

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

**Subject: - Sanitary Engineering (CE656)**

- ✓ 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 favorable conditions for the adoption of separate and combined sewerage system? [4]
  2. ✓ A population of 30000 is residing in a rural area of 60 hectares. If the average coefficient of runoff for this area is 0.60, time required to the entry port is 25 minutes and the time of travel from the entry port to the section of sewer under consideration for design is 5 minutes. What will be the design discharge for a combined sewer at the section to be considered if the average flow of sewage in rural is 45 lpcd and pack factor is 2.7? [4]
  3. ✓ Design a sewer for separate system to carry peak flow  $0.5 \text{ m}^3/\text{sec}$  at a slope 10 in 10000. Sewer should run 0.7 times depth at peak flow. The value of  $n$  in Manning's formula is 0.012. Will the self cleansing velocity be maintained in the sewer during dry weather flow? Take peak factor = 3. [8]
  4. ✓ Explain the necessity of providing drop manhole in sewer line with a neat sketch. [4]
  5. a) ✓ Describe the procedure of BOD in laboratory. [4]
  - b) ✓ If the 5 day BOD at  $37^\circ\text{C}$  is 200 mg/lit and if the rate of deoxygenation is 0.17/ day, calculate the ultimate BOD and BOD remaining after 5 days. [4]
  6. What are various methods of sewage disposal? Describe with their advantages and disadvantages. [8]
  7. a) What is tricking filter? Why it is used? Explain the construction of tricking filter with a neat sketch. [8]
  - b) Design a sedimentation tank and oxidation pond for a town with the following data: [8]
    - Population = 10,000
    - Sewage flow = 100 lpcd
    - BOD of incoming sewage = 250 mg/l
    - BOD in the effluent of oxidation pond should be less than 30 mg/l
  - c) ✓ Design a grit chamber for the following data: [8]
    - Discharge = 5 MLD
    - Size of the grit particles = 0.2 mm
    - Sp. gravity of grit particles = 2.65 at temperature  $20^\circ\text{C}$
  8. Design a sludge digestion tank to treat sludge of primary sedimentation tank from the following data: [8]
    - Capacity of sedimentation tank =  $812.5 \text{ m}^3$
    - Detained time in Sedimentation = 3 hrs.
    - Suspended Solids in raw sewage = 250 mg/lit
    - Water content in fresh sludge = 95%
    - Water content in digested sludge = 80%
    - Specific gravity of sludge = 1.02
    - Digestion period in digester = 2 months
    - Primary sedimentation tank removes 55% of suspended solids
  9. Design the septic tank and dispersion trenches in Nepalese perspectives for 20 users. [8]
  10. Write short notes on sanitary landfill of solid waste. What are its advantages and disadvantages? [4]

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1. Describe the components of solid waste management methods. [4]
2. Differentiate dry weather flow and we weather flow. Briefly describe various sources of sanitary sewage. [4]
3. Design a circular section of combined sewer from the following data: [2+6]
  - Area to be served = 60 ha
  - Population = 65,000
  - Maximum permissible velocity = 3.2 m/sec
  - Time of entry = 5 minutes
  - Time of flow = 18 minutes
  - Rate of water supply = 235 lpcd
  - Overall runoff coefficient = 0.55

Assume suitably any other data required.
4. Describe street inlets and catch basins with neat sketches. [4]
5. Describe briefly the physical characteristics of wastewater. How the decomposition of wastewater takes place? Explain the processes. [8]

**OR**

Define BOD and COD and explain their significance in wastewater examination. Derive BOD equation showing relation between ultimate BOD and BOD remaining at any time, t. [8]

6. A wastewater treatment plant disposes off its effluents into a stream at a point A. Characteristics of the stream at a location upstream of point A and of the effluent are as follows: [8]

Item	Effluent	Stream
Flow Rate, m <sup>3</sup> /sec	0.35	0.60
Dissolved Oxygen, mg/l	2	7
Temperature, °C	29	22
BOD <sub>5</sub> at 20°C, mg/l	155	2

Assume that the deoxygenation constant at 20°C (base e) = 0.2 per day and the reaeration constant at 20°C (base e) = 0.35 per day. For the mixture, equilibrium concentration of dissolved oxygen for the freshwater is as follows:

Temperature, °C	21	22	23	24	26	28
DO, mg/l	8.99	8.83	8.68	8.53	8.22	7.92

The velocity of stream downstream of the point A is 0.25 m/sec. Determine the critical oxygen deficit and its location.

