. [10]

   b) For a SDOF system is subjected to a rectangular pulse load of amplitude 120kN and duration 0.4 second. Determine the response of the tower having mass 500kg and stiffness 200kN/cm during forced vibration and free vibration phase. Assume undamped system. [6]

3. a) The mass and stiffness properties of a three-story shear building are shown in figure 1. The structure is set into free vibration by displacing the floors as follows: $v_1 = 0.3$ in, $v_2 = 0.8$ in and $v_3 = 0.3$ in and then releasing them suddenly at time $t = 0$. Determine the displaced shape at time $t = 2$ sec assuming undamped vibration. [16]
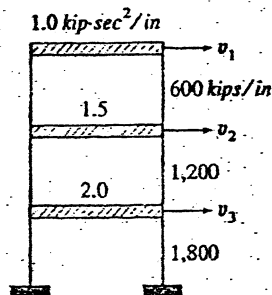
Figure 1

   b) Verify the orthogonality properties of the structure shown in above figure 1. [4]

4. Find the fundamental vibration mode shape and frequency for the structure as shown in figure 2 using Stadola or Holzer method. [12]
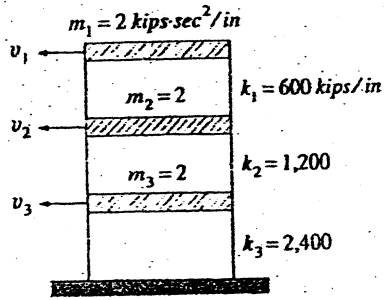
$m_1 = 2 \text{ kips·sec}^2/in$

v_1

$m_2 = 2$ $k_1 = 600 \text{ kips/in}$

v_2

$m_3 = 2$ $k_2 = 1,200$

v_3

$k_3 = 2,400$

Figure 2

[4×4]

5. Write short notes on:
   a) Frequency domain analysis for supprot motion
   b) Stodala Method
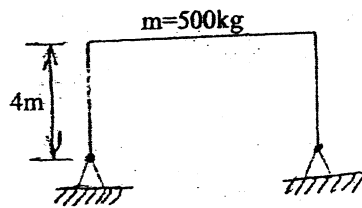   c) Seismic instrument
   d) Axial vibration of rod

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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: - Structural Dynamics *(Elective I) (CE 72501)*

✓ 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) How to differentiate between static and dynamic loading? Describe types of dynamic loading. Explain D'Alembert's Principle. [8]

   b) A SDOF system consists of the following parameters: mass, m = 5 kg, k=100 N/m and damping e=3 N-sec/m. Determine:

      (i) the damping factor
      (ii) the natural frequency of the damped vibration
      (iii) logarithmic decrement
      (iv) No. of cycles after which the original amplitude is reduced to 20%? [8]

2. a) Determine the response of the following system under the given initial conditions. Stiffness 320 kN/cm, weight = 58.86 kN, damping constant = 4, initial displacement= 2cm and initial velocity = 7.6 m/sec. Also plot the response. [8]

   b) For a SDOF system is subjected to a rectangular pulse load of amplitude 100KN and duration 0.4 second. Determine the response of the tower having mass 500kg and stiffness 200 kN/cm during forced vibration and free vibration phase. Assume undamped system. [8]

3. a) A steel rigid frame, as shown in figure below, supports a rotating machine, which exerts a horizontal force at the girder level of 50,000 sin11tN. Assuming 4 percent critical damping, what is the steady state amplitude of vibration? $I_{column} = 1500\times10^{-7}$ m⁴, E=21×10¹⁰ N/m². [6]

   b) Explain with an example how Holzer's method is carried out to determine the first mode of frequency of shear building. [10]

4. Find out the frequencies and mode shapes of a building system having multi degree of freedom as shown in figure below by matrix partition method. [16]

5. Write short notes on: (Any Four) [4×4]

   a) Vibration isolation and its effectiveness
   b) Time domain analysis for general dynamic loading
   c) Mode superposition method
   d) Transverse vibration of beam
   e) Axial vibration of a bar

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Subject: - Structural Dynamics *(Elective I) (CE72501)*

✓ 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 machine weighting 100KN is mounted through springs having a total stiffness 20KN/m to a simple supported beam in the mid-span. Assuming 10% of critical damping and neglecting the weight of beam, determine: [10]

   (i) Equivalent mass
   (ii) Equivalent stiffness
   (iii) Natural frequency
   (iv) Equivalent damping coefficient

   b) A sensitive instrument with weight 450N is to be installed at a location where the vertical acceleration is 0.1g at a frequency of 10 Hz. This instrument is mounted on a rubber pad of stiffness 15 KN/m and damping such that the damping ratio of the system is 10%. What is the acceleration transmitted to the instrument? [10]

2. a) A delicate instrument weighting 100kg is to be mounted on a rubber pad to the floor of a test laboratory where the vertical acceleration is 0.2g at frequency of f=12 cps. It has been determined experimentally that ratio of the stiffness k, to the damping coefficient c, is equal to 100(1/sec) for the type of rubber pad material used in the isolation. What is the stiffness of the isolation required to reduce to 0.02g the acceleration transmitted to the instrument? [10]

   b) For a SDOF system is subjected to a triangular pulse load of amplitude P_0 and during 't_1' as shown below. Determine the response of the undamped system during forced vibration and free vibration phase. [10]
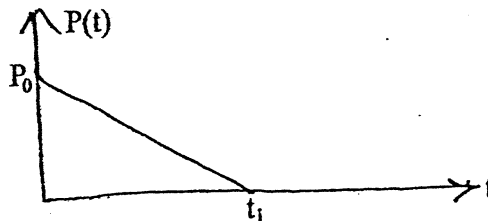
3. a) Determine the natural frequencies and mode shapes of the two storied shear building as shown. Also sketches the mode shapes and illustrate that modes shape satisfy the orthogonally conditions.
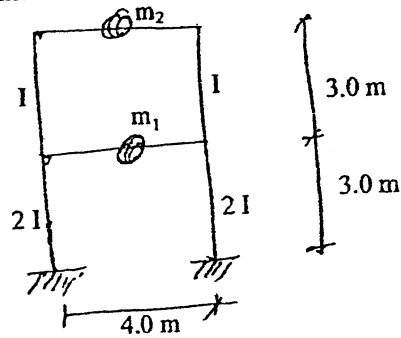
Where $m_1 = 2400$ kg; $m_2 = 1700$ kg   [10]
$EI = 8,000$ KN-m^2. If required to solved the problem.

   b) Illustrate with example how the Stodola method is used to find the first mode of shear building.   [10]

4. Write short notes with appropriate expressions and description of notation (any two):   [2×10]

   a) Transverse Vibration of a string
   b) Frequency domain analysis for support motion
   c) Uncoupled equation of motion for the structure

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

Subject: - Structural Dynamics *(Elective I) (CE72501)*

✓ 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) A structure is modeled as a damped oscillator with spring constant 100 kN/cm and an undamped natural frequency $\omega = 20$ rad/sec. It was found that a force of 80 kN produced a relative velocity of 2.0 cm/sec in the damping element. Find (a) the damping ratio ξ, (b) the damped period T_D, (c) the logarithmic decrement δ, and (d) ratio between two consecutive amplitudes. [10]

   b) Determine the response of SDF system to the constant force shown in fig1: [10]
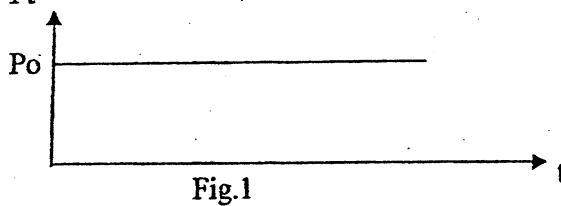
Fig.1

2. (a) Derive the expression for the response of the structure to the free vibration of underdamped system. [10]

   (b) A machine of weight of 120 kN is mounted centrally on a simply supported beam of span 4.0 m producing harmonic force of magnitude F= 150 kN at frequency $\overline{\omega} = 70$ rad/sec. Neglect the weight of the beam and assume 15% of critical damping, determine the amplitude of motion of the machine, transmissibility ratio, force transmitted to the support and corresponding phase angle. [10]
   Take $E = 2.1 \times 10^5$ N/mm^2, $I = 45 \times 10^6$ mm^4.