7. a) Design a grit chamber for a wastewater flow of 180 l/s with SOR = 1.5 cm/second and detention period of 50 seconds. Specific gravity of organic and inorganic particles are 1.2 and 2.65 respectively. Assume the size of both organic and inorganic particles as 0.25 mm. Take  $k = 0.06$  and  $f = 0.03$ . [8]
- b) A municipal wastewater having a  $BOD_5$  of 190 mg/l is to be treated by a two stage trickling filter. The desired  $BOD_5$ , 20°C of the final effluent is to be 25 mg/l. If both the filter's depth is to be 1.85 m and recirculation ratio for both filters is 0.5, determine the required filter diameters. Assume the wastewater flow rate of 7665 m<sup>3</sup>/day, and 35% BOD is removed in primary sedimentation tank. [8]
- c) What is meant by activated sludge? Describe with sketches the treatment process of wastewater by activated sludge process. [8]

OR

Describe the theory of oxidation pond. Design an oxidation pond for treating domestic sewage of 2500 persons supplied with 225 lpcd of water. The  $BOD_5$  of the wastewater is 250 mg/l. Permissible organic loading for the pond is 550 kg/ha/day and the detention time is 12 days. Assume the width to length ratio of the pond as 1:2 and the operational depth as 1.25 m. [3+5]

8. Why treatment of sludge is necessary? Explain the method of dewatering of sludge by sand drying bed. [8]
9. Describe the purpose, construction and design criteria of VIP latrine with neat sketch. Differentiate it with pit latrine. [8]
10. Write a short note on incineration of solid waste. [4]

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1. Compare between water carriage and conservancy methods of sewage disposal with merits and demerits of each method. [4]
2. The catchment area of a city is 45 hectares. Assuming that the surface on which rain falls is classified as follows: [4]

Type of Surface	% Area	Runoff Coefficient
1. Forest and Wooden Area	10	0.15
2. Open ground + Unpaved street	10	0.20
3. Parks + Lawns + Gardens	15	0.15
4. Gravel Road	20	0.25
5. Asphalt Pavements	20	0.85
6. Water tight Roof Surfaces	25	0.90

Calculate the quantity of storm water if time of entry is 20 minutes and time of flow is 10 minutes.

3. With the help of neat sketches, describe in detail the various steps of sewer construction. [8]
4. With the help of neat sketch, describe the purpose and construction of a drop manhole. [4]
5. a) Describe in detail about BOD and COD with their significances. [4]
- b) 2.5 ml of raw sewage is diluted to 250 ml. D.O. concentration of the diluted sample at the beginning was 8.0 mg/l and 54.0 mg/l after 5 days of incubation at 20°C. Find 5-day B.O.D. of raw sewage and kg. B.O.D. contained in 5 million liters of sewage. [4]
6. The population of a town is 30,000 and domestic sewage is 175 lpcd. The per capita BOD is 50 gm/day. The dairy waste of the town is  $2.2 \times 10^6$  liters/day with BOD of 5000 mg/l and the waste from other industries is  $1.80 \times 10^6$  liters/day with BOD of 2200 mg/l. DO of both domestic and industrial wastes are zero. The effluent from the sewage treatment plant is to be discharged in the natural river having minimum discharge of 8000 liters/sec, a dissolved oxygen content of 8.0 mg/l and BOD of zero. The minimum DO content in the river to be maintained is 4.5 mg/l. Determine the degree treatment required to the sewage. Assume saturation DO in the river after mixing with waste is equal to DO content of river before mixing. Assume any other data not given. [8]
7. a) Design a grit chamber for a sewage flow of 200 liter/sec with SOR = 2 cm/sec and detention time = 1 min. Specific gravity of organic and inorganic particles are 1.2 and 2.7 respectively. Assume size of both organic and inorganic materials as 0.21 mm. Take  $k = 0.06$  and  $f = 0.03$ . [8]

- b) With the help of neat sketch, explain the activated sludge process. What are its advantages and disadvantages? [8]
- c) A sewage having BOD of 180 mg/l is fed to a two stage trickling filter with a flow of 5 million liters per day. The BOD required in the final effluent is  $\leq 30$  mg/l. The efficiency of the first stage trickling filter is 2 times the efficiency of the second stage trickling filter. If depth and recirculation ratio of both first stage and second stages are 1.2 m and 2 respectively, determine the diameters of the first stage and second stage trickling filters. [8]
8. a) Describe the purpose and methods of sludge thickening. [4]
- b) A sedimentation tank treats 6 mld of sewage containing 300 mg/l of suspended solids. The tank removes 65% of the suspended solids. Compute the volume of the sludge produced yearly if the moisture content of the sludge is 95%. [4]
9. a) Describe the purpose and construction of an evapo-transpiration mound. [4]
- b) Design a double pit VIP latrine for a family of 15 users. Assume the necessary data suitably. [4]
10. Describes briefly the various methods of solid waste disposal. [4]

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1. Why waste water management is important for civil society. State the objectives of waste water disposal. [4]
2. Calculate the diameter of combined circular sewer with following data: water supply rate = 100 lpcd, population density = 100 persons/hect, peak factor = 2.7, area = 35 hectares, rainfall intensity = 15mm/hr, slope = 1/750, Manning's coefficient of rugosity = 0.011. The coefficient of run-off = 0.4. The sewer should run 0.6 depth full during peak flow. [8]
3. State the steps involved in construction of sewers in urban area. Briefly describe the testing of sewer line. [4]
4. With the help of neat sketch, explain the necessity and construction of drop manhole. [4]
5. If one day BOD of a sewage sample at 23°C is 105 mg/l. What will be its five day BOD at 30°C? Assume  $K_{20} = 0.1$  per day. [8]
6. An industry is going to be established in an urban area near to the river side. The river water and industrial effluent characteristics are as follows: [8]

	Industrial effluent	River water
Flow ( $m^3/s$ )	1.8	22
DO (mg/l)	0	8.7
BOD <sub>5</sub> , 20°	350	6.0

$$k_d, 20^\circ = 0.25 \text{ d}^{-1}$$

$$k_r, 20^\circ = 0.11 \text{ d}^{-1}$$

$$\text{DO saturation} = 9.1 \text{ mg/l}$$

At what location in the river critical DO deficit would occur if the flow velocity in the river is 0.20 m/s. Also find out DO at the end of 1 and 3 days.

7. a) With neat sketch, describe briefly about the skimming tank. Also enlist differences between grit chamber and sedimentation tank. [5+3]
- b) What do you mean by suspended and attached growth process? Explain the principals of biological treatment. [8]

**OR**

The effluent from PST is applied to a standard rate Trickling Filter at the rate of 1.2 million liters/day having BOD<sub>5</sub> of 200 mg/l. Determine the depth and volume of filter considering surface loading of 1200 liters/m<sup>2</sup> day and organic loading of 250 gm/m<sup>3</sup> day. Also, calculate the efficiency of filter using NRC equation. [5+3]

- c) A town discharges sewage at the  $55 \times 10^6$  l/d. The specific gravity of grit particles in that sewage is found from an experiment as 2.65 and the temperature as 27°C. Design grit chamber for removal of grit particles of 0.21 mm. Use:  $K = 0.06$  and  $f = 0.03$ . [8]
8. Briefly describe about the methods of sludge treatment with its functions. [8]
9. With a neat sketch describe the working and design procedure of ventilated improved pit latrine. [8]
10. Describe sanitary landfill with its advantages and disadvantages. [4]

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1. Compare the separate and combined systems of sewerage in a tabular form. [4]
2. Define sanitary sewage. Describe various factors affecting quantity of sanitary sewage. [4]
3. Design a circular sewer running 0.70 full at maximum discharge for a town provided with the separate system serving a population of 100000 persons. Water is supplied from the water works at a rate of 200 liters per capita per day. Take a constant value of  $n = 0.013$  at all depths of flow. The permissible slope is 1 in 600. Take a peak factor of 2.25. [8]
4. What are sewer appurtenances? Explain brief the necessity of sewer appurtenances. [4]
5. How sewage sampling is done? Explain the method of BOD determination in the laboratory by dilution method. [8]

**OR**

Why examination of wastewater is necessary? Describe in detail the procedure of determining fixed, volatile and total solids in the laboratory.