3. (a) The figure shown below idealized as two storey shear frame building.
   i) Determine the natural frequencies, mode shapes and sketch. [20]
   ii) Verify the orthogonality properties.
   iii) Normalize each mode so that roof displacement is unity.
   iv) Normalize each mode so that the modal mass M_n has unit value.
   v) Determine the free vibration response of the structure of at t= 0.2 sec, if initial displacement is $<0.04 \quad 0.08>^T$ and initial velocity is $<0.2 \quad 0.4>^T$
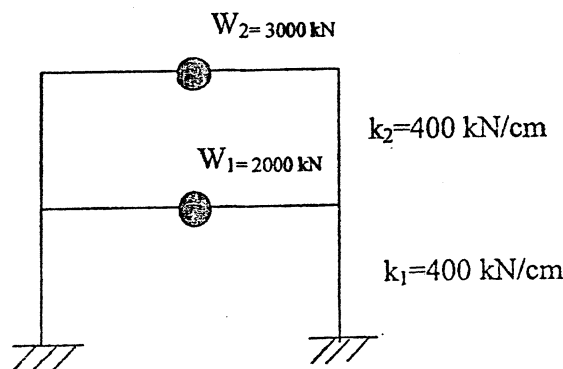

Fig.2

4. a. Find the fundamental vibration mode shape and frequency for the structure shown in fig 3 using Stodola or Holzer method. [10]
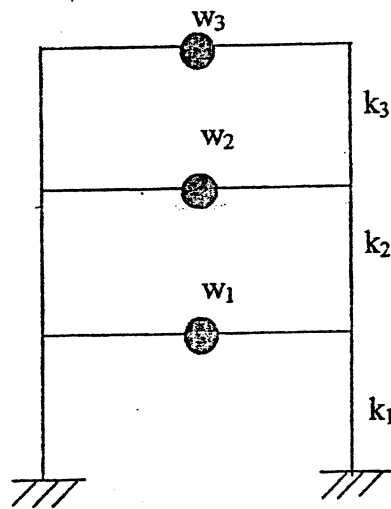

Fig.3

$W_1 = W_2 = 400$ kN; $W_3 = 350$ kN;
$K_1 = 400$ kN/cm; $K_2 = 350$ kN/cm and $K_3 = 300$ kN/cm

b. Derive the expression for the equation of motion for transverse vibration of a beam. [10]

5. Write the notes on (any four): [5x4]
   a. Uncoupled equation of motion
   b. Duhamel integral
   c. Mode superposition method
   d. Time domain analysis for general dynamic loading
   e. Lagrange's equation of motion

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

Subject: - Structural Dynamics *(Elective I) (CE72501)*

✓ 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) A free vibration test is conducted on an empty elevated water tank. A cable attached to the tank applied a horizontal force of 20KN and pull the tank horizontally by 7 cm. The cable is suddenly cut and the resulting free vibration is recorded at the end of 10 complete cycle the time is 4 sec and the amplitude is 2 cm, from the data compute the following. [10]
   a) Damping ratio
   b) Natural period of undamped vibration
   c) Stiffness coefficient
   d) effective weight
   e) Damping coefficient
   f) No. of cycle required for the displacement amplitude to decrease to 0.2 cm.

   b) For a SDOF system is subjected to a triangular pulse load of amplitude Po and during 't1' as shown in the figure below. Determine the response of the undamped system during forced vibration and free vibration phase. [10]
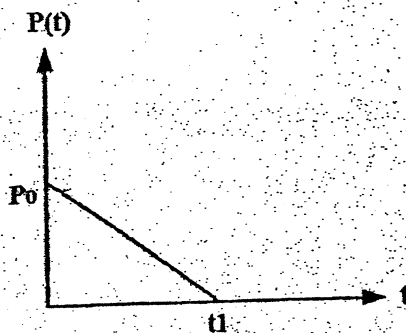
2. a) A machine of mass 100 kg is supported on steel springs that deflect 1.2 mm under the weight of the machine. At the operating speed of the motor of 3000 rpm, imbalance causes a maximum disturbing force of 360 KN. What is the maximum force transmitted to the foundation if damping in the steel springs is negligible? If the steel springs were replaced by neoprene pads having the same stiffness but a damping ratio 0.2, what would be the maximum transmitted force? [10]

   b) What is dynamic magnification factor? What are the factors influencing dynamic magnification factor? Explain with suitable curve plot. [10]

3. a) Determine the Eigen values and Eigen vector for the shear building as shown in figure. Draw the Mode Shapes and write down the modal matrix. [15]
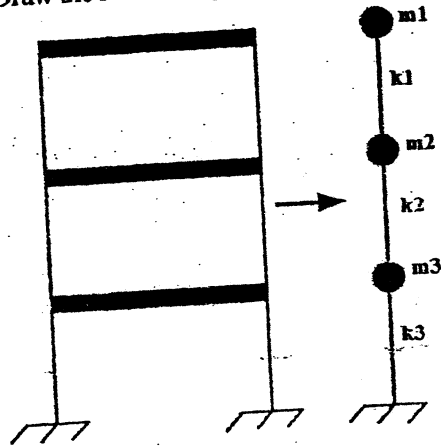
Top story: $m_1 = m = 150$ kN.sec^2/m, $k_1 = k = 43750$ kN/m
Middle story: $m_2 = 2m$, $k_2 = 2k$
Ground story: $m_3 = 2m$, $k_3 = 2k$

b) Demonstrate numerically that the computed mode shapes satisfy the orthogonality conditions with respect to stiffness only. [5]

4. a) Illustrate with an example how Holzer method is carried out to determine the first mode frequency of a shear building. [10]

b) Write down the partial differential equation of motion of transverse vibration of a string and beam. Explain about associated boundary condition. [10]

5. Write in brief with necessary relationships: (any four) [4X5]
   a. Duhamel's integral and its solution.
   b. Logarithmic decrement
   c. Dirac-Delta Function and Unit Impulse Response Frequency
   d. Mode Superposition Method.
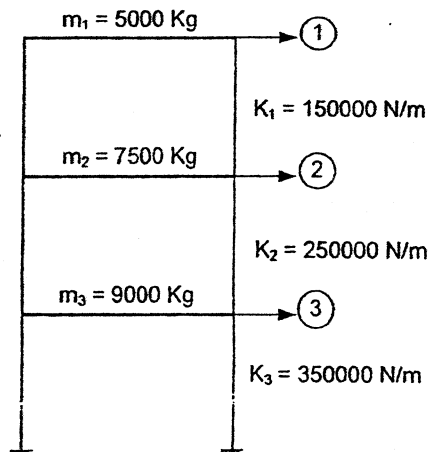   e. Vibration isolation and Transmissibility

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Subject: - Structural Dynamics *(Elective I) (CE72501)*

✓ 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) An SDOF system (m = 20kg, k = 20N/m) is given an initial displacement of 10mm and initial velocity of 150 mm/sec. Find: [8]

   (i) The natural frequency
   (ii) The period of vibration
   (iii) The amplitude of vibration
   (iv) The time at which the fifth maximum peak occurs

   b) A vibrating system consisting of a mass of 2.15 kg and a spring stiffness 17N/cm is viscously damped such that the ratio of any two consecutive amplitude is 1.00 and 0.97. Determine (i) the natural frequency of the damped system (ii) the logarithmic decrement (iii) the damping factor (iv) the damping coefficient [8]