6. A stream saturated with DO has a flow of  $2\text{m}^3/\text{s}$ , BOD of  $3\text{mg}/\text{l}$  and rate constant ( $K_1$  to base 10) of 0.1 per day. It receives an effluent discharge of  $0.5\text{m}^3/\text{s}$  having BOD of  $200\text{mg}/\text{l}$  and DO of  $2\text{mg}/\text{l}$ . The average velocity of stream is  $0.2\text{m}/\text{s}$ . The average depth of stream is  $1.2\text{m}$ . Calculate DO deficit  $60\text{km}$  downstream of outfall. Assume temperature of  $20^\circ\text{C}$  throughout and saturation DO at  $20^\circ\text{C}$  is  $9.17\text{mg}/\text{l}$ . [8]
7. a) With neat sketches, describe the theory, construction, design criteria, commissioning and maintenance of an oxidation pond with its advantages and disadvantages. [8]

**OR**

What do you understand by suspended growth and attached growth processes in wastewater treatment? Explain in detail the principles of biological wastewater treatment.

- b) Determine the size of a high-rate single stage trickling filter for the following data: [8]
  - i) Sewage flow =  $5\text{MLD}$  (ii) Recirculation ratio = 1.5 (iii) BOD of raw sewage =  $250\text{mg}/\text{lit}$  (iv) BOD removal in primary clarifier = 30% (v) Final effluent BOD desired =  $30\text{mg}/\text{lit}$
- c) What is a grit chamber? Describe with the help of neat sketches the construction and design criteria of a grit chamber. [8]

**OR**

**OR**

Why recirculation is necessary in trickling filters? Compare the low rate and high rate trickling filters.

8. Sewage with a suspended solid content of 200mg/l flows continuously in a sedimentation tank of 500m<sup>3</sup> capacity. Sewage is detained in the sedimentation tank for 4 hours. Sixty percentages of solids are removed in the sedimentation tank during its detention. The sludge produced in the sedimentation tank has moisture content of 98% and specific gravity of 1.02. The sludge from sedimentation tank is fed to digester for its digestion. The volume of sludge is reduced to 40% of its original volume during digestion. Calculate the diameter of digester if its effective depth is 6m. Assume detention period in the digester is 30 days. [8]
9. Design a septic tank and soak pit to dispose the sewage generated from a household of 8 persons. The sewage is generated at the rate of 100 liters/person/day. Assume that septic tank is cleaned once in 3 years and infiltration rate of soil is 50 liters/m<sup>2</sup>/day. [8]
10. Describe the methods of composting for solid waste disposal. [4]

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1. a) Wastewater and solid waste management are the major issues in metropolitan cities. Discuss it briefly with respect to their importance and types of sanitation systems. [6]

b) A wastewater sample was incubated at 25°C and following observations were made: 5 day BOD of sample = 200mg/l, 11 day BOD of sample = 268mg/l. Calculate rate reaction constant and 6 day BOD at 30°C.

$$K_{25} = 0.1015/\text{day}$$

$$L_0 = 290.191 \text{ PPm}$$

$$K_{30} = 0.0772/\text{day}$$

$$K_{30}^{[6]} = 0.1222/\text{day}$$

$$\text{BOD}_6^{30} = 236.55$$

2. a) If you were appointed as a sanitary engineer, how would you determine quantity of storm water for a highly populated sub-urban area. What type of limitations exist in storm water quantity determination for such area? Discuss in detail.

$$p = 0.743^m$$

$$f_{\text{run}} = 2.47 \text{ m/s}$$

$$f = 2.40$$

$$l = 2.734 \text{ m/s}$$

$$0.75 \text{ SD}$$

$$0.94 \text{ m/s}$$

$$0.79$$

b) Calculate the diameter and velocity of a circular combined sewer at a slope of 1 in 150 when it is running just full at a discharge of 1.05m<sup>3</sup>/sec. The value of n in Manning's formula is 0.011. What will be the discharge and velocity when flowing at 0.75 depth of pipe for the same slope? [10]