2. a) A centrifugal fan running at a constant speed of 1000 rpm weighs 100 kg and has a rotating unbalance of 30 kg-cm. When dampers having damping factior $\xi = 0.1$ are used, specify the spring stiffness for mounting such that only 10% of the unbalance force is transmitted to the floor. Also determine the magnitude of transmitted force. [8]

   b) The equation of motion of a SDOF system is given by $1000\ddot{\upsilon}(t)+1600\upsilon(t)=P(t)$ with initial displacement and velocity equal to zero. The system is subjected to a rectangular impulse of 20 KN for 0.2 seconds. Determine the response of the system at t = 0.3 Sec. Units of mass and stiffness are Kg and KN/m respectively. [8]

3. The below figure represents a two storey frame idealised as a shear building. The mass and the stiffness parameters are indicated in the same figure. For the given system, [16]

   a) Formulate the equation of motions
   b) Determine the modal frequencies
   c) Draw the made shapes of the frame
   d) Determine the free vibration response at t = 0.4sec if initial displacement = $[0.01 \quad 0.08]^{T}$m and initial velocity = $[0.2 \quad 0.1]^{T}$ m/sec.

m_1= 1000 kg ────► 2

k_1 =100 KN/m

m_2= 2000 kg ────► 1

k_2 =120 KN/m
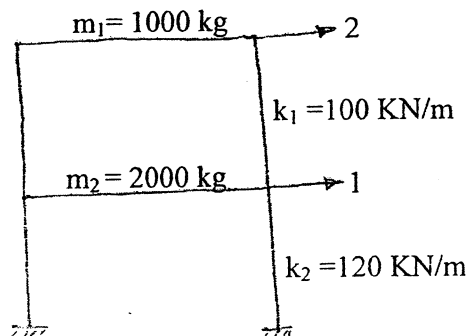
4. a) Write down the steps to determine frequencies and mode shapes of a system having multi degree of freedom by matrix iteration (Stodola) method. [6]

b) Using Improved Rayleigh (R00, R01 and R11) method, determine fundamental frequency of vibration of three storey building frame shown in below figure. [10]

m_1 = 5000 Kg → (1)

K_1 = 150000 N/m

m_2 = 7500 Kg → (2)

K_2 = 250000 N/m

m_3 = 9000 Kg → (3)

K_3 = 350000 N/m

5. Write short notes on: (Any Four) [4×4]

a) Orthogonality conditions for mode shapes
b) Vibration isolation and its effectiveness
c) Traserverse vibration of beam
d) Axial vibration of rod
e) Response to rectangular impulse

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| Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / 1	Time	3 hrs.

Subject: - Structural Dynamics (Elective I) (CE72501)

✓ 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) Assume that mass and stiffness of a system are 200 Kg and 5000 N/m respectively and it is undamped. If initial displacement is 40 mm and the displacement at $t = 1.2$ second is also 40 mm, determine displacement at $t = 2.4$ second. Also determine the amplitude of free vibration. [8]

   b) A single bay concrete frame having with fixed support at its base has height 4m, column size 240 mm × 240 mm, $E = 25000$ N/mm^2 and structure weight 100 KN lumped at its floor level. If the frame is subjected to a sinusoidal ground motion $v_g(t)$ = 4sin5t mm, determine i) transmissibility of motion to girder, ii) maximum shear force and bending moment in support columns and iii) maximum stress in the columns. [4+2+2]

2. a) Derive the expression for the response of the structure to the harmonic loading of the undamped system. [8]

   b) An electric motor of mass 150 kg is mounted on an isolator block of mass 1200 kg and the natural frequency of the total assembly is 150 cpm with damping factor $\zeta = 0.15$.

   If there is an unbalance force of $F = 80 \sin 31.4t$, determine amplitude of the vibration of the block and transmitted to the floor. [8]

3. The figure shown below represents a two-storey frame idealized as a shear building. The mass and the flexural rigidity parameters are indicated in the same figure. For the given system determine free vibration response at $t = 0.5$ sec if initial displacement and velocity are $[0.02 \quad 0.01]^T$ m and $[0.3 \quad 0.2]^T$ m/s respectively. [16]
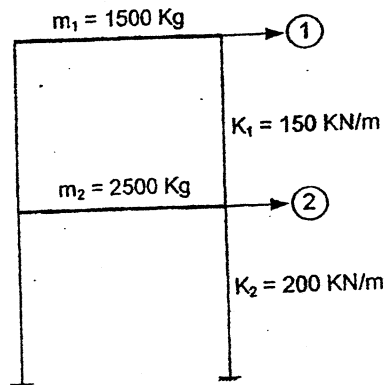
4. a) Find the fundamental vibration mode shape and frequency for the structure shown in figure below using Stodola or Holzer method. [10]
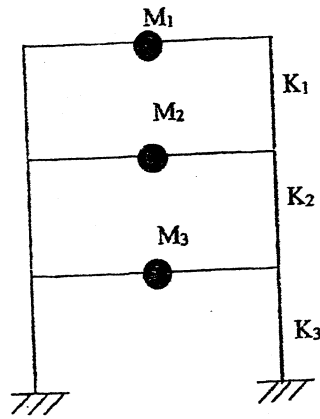
M_1 = 40 kg; M_2=M_3 = 60 kg;
K_1 = 600 N/m; K_2= 800 N/m and K_3 = 1000 N/m

b) Derive the expression for the equation of motion for an axial vibration of a bar. [6]

5. Write short notes with appropriate expressions and description of notations. (Any four) [4×4]

a) Over damped system
b) Unit impulse response function
c) Mode superposition method
d) Uncoupled equations of motion
e) Complex frequency response function

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04A 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: - Structural Dynamics *(Elective I) (CE72501)*

✓ 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 and explain with a simple example structural damping. [4]

   b) A SDOF system consists of the following parameters: mass, m = 5 Kg, K = 100 N/m and damping C = 3 N Sec/m. Determine (i) the damping factor, (ii) the natural frequency of damped vibration (iii) logarithmic decrement (iv) the ratio of two consecutive amplitudes and (v) the number of cycles after which the original amplitude is reduced to 20 %. [8]

   c) A single bay concrete frame having fixed support at its base has height 3 m, column size 240 mm×240 mm, E = 25000 N/mm² and structure weight 20 KN lumped at its floor level. A rotating machine exerts a horizontal force P(t) = 10 sin20t KN at the girder level. Assuming 5 % of critical damping, determine (a) Steady state amplitude of vibration and (b) Maximum dynamic stress in the columns. Assume that the girder is rigid. [8]

2. a) Determine the response of the following system by the applied force prescribed below. The system initially at rest condition. [8]
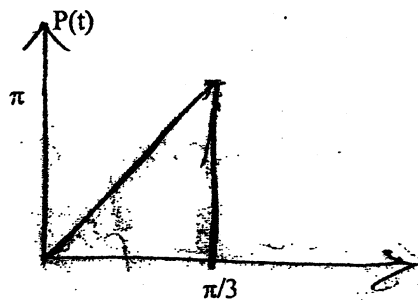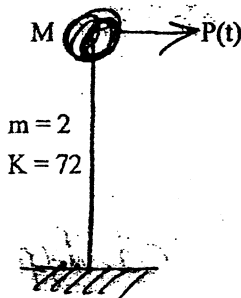
   b) Explain with an example how Hozler method is carried out to determine the first mode of frequency of a shear building. [12]

3. a) Determine the natural frequencies and mode shape for the shear building as shown in figure below. Draw the Mode Shapes and write down the modal matrix. [15]
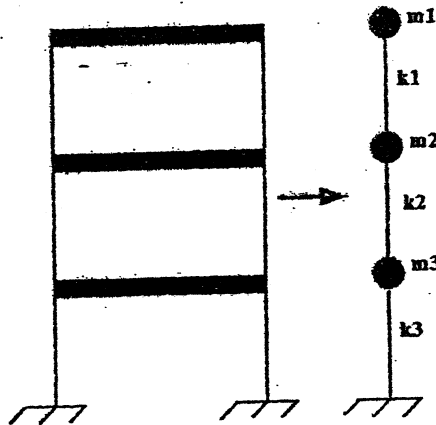
Top story: $m_1 = m = 150 \text{ kN.sec}^2/\text{m}$, $k_1 = k = 43750 \text{ kN/m}$

Middle story: $m_2 = 2m$, $k_2 = 2k$

Ground story: $m_3 = 2m$, $k_3 = 2k$

Height of building (h) = 3m

b) Demonstrate numerically that the computed mode shapes satisfy the orthogonality conditions with respect to mass only. [5]

4. a) Write down the partial differential equation of motion for transverse vibration of a string and beam. Explain the associated boundary conditions. [12]

b) What is dynamic magnification factor? What are the factors influencing dynamic magnification factor? Explain with suitable curve plot. [8]

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

Subject: - Structural Dynamics (CE72501) (Elective I)

✓ 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) A system vibrating with a natural frequency of 8 cycles per second starts with an initial amplitude (v_0) of 3 cms and initial velocity of 40 cm/sec. Find out the following:

     (i) Natural period, T and angular frequency, ω.
     (ii) Amplitude of the motion, p.
     (iii) Maximum velocity.
     (iv) Maximum acceleration.
     (v) Phase angle, φ.
     (vi) Static deflection, v_{st}.   (8)

(b) A vibrating system consists of a mass of 4 kg and a spring of stiffness of 150 N/m and a damper of coefficient of 5 N-s/m. Determine:

     (i) Damping factor
     (ii) Natural frequency of damped vibration
     (iii) Logarithmic decrement
     (iv) Ratio of two successive amplitude
     (v) Number of cycles after which the initial amplitude is reduced to 25%.   (6)

(c) Determine the response for a spring-mass system during forced vibration and free vibration phase, when it is subjected to a triangular force as shown in the figure given below.   (6)
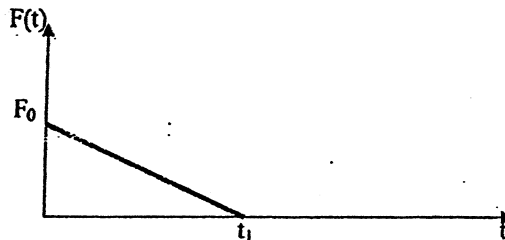
2 (a) Define dynamic magnification factor, and response ratio. Describe in brief with a neat sketch the influence of frequency ratio and damping ratio on dynamic magnification factor.   (5)

(b) A damped SDOF system has a mass of 50 kg, a damping ratio of 0.1, a natural frequency of 10 rad/sec, and is subjected to a harmonic excitation of amplitude 2500 N and frequency of 150 rad/sec. Determine the steady-state amplitude and phase angle of the response.   (7)

(c) A machine of 200 kg mass is supported on four parallel springs of total stiffness 750 N/m has an unbalanced rotating component which results in a disturbing force of 350 N at a frequency of 2121 rpm. If the damping ratio is 0.2, determine:

     (i) Amplitude of motion due to unbalance
     (ii) Transmissibility
     (iii) Transmitted force.   (8)

3(a) Determine the natural frequencies and mode shapes of the two-storied shear frame shown in the figure given below.. Sketch the mode shapes, and also illustrate that the modes shapes satisfy the orthogonality conditions. (12)

$m_1 = 1360$ kg;
$m_2 = 660$ kg;
$k_1 = 11.11 \times 10^{-3}$ N/m;
$k_2 = 19.2 \times 10^{-3}$ N/m;
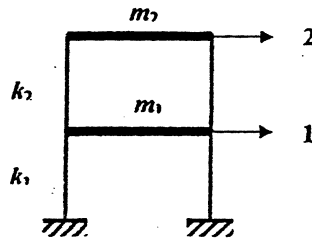
(b) Write down the uncoupled equations of motion for the structure of No. 3 (a) above, and determine the response of the structure for the force vector: (8)

$$\{P(t)\} = \left\{ \begin{array}{c} 0 \\ 300\sin 20t \end{array} \right\} N$$

4(a) Illustrate with an example how Stodola method is carried out to determine the first mode frequency of a shear building. Also explain how the first mode frequency can be approximated after the first iteration. (10)

(b) Derive the equation of motion in terms of partial differential equation for transverse vibration of beam, and the boundary conditions. Write down the partial differential equations of motion for: transverse vibration of a string, and axial vibration of a rod, with associated boundary conditions. (10)

5. Write in brief the principles and concepts of (any four only): (4x5)
   (a) Base isolation
   (b) Duhamel Integral
   (c) Response due to periodic loading expressed in Fourier series
   (d) Natural frequencies and mode shapes for transverse vibration of a string
   (e) Response of a SDOF system subjected to support motion
   (f) Mode superposition method.

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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: - Soil Conservation and Watershed Management *(Elective I) (CE72506)*

✓ 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. Point out the need and scope of soil conservation and watershed management in Nepal. [4]

2. Briefly describe the methods for delineating a watershed area and estimating design floods from that area of required frequency. [3+5]

3. Describe USLE briefly. Determine the topographic factor for a slope of 100 m in 1 km from an unbroken slope length of 0.55 km. [3+3]

4. Describe briefly land use and soil conservation measures for land capability classes which are highly suspected to erosion hazard. [5]

5. Design a surplus weir for a catchment of 60 ha and intensity of rainfall equal to 90 mm/hr. Assume HFL over the crest equal to 90 cm. Also assume that 45% rainfall is lost before the runoff takes place. [5]

6. Design a contour bund for a watershed having lateral slope of 15%. Daily maximum rainfall for 10 years' frequency in the area is 140 mm. Assume top width of bund equal to 0.75 m and side slope 1:1. Compute the total area lost due to bunding and total earthwork for bunding, if the area under bunding is 8 ha. [8]

7. Design a grassed waterway of parabolic shape to carry a flow of 2.5 m^3/s down a slope of 3.5 %. Assume Manning's roughness coefficient 0.045 and a permissible velocity of 1.5 m/s. [8]

8. Design a concrete chute for erosion control in a gully. The chute has to be designed for a flood of 800 lps at a ground slope of 1:1 and to be dropped by 2.75 m. The gully has an average width of 100 cm and average depth of water in the gully at this flood is equal to 60 cm. [8]

9. Calculate the minimum bottom width required for a dam of height 7.5 m. Maximum depth of water to be impounded is 6.5 m and the face in contact with water is vertical. Top width of section is to be 1.7 m. Assume the density of masonry equal to 2.2 ton/m^3 and coefficient of friction between masonry and earth equal to 0.62. [8]

10. Design a sediment retention structure to capture fine sand having settling velocity of 7 cm/s. The annual sediment load estimated by USLE is 500 ton having density of 1900 kg/m^3. Design the structure for a flood discharge of 1200 lps. [6]

11. Describe any two types of vegetative conservation techniques with neat sketches. [4]

12. Describe any two types of water conservation methods for cropland. [4]

13. Point out the causes and consequences of watershed deterioration. [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Soil Conservation and Watershed Management *(Elective I)(CE 72506)*

✓ 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 is watershed management? Why is it necessary in context of Nepal? What are the problems with watershed in mountainous countries like Nepal? [8]

2. What is time of concentration? A catchment has an area of 500 ha. The average slope of the land surface is 0.5% and the water course is approximately 2km. The maximum depth of rainfall in the area with a return period of 25 years is as tabulated below:

Rainfall duration (min)	5	10	15	20	25	30	40	60
Rainfall depth (mm)	15	25	32	45	50	53	60	65

   Consider that 200ha of the catchment has cultivated sandy loam soil (C = 0.2) and 300 ha has light clay cultivated soil (C = 0.7). Determine the peak flow rate of runoff by using the Rational method. [2+6]

3. Define land capability classes of Nepal with land use. [5]

4. Explain any four agronomic methods of soil and water conservation. [8]

5. a) Design a contour bund with the following data. [8]
      Hill slope = 15%
      Soil type = sandy soil
      24-hour rainfall = 140mm
      Top width = 0.5m, Side slope = 1H:1V
      Also, calculate the area lost due to bunding and earthwork for bunding if the area under bunding is 6 ha.

   b) Design a trapezoidal grassed waterway having side slope 1:1, Longitudinal gradient =2%, Permissible velocity = 1.5m/sec, Manning's n = 0.04, Design discharge = 3 cumecs. [8]

   c) Elaborate different types of bench terraces. [4]

6. a) Where do you find the use of straight drop spillway? Design a straight type of drop spillway for controlling gully having width and depth as 4.2m and 2.6m respectively. The peak flow through the gully is 1.6m³/s and longitudinal slope of the gully is 1%. [2+6]

   b) A drop inlet spillway is proposed for the control of a gully having a vertical drop of 3.5m. Peak discharge of 2.5m³/s is expected to occur in 25 years return period. The earthen embankment of the spillway has base width of 12m. Calculate the size of pipe to be used for embankment of the spillway has base width of 12m. Calculate the size of pipe to be used for disposing the stored water under full flow condition. Assume 60% of the peak flow is required to discharge from the pipe. The entrance and friction loss coefficients of the pipe are 0.5 and 0.18 respectively. [6]

7. What is bioengineering? Explain the interaction between bioengineering and engineering structures? Explain any three bioengineering techniques. [8]

8. Describe sand dam with neat sketches. [4]

9. List out different causes of watershed deterioration and short description about each of them. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Soil Conservation and Watershed Management *(Elective I) (CE72506)*

✓ 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. Point out the need of Soil and Water Conservation in the context of Nepal. [5]

2. List out the methods of flood prediction for design of watershed structures. Determine the design flood for 20 years depth of rainfall which are 2, 3 and 4 cm during 5, 20 and 40 minutes respectively in a watershed of 2 sq.km having longest flow path of 950 m and a slope of 0.5%. Assume the watershed loss as 45%. [8]

3. Why land capability classification is necessary? Which classes are not recognized as suitable for agricultural purposes? Describe briefly. [6]

4. What types of agronomic measures are suitable for soil and water conservation in Nepal? Describe briefly. [5]

5. Design a contour bund for a watershed having a lateral slope of 19%. Daily maximum rainfall of 10 years frequency in the area is 145 mm. Assume top width of bund equal to 0.65 m and side slope 1:1. Also compute total area lost due to bunding and earthwork for bunding, if the area under bunding is 6 ha. [5]

6. Design a grassed waterway of parabolic shape to convey a flow of $3m^3/s$; down a slope of 3%. The roughness coefficient for the grass is equal to 0.045. [8]

7. Design a surplus rectangular weir for a catchment of 45 ha and intensity of rainfall equal to 60 mm/hr. Assume HFL over the crest equal to 50 cm. Runoff coefficient may be taken equal to 0.4. [6]

8. Design a straight inlet drop structure for controlling a gully, which is 2.5m deep and 3.2m wide. The peak discharge through the gully is 1.15 cumecs. Also, determine the spacing of drops, if longitudinal slope of gully is 1.6%. [8]

9. Calculate the minimum bottom width required for a dam a height 6.5m. Maximum depth of water to be impounded is 5.4m and the face in contact with water is vertical. Top width of section is to be 1.5m. Assume the density of masonry equal to 2.3gm/cc and the coefficient of friction between masonry and earth equal to 0.72. [8]

10. Describe bio engineering measures for soil and water conservation with sketches. [8]

11. Briefly describe small weirs and sand dams for water conservation and harvesting. How the ground water reserve can be maintained and suitably used? [8]

12. Briefly describe the objectives, steps and people's participation of watershed management. [5]

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INSTITUTE OF ENGINEERING

Examination Control Division

2075 Ashwin

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

Subject: - Soil Conservation and Watershed Management *(Elective I) (CE72506)*

✓ 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) What is watershed management? Why is it necessary in context of Nepal? What is the importance of participatory approach in context of Nepal?

   b) Using universal soil loss equation (USLE), estimate soil loss from a watershed having topographic factor equal to 1.5 and average value of soil erodibility factor equal to 0.6. The soil conservation practice factor is equal to 0.8. Rainfall erossivity factors for two seasons are 250 and 65 respectively and crop management factors are 0.45 and 0.25 respectively.

2. a) What is Land Capability classification? Describe the land capability classes for agricultural lands with their land use and soil conservation practices.

   b) Design a contour bund with the following data:

   Hill slope = 15%

   Soil type = sandy soil

   24-hour rainfall = 120 mm

   Top width = 0.5 m

   Side slope = 1h:1v

   Also calculate the area lost due to bunding and earthwork for bunding if the area under bunding is 6 ha.

3. a) Write short notes on:
      i) Contour cultivation
      ii) Strip cropping
      iii) Conservation farming
      iv) Horticulture

   b) Design a trapezoidal grassed waterway with the following data

   Longitudinal gradient = 2%
   Permissible velocity = 1.5m/sec
   Manning's n = 0.04
   Design discharge = 3 cumecs

4. a) Design a straight inlet drop structure for controlling a gully which is 2.0 deep and 3.0 m wide. The peak discharge through the gully is 1 m^3/s. Determine the spacing of the drops if longitudinal slope of gully is 2%.

   b) Design an earth dam with following data;

   RL of natural surface at dam site = 100.00 m
   Reduced level of F.R.L = 118.3 m
   Reduce level at H.F.L = 121.3 m
   Fetch of the wave = 25 km
   Slope of the saturation line = 4H:1V

5. a) Illustrate with sketch the co-relation between bio-engineering measures and civil engineering structures for slope stabilization. Explain any two Bio-engineering methods.

   b) What is watershed management plan? If you were a government authority what provisions would you make in the policy for watershed management and soil conservation?

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

Subject: - Soil Conservation and Watershed Management *(Elective I) (CE72506)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Elaborate your answers with freehand sketches wherever possible.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) What is watershed and what are the basic concepts of watershed management? [2]

   b) Define the term runoff and describe about methods of runoff estimation. [2+4]

2. a) Land capability classification (LCC) is the basis of any soil conservation and watershed management programmes. How do you define LCC? Describe about different land capability class and their characteristics. [2+4]

   b) Among different soil conservation measures, agronomic measures of soil conservation is considered effective method of soil conservation. Justify this statement with example. Also explain about strip cropping. [8+2]

3. a) What are terraces? Describe about various types of bench terraces. [2+4]

   b) If grassed waterway is required to carry a flow of 5 cumec, calculate the dimensions of the waterway which is parabolic in shape and the downslope of the land is 5%. Assume Manning's roughness coefficient n = 0.05. [6]

4. a) Gully control structures are constructed for various purposes. Discuss about different types of gully control structures. [8]

   b) Design a drop spillway for watershed with area of 1.5 sq km. The drop is 1.5 m and the intensity of rainfall to be considered for the watershed is 120 mm/hr. The coefficient of surface runoff for the watershed is 0.3. [8]

5. a) Write down the site requirements, procedure and problems for the implementation of live check dam as a bio-engineering system. What can be achieved after its construction? [3+3]

   b) Given the following parameters, calculate the dimensions of and earthen dam: [10]

   RL of ground = 112 m   RL of FRL = 120.3 m
   RL of HFL = 123.3 m   Slope of natural line = 4:1

6. Write short notes on: (Any two) [6×2]
   a) Soil erosion and USLE
   b) Crop Rotation and Multiple Cropping
   c) Bunding vs Terracing

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04F   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 / II	**Time**	3 hrs.