3. a) What do you understand about the Dorco aeration method; briefly describe its operation with neat sketch. [6]

b) The raw sewage has ultimate BOD of 215 mg/l. The primary treatment removes 30% BOD. The required effluent BOD should be equal to or less than 32 mg/l. Does a single high rate trickling filter having volume of 550m<sup>3</sup> which receives a flow of 4.1 MLD is enough to attain required effluent BOD level? What will be the recirculation ratio required for a single/two stage high rate trickling filter? [10]

$$q = 150.5 \text{ P}$$

$$W_1 = 617.05$$

$$E_1 = 4$$

$$E = 7$$

4. a) In what cases natural methods of sewage disposal systems are applied and what are the necessary condition for implementation of those methods? Discuss. [4]

OR

Describe the purpose and working of sludge drying bed with a neat sketch.

b) A small town with a population of 12000 is to be designed with a sewage treatment plant to handle both its industrial and domestic wastewater. A sanitary survey reveals the following: dairy waste of 2.7\*10<sup>6</sup> l/d with BOD of 4400 mg/l, sugar mill waste of 2.2\*10<sup>6</sup> l/d with BOD of 2200mg/l, and domestic sewage is 200 lpcd having BOD 88 gm/day. DO of both industrial and domestic waste are zero. The effluent from the treatment plant is to be discharged into a stream with a minimum flow of 7000 lit/sec. and dissolved oxygen content of 8.0 mg/l. It is necessary to maintain a DO content of 4.0mg/l. Find the degree of treatment required for the plant? Assume K<sub>1</sub> = 0.4 day<sup>-1</sup>, K<sub>2</sub> = 0.6 day<sup>-1</sup> (both to the base 10) and saturation DO in the river after mixing with

$$Q_{SS} = 7.3 \times 10^6$$

$$Q_{SE} = 604.87$$

$$\text{BOD}_S = 2435.$$

$$D_{\text{mix}} = 7.99$$

$$D_0 = 1.2$$

$$D_c = 5.1$$

$$L_0 = 15.941$$

$$\text{A.C.D. mix 21}$$

$$K_{30} = 0.0772$$

$$K = 0.1222/\text{day}$$

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waste is equal to the DO content of river before mixing.  $DO_{saturation} = 9.1 \text{ mg/l}$  and  $BOD = 0 \text{ mg/l}$  of river.

[12]

5. a) What will be the internal dimension and numbers of soak pit for a resort at Dhangadhi having 110 number of average users. Rate of sewage discharge is 65 lpcd. Cleaning period of septic tank is 4 years interval. Assume other necessary data if required. [6]
- b) What will be the suitable dimensions of a circular sewage sedimentation tank for an industrial area having population of 5500. The average water demand is 210 lpcd. Assume that 70% water reaches the treatment plant and maximum demand is 2.7 times average demand. Diameter of the suspended silica particles available in influent water is more than 0.14mm. [10]

5a)  $t = 25$   $Q = 7150 \text{ l/d}$   
 $I = 26 \text{ l/m}^2/\text{day}$   
 $A = 275 \text{ m}^2 \leftarrow \frac{7150}{26}$   
 $\phi = 3.5$   $\phi = 0.9$   
 $n = 13$   $n = 49$   
 $\text{depth} = 2 + 0.3$   
 $= 2.3 \text{ m}$

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5 b)  $Q = 2182.95 \text{ m}^3/\text{d} \Rightarrow 0.02526 \text{ m}^3/\text{s}$   
 $T = 1 \text{ hr} [1-3 \text{ hr}]$   
 $C = 90.956 \text{ m}^2$   
 $h = 2 \text{ m} [2 \text{ to } 3.5 \text{ m}]$   
 $A_s = 45.478 \text{ m}^2$   
 $\text{check SOR} = 48 \text{ m}^3/\text{d}/\text{m}^2$   
 $[40-50 \text{ m}^3/\text{d}/\text{m}^2]$

circular tank OK ay  
 $\phi = 7.609 [12-30 \text{ m}]$   
 Not okay  
 $H = 2 + 0.5 + 0.5$   
 $= 3 \text{ m}$