Subject: - Soil Conservation and Watershed Management *(Elective I) (CE72506)*

✓ 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) Describe the major factors affecting watershed operations.

   b) Estimate soil loss using USLE from a watershed having topographic factor equal to 1.2 and average value of soil erodibility factor equal to 0.6. The watershed having two crop seasons has no soil conservation practice. Rainfall erosivity factor of two seasons are 280 and 45 and crop factor of two seasons are 0.45 and 0.25.

2. a) Describe land capability classification for non-agricultural lands with their land use and soil conservation practices.

   b) Introduce any five agronomic measures with its advantage and limitations.

3. a) Design a contour bund for a watershed having a lateral slope of 15%. Daily maximum rainfall of 10 years frequency in the area is 140 mm. Assume top width of bund equal to 0.6 m and side slope 1:1. Also compute total area lost due to bunding and earthwork for bunding, if the area under bunding is 6 ha.

   b) Design a grassed waterway of parabolic shape to convey a flow of 3.2 m^3/s down a slope of 4%. The roughness coefficient for the grass is equal to 0.042.

4. a) Design an earthen dam with following data:
   RL of natural surface = 105 m
   RL of FRL (full reservoir level) = 120 m
   RL of HFL (high flood level) = 122 m
   Saturation gradient = 4:1
   Fetch of wave (f) = 25 km

   Assume other data suitability

   b) Define bio-engineering and describe any three common bio-engineering techniques used for soil conservation.

5. a) Design a straight inlet drop structure for controlling a gully, which is 2.5 m deep and 3.2 m wide. The peak discharge through the gully is 1.2 cumecs. Also, determine the spacing of drops, if longitudinal slope of gully is 1.8%.

   b) Give an account on policy framework for watershed management in Nepal. Explain project planning in watershed management.

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04J 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: - Solid Waste Management (Elective I) (CE72511)

✓ 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 assimilation capacity. Explain how ISWM approach can be useful to solve the present waste management problems seen in emerging town of Nepal, outside the Kathmandu valley. [8]

   b) Explain the history of development of solid waste management in Nepal highlighting the positive and negative aspects of the German project in Kathmandu valley. [8]

2. a) What are the type of Solid Waste? Define hazardous and clinical wastes. Explain the different sources of hazardous waste. [8]

   b) How is heat value of solid waste calculated? Explain the solid waste management techniques in low, high and medium rise buildings? [8]

3. a) What is SCS and HCS? Solid waste from large hotels of Pokhara Lakeside is collected in HCS basis using hoist truck. Time taken to reach the first container site from the garage is 30 min. and to the garage from the last location is 45 min. If the average time required to drive between containers is 5 min. and one way distance to the disposal site is 20 km (speed limit 40 kmph); determine number of containers that can be emptied per day based on 8 hr/d working schedule. What would be the amount of waste that can be collected in a day by this truck if the 4 m³ containers are in an average 3/4th full. Take Pc + Uc = 0.067 and S = 0.053 hrs/trip. [2+8]

   b) Describe 3R principles that are in used either in your college or locality. [6]

4. a) Why transfer station is needed? What will be the break even haul distance between a direct haul system and a transfer station operation with the following properties: [2+8]

   - Direct haul system uses 4 m3 skips
   - Cost of operation of skip vehicles = Rs. 9/m3-km
   - The transfer station (TS) uses 20 m3 transfer trailer
   - The cost of operation of tractor trailer = Rs. 3.50/m3-km
   - Initial investment in TS = Rs. 35000000 (for buildings, equipments, facilities, etc.)
   - Useful life of TS = 20 years
   - Interest rate = 10%
   - Cost of operation and maintenance of TS = Rs. 500000/yr
   - Volume of waste handled = 400000 m3/yr

   b) What are the factors considered in selection of LFS (Land Fill Site)? [6]

5. a) Define composting? What are the different uses of composting byproduct? Explain the different types of composting? [8]

   b) Define necessary of solid waste. What are the various methods adopted for the recovery of organic waste in Nepal? [2+6]

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

Subject: - Soil Conservation and Watershed Management *(Elective I) (CE725)*

✓ 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 the objectives of watershed management? [3]

   (b) Design a parabolic shaped grassed waterway to carry a flow of 2.0 m³/s down a slope of 3%. The waterway has a good stand of grass and a velocity of 1.75m/s can be allowed. Take Manning's n = 0.045. [8]

2. (a) Differentiate between rill and sheet erosion. [4]

   (b) Explain sand dams with sketch. [6]

   (c) The data obtained from a field plot where no soil conservation practice has been used is as under: [4]

   A = 10 t/ha/year, R = 40, C = 0.35, LS = 1.2. Determine the value of K using USLE equation.

3. (a) Describe contour cultivation and strip cropping technique for soil conservation. [6]

   (b) In a hilly region, a bench terrace is proposed for cultivation purpose. The general land slope is 20%. Average soil depth is about 1m. Riser is to be laid on 1:1 gradient. The intensity of rainfall of the area is 15cm/hr for the duration equal to time of concentration. Design the inward sloping bench terrace. (Take C = 0.6). [8]

4. (a) Describe briefly the different types of water conservation methods for cropland. [8]

   (b) Determine the depth of flow in a surplusing structure, having design length equal to 1.7m. Surplus water is due to 73mm/hr rainfall from 0.9 km² catchment. Assume necessary data suitably. [6]

5. (a) Define check dams and explain different types of them with sketch. [6]

   (b) Calculate the minimum bottom width required for a dam of height 6.5m. Maximum depth of water to be impounded is 5.8m and the face in contact with water is vertical. Take top width = 1.5m, density of masonry = 2.2gm/cc and density of water = 1gm/cc, coefficient of friction between masonry and earth = 0.5. [9]

6. Write short note on: (any three) [3×4]

   (a) Stream bank protection
   (b) Wattling and mulching
   (c) Causes and consequences of watershed deterioration
   (d) Land capability classification

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

**Subject**: - Soil Conservation and Watershed Management (CE70506) (Elective I)

✓ 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) Write about the concept of Integrated Watershed Management. Discuss the importance of participatory approach on watershed management. [8]

   b) For a catchment of 10 sq km arial coverage, the values of topographic factor = 1.25, crop management factor = 0.2, conservation practice factor = 1.0. Estimate the soil erodibility factor (k) for the catchment soil, if in a particular season the soil loss was measured as 18 tons/ha with following rainfall data: [8]

Cumulative Time (min)	0	15	22	32	52	60	63
Cumulative rainfall depth (mm)		1	3	9	27	30	32

   Maximum I30 = 40 mm/hr.

2. a) What are the different factors limiting land capability? Discuss the characteristics of land system suitable for agricultural purpose. [8]

   b) Design a concrete chute spillway for the discharge of 4 m³/sec and drop of 3 m. The channel width and depth in upstream are 4 m and 1 m respectively. The ground has slope of 2:1 (H:V). [8]

3. a) Describe different types of Bench Terraces with sketches. [6]

   b) Design a contour bund with following data: [10]

      Slope of watershed (S) = 25%
      Maximum daily rainfall to retain (i) = 10 cm
      Assume top width of bund = 0.5 m and side slope of bund = 1:1
      Find out the cross section of bund, Area lost due to bunding and required earth work for bunding, if the area under bunding is 4 ha.

4. a) Discuss the benefits of using bio-engineering measures along with civil engineering structures. Write about the use of palisade vegetative conservation technique an soil and water conservation. [4+4]

   b) Design a earthen dam having fetch of wave (F) = 30 km. The RL of natural surface is 310 m, RL of full reservior level is 318 and RL of high flood level is 320 m. Assume saturation gradient equal to 4:1 (Assume slopes of dam suitable) [8]

5. Write short notes on: (any four) [4×4]

   i) Agro-forestry for soil and water conservation
   ii) Contour and staggered trenching
   iii) Watershed measurement plan
   iv) Road slope stabilization
   v) Conservation ponds (Farm ponds)

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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: - Soil Conservation and Watershed Management (Elective)

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

1 a What are the cause and consequences of watershed deterioration? Describe in context of Nepal. [8]

b Describe the design steps of Chute spillway with necessary sketch. [8]

2 a For a catchment the values for Topographic factor = 1.3, Crop Management factor = 1.5, Conservation Practice factor = 1.0 . Estimate the soil Erodibility factor (K)of the catchment Soil, if in a particular season the soil loss was measured as 18 tons/ha with following rainfall: [8]

Duration (min)	15	10	7	12	8	5
Rainfall depth (mm)	1	3	2	6	4	2

Maximum I_{30} = 34 mm/hr

b What are the different measures for Gully Control? Describe with necessary sketch. [8]

3 a What do you know about land capability classification? Write about the land classes suitable for agricultural lands. [8]

b Find out the dimensions of trapezoidal grassed waterways for peak discharge of 3.5 m3/sec. The channel should be designed with 0.3 % of grade. Allwoable flow velocity is 1.2 m/sec and side slope (z)= 2. Assume manning's roughness coefficient equal to 0.045. [8]

4 a Design a contour bund for a watershed having lateral slope of 25 %. Daily maximum rainfall equal to 13 cm. Assume top width of bund and side slope equal to 0.5 m and 1.1 respectively. Find out the percentage (%) of area lost due to bunding and required earth work for bunding, if the area under budning is 5 ha. [8]

b Descibe about the Universal Soil loss equation (USLE). What are the limitations of USLE. [8]

5 a What are the different vegetative techniques used for soil conservation? Describe two of them briefly with sketches. [8]

b Find the required surface area of settling basin to catch fine sand (settling velocity=0.007m/sec). the discharge entering the basin is 310 lps. Find the required storage depth within basin id total annual volume of sediment is equal to 320 m^3. [8]

6 Write short notes (any four) [4×4]
   a) Conservation pond
   b) Contour and staggered trenching
   c) Mechanics of water erosion
   d) Watershed management plan
   e) Graded bunding

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

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

Subject: - Soil Conservation and Watershed Management *(Elective I)*

- ✓ 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) Why Land Capability Classification is necessary? Which classes are recognized as suita agricultural purposes? Describe briefly.   [2

   b) Design a contour bund for a watershed having lateral slope of 22%. Daily maximum rainfal area is 11 cm. Assume top width of bund equal to 0.6 m and side slope 1:1. Also compute ar due to bunding and earthwork for bunding, if the area under bunding is 5 ha.   [4

2. a) What are the causes and consequences of watershed deterioration?   [5

   b) Design a grassed waterway of parabolic shape to carry a flow of 3.2 m³/s, down a slope o The waterway has a well-established sod of excellent quality and a velocity of 1.5 m/s can be per Assume n= 0.045.   [6

3. a) A masonry dam is 5.8 m high, 1.2 m wide at top and 4.8 m at bottom and has a vertica face. The dam impounds water to a height of 4.8 m. Calculate the magnitude of the resultant force point of application with the base, when the reservoir is full and when it is empty.   [6

   b) Design an earthen dam having fetch of wave equal to 30 km. The reduced levels of river bed a reservoir level are 850 m and 868 m respectively. Assume saturation gradient equal to 3.5:1 ups dam slope 2.5:1 and downstream dam slope 2:1.   [8

4. a) Describe engineering measures for erosion control in non - agricultural land.   [8

   b) Design a concrete chute spillway for a flood of 3 m³/s and drop of 3 m. The channel width and d upstream are 3m and 1m respectively. The ground slope at drop is 2:1 (H:V).   find v = Q = 3   [6
                                                                                                              A   3

5. a) Describe engineering measures adopted for erosion control in agricultural land.   L = 6 m   [6
                                                                                    H.S: 1.5:1 u/c
                                                                                    R = 3 m (H:V)
   b) Briefly describe vegetative techniques for soil conservation with neat sketches.   [6

6. Write Short notes on any four of the following: [4

   a) Need and Scope of Soil and Water Conservation in Nepal
   b) Bench Terrace
   c) Universal Soil Loss Equation
   d) Soil Texture and Structure
   e) Small Storage Structures

6

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: - Design of Suspension Bridge (Elective I) (CE72503)

✓ 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 in brief the various factors to be considered in assessing the socio-economic and Technical feasibility of a pedestrian suspension bridge site. [6]

2. Describe factors that should be considered for selection of an optimum bridge site across a river. [6]

3. A trail bridge has to be constructed over a river, describe how you conduct detailed survey for different cases. [8]

4. Prove that $b=\frac{(\sqrt{fa}+\sqrt{fb})^2}{4}$ with sketch necessary showing major components. Symbols in the equation present usual meanings. [6]

5. A suspended bridge has to be designed to suite a site condition. Based on the following data check the factor of safety of cable. [12]
Span of the bridge 152 m Dead load sag 7.8 m, diameter of cable used = 4Xφ36 mm main cable and 2X32 handrail cable, elevation difference between saddles = 0m. Dead load of bridge per meter except cables 0.55 kN/m. live load of bridge per meter =4.75 kN/m.

Cable size, ϕ mm	Pre-stretched	Cable size used	Number of wires	Metallic area	Unit mass	Min.Breaking Load	Perm. Load	Remarks
				mm^2	Kg/m	kN	kN	Tensile strength of wire = 1.57 (kN/mm^2)
13	Non	SSTB LSTB	7 x 7 (6 x 1)	73	0.64	103	34	Modulus of Elasticity, E = 110 (kN/mm^2)
26	Yes		7 x19 (12 x 6 x 1)	292	2.51	386	129	
32				442	3.80	585	195	
36		LSTB		560	4.81	740	247	
40				691	5.94	914	305	

6. From the following data of foundation on rock find the number and size of anchorage rods necessary to maintain the foundation safe on sliding. Also check the factors of safety against overturning, bearing capacity failure and find whether tension crack is produced in foundation or not. [14]
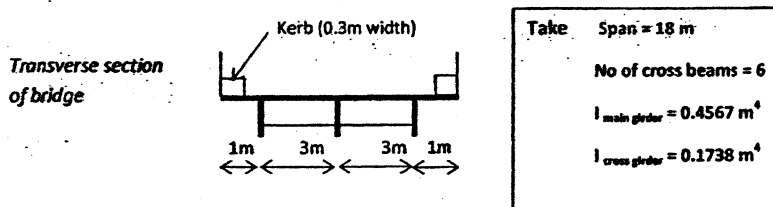Rock depth = 0 m
Sliding friction angle = 32°
Rock quality coefficient = 1.75
Permissible ground bearing pressure = 450 kN/m^2
Retaining wall load above foundation top, A= 160 kN
Eccentricity of top load, a = 6 m
Use the anchor rods having permissible stress of (σ_{comb}) = 0.75 kN/mm^2 and unit weight of concrete is 24 kN/m^3
Assume trail values for the foundation dimension are:
H$_1$= 2.6 m, H$_2$ = 1.2 m, B=6.8 m, L=3.1 m

7. Calculate number of suspender and calculate necessary detailed of a third suspender from the entrance of a LSTB suspension Bridge having survey span of 150 m, dead load sag 9.12 m, and Camber 1.79 m. Assume all suspenders are of 12 mm diameter. [8]

8. . What inspections are carried out to ensure the quality of HOT DIP Galvanization? List out the process for the HOT DIP galvanization. [8]

9. Write about the importance of maintenance of old trial bridge. How the maintenance work is done? [6]

10. Write down the detailed procedure for cable hoisting and sag setting of the LSTB suspended bridge. [6]

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

Subject: - Design of Bridge *(Elective II) (CE 76502)*

✓ 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, table, chart and graphs are allowed to use.*
✓ Assume suitable data if necessary.

1. List the live loads of IRC and show Class AA loading with neat sketches. Arrange Class AA wheeled load on a bridge of span 17 m to get maximum longitudinal BM and SF and find maximum bending moment and shear force at one third of its span due to this load (without lateral load distribution).   [6+14]

2. Compare the Hendry - Jaeger's and Courbon's Methods of lateral load distribution in bridge deck analysis. Which method do you prefer when bridge is transversely very stiff? Why?
    Find maximum reaction on exterior girder of a bridge due to Class AA tracked load by Hendry - Jaeger's Method.   [8+12]


Transverse section of bridge — Kerb (0.3m width). 1m 3m 3m 1m

Take Span = 18 m
No of cross beams = 6
$I_{main\ girder} = 0.4567\ m^4$
$I_{cross\ girder} = 0.1738\ m^4$

3. Write limitation of Pigeaud's Method of slab analysis.   [6+14]
    Analyze RC slab panel 'I' of a T beam bridge of 20 m span and find maximum BM and SF in shorter direction of slab.

    Take, 250mm thick RC slab, 80mm thick asphalt concrete wearing course

Plan of bridge — 4 × 5 m, 2 × 3 m, Cross beam, Main beam
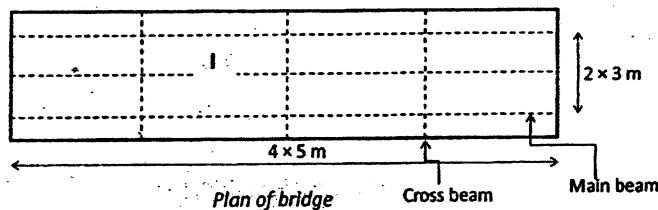
4. Give preliminary size of RC abutment to meet the following requirements.
    Find overturning and restoring moment due to active earth pressure (static), surcharge and self weight of abutment.   [8+12]
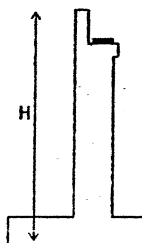
*   H = 12 m
*   Bearing size = 350 mm × 400 mm × 80 mm
*   Depth of girder = 2 m
*   Angle of internal friction of soil = 35°
*   Unit weight of soil = 18 KN/m³
*   Slope of backfill = 1°
*   Span of bridge = 18 m

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 Suspension Bridge (CE72503) (Elective I)

✓ 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 briefly various types of trail bridges and standards in Nepal. (6)

   (b) Explain briefly, how a bridge site is selected? How is high flood level fixed in the bridge site? (5+5)

2. (a) What are the components of a trail bridges? Why are these components standardized? (2+4)

   (b) Determine the hoisting sag of a 150 m long suspended bridge using the following general arrangement drawing data: Dead load sag = 7.5 m, Number and diameter of all cables = 6-36 mm, Metallic area of one cable = 560 mm^2. Elevation difference between saddles = 1.0 m, Take E = 110 kN/mm^2, Weight of one cable per meter = 0.48 kN/m. (10)

3. (a) What are the failure modes of trail bridge foundations ? How do you decide a foundation size in a design? (3+3)

   (b) Check the stability of a drum anchorage foundation on rock based on the following data. (10)

Number of main cables	nM	=	4nos
Main cable tension	TMf	=	1165.728kN
Haindrail cable tension	THf	=	246.304kN
Cable inclination	βf	=	7.476deg
Sliding friction angle	φSL	=	35.000deg
Rock quality coefficient	K	=	1.750
Friction angle of Sub- Soil	φ1	=	30.000deg
Unit weight of sub-Soil	γl	=	18.000kN/mm^3
Friction angle of backfilling soil	φ2	=	22.000deg
Unit Weight of backfilling soil	γ2	=	17.000kN/mm^3
Ground bearing pressure	σperm	=	450.000kN/mm^2
Minimum embedded depth	T	=	1.000m
Back height	H1		2.50 m
Front high	H2		1.50 m
width	B		5.00 m
length	L		4.00 m
Active pressure height	Ha	=	0.00m
Unit weight of Cement masonry	γm	=	22.00kN/mm^3
Unit weight of Cement Concrete	γc	=	22.00kN/mm^3

4. (a) How are suspender lengths calculated? Write down the differences in suspenders of LSTB and SSTB N type suspension bridges. (4+4)

   (b) Explain with sketches, how a wind bracing system is designed to resist wind loading. (8)

5. (a) Why is cable-hoisting sag calculated in bridge site? Explain cable-hoisting works? (2+6)

   (b) What are the critical stages of works to be monitored during the supervision of a trail bridge construction? Why? (4+4)

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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: - Water & Wastewater Quality Analysis *(Elective I)(CE 72512)*

✓ 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 do you mean by water pollution? List out them and discuss its effects due to pollution. [6]

2. How sampling have to be taken in water sources like river, lake, impounded reservoir, spring and drainage? What are the major parameters tested for water and wastewater analysis? Discuss with logics. [10]

3. What causes conductivity and salinity in drinking water? How can you determine those in water sample? Explain. [6]

4. Describe the procedure of determining total solids, total volatile solids and total fixed solids with an example in detail. [10]

5. What causes the hardness in water? Discuss the relationship with alkalinity and hardness with an example. [6]

6. What will be the health impact due to presence of copper, fluoride and manganese? Discuss its limit values with respect to WHO and Nepal standard. [10]

7. Why chromium is not acceptable in drinking water? Describe the treatment process to remove chromium from drinking water? [10]

8. Discuss, why we need coliform bacteria test and E-coil test as well for drinking water purpose? How they are determined, briefly describe. [10]

9. If wastewater consists BOD = 350mg/l, COD = 590mg/l, total fixed solid = 2200 ppm and total volatile solids = 2500mg/l in laboratory analysis; what will be the stages of treatment process to achieve Nepal effluent standard for discharging in river water bodies. Briefly describe each and every necessary components, technical considerations, probable treatment quantities with flow chart. Assume necessary data if required? [12]

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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: - Water and Wastewater Quality Analysis *(Elective I) (CE72512)*

✓ 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 important general considerations and principles of WHO guidelines? [4]

2. What are the possible impurities in water, explain with examples? [2+6]

3. How sampling of drinking water is done confirming NDWQS standard? What are the criteria of selecting sample points as per NDWQS standard? [4+4]

4. Explain how COD & BOD samples are prepared? List different methods used for testing or analysis of domestic and wastewater samples. [6+4]

5. What causes odor and taste in drinking water? How can you determine odor in water sample? Explain. [2+4]

6. During a lab test, 135 ml of wastewater sample was taken which weighted 445 grams with container, while the weight of dry container was 255 grams. It was dried in oven (103~105^{0}C) and cooled, the remains with container weighted 335 grams. The oven dried sample was again placed in furnace which was ignited at 600^{0}C. The final weight of sample with container after cooling weighed 293 grams. Calculate the amount of total solids, total volatile solids and total fixed solids present in water. [14]

7. Why is it important to determine arsenic concentration in drinking water? Why is it not feasible to set the arsenic standard of WHO with that of NDWQS 2005? [2+4]

8. Why presence of high level of mercury in drinking water is undesirable? Describe the treatment process to remove mercury from drinking water. [2+4]

9. Why coliform bacteria and/or E. coli is determined to check microbiological contamination in water or food? List the difference between faecal and non-faecal coliforms. [3+7]

10. Explain different stages of treatment of wastewater. [8]

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