$0.78737 = \frac{1}{1 + 0.44 \sqrt{\frac{617.05}{550 \times f_1}}}$   
 $f_1 = 2.978$   
 $\frac{1+r}{(1+0.18)^2} = 2.978$

$= 913.957 \text{ ppm} < 2135.068 \text{ ppm}$

sewage allowable  
 Treatment necessary  
 $\% \text{ treatment} = 62.466\%$

$\text{ppm}$   
 $\text{residual} = 10.9 \text{ ppm}$

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1. a) Describe in detail the objectives of sewage disposal. [6]  
 b) Calculate the diameter and velocity of a circular sewer at a slope of 1 in 400 when it is running just full at a discharge of  $1\text{m}^3/\text{sec}$ . The value of  $n$  in Manning's formula is 0.012. Will the self cleansing velocity be maintained in the sewer when flow drops to  $0.6\text{m}^3/\text{s}$ ? [10]
2. a) As a designer for a highly populated urban core area how would you determine quantity of storm water? Discuss. [6]  
 b) The  $\text{BOD}_5$  of a sewage incubated for one day at  $30^\circ\text{C}$  has been found to be  $170\text{mg/l}$ . What will be the 5 day BOD at  $20^\circ\text{C}$ ? Assume  $K = 0.12$  per day (base 10) at  $20^\circ\text{C}$ . [10]
3. a) Explain the necessity of providing a manhole in a sewer line. Describe, with the help of a neat sketch the components of a manhole. [6]  
 b) The sewage of a town is a mixture of domestic sewage and industrial sewage. The sewage is to be treated at the sewage treatment plant before discharging into river. Determine the degree of treatment required for the following data: [10]  
 Population = 40000  
 Domestic sewage = 175 lpcd  
 BOD of domestic sewage =  $50\text{gm/capita/day}$   
 Flow of industrial waste =  $4 \times 10^6$  liters/day  
 BOD of industrial waste =  $4000\text{mg/l}$   
 DO of both domestic and industrial sewage = 0  
 River discharge = 8500 liters/sec  
 BOD of river water = 0  
 DO of river water =  $8\text{mg/l}$   
 $k_1 = 0.1/\text{day}$  and  $k_2 = 0.1/\text{day}$ .  
 Assume other data as required.
4. a) With neat sketches, describe the purpose and construction of a grit chamber. [6]  
 b) The effluent from a primary sedimentation tank is applied to a standard rate filter at the rate of 3 million liters per day, having a  $\text{BOD}_5$  of  $175\text{mg/l}$ . Determine the depth and volume of filter, adopting a surface loading of  $150\text{gm/m}^3/\text{day}$ . Also determine the efficiency of such filter unit, using NRC formula. Assume recirculation ratio = 1:2. [10]
5. a) Explain the necessity of sludge treatment. Draw a sketch of sludge digester and explain its working. [2+6]  
 b) Design a double pit VIP latrine for a family of 15 users. [8]
6. Write short notes on: (any four) [4x4]
  - a) Types of sewerage system
  - b) Catch basin
  - c) Time of concentration
  - d) Bacteria-algal-symbiosis process
  - e) Incineration of solid waste

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- 
1. a) Compare separate and combined systems of sewerage in a tabular form.  
b) As a designer for rural with scattered populated area how would you determine the quantity of storm water? Discuss in detail.
  2. a) The BOD<sub>5</sub> of sewage sample at 20°C is 300mg/l. If  $K=0.23$  (base e), what is the ultimate BOD? Calculate BOD<sub>3</sub> at 15°C.  
b) Design a septic tank and soak pit for the following data:  
No. of persons = 100  
Sewage/Capita/day = 120 liters  
Sludge cleaning period = 1 Year  
Soil infiltration = 40 l/m<sup>2</sup>/d
  3. a) Calculate the diameter and velocity of a circular sewer at a slope of 1 in 400 when it is running just full at a discharge of 0.85m<sup>3</sup>/sec. The value of n in Manning's formula is 0.011. What will be the discharge and velocity when flowing 0.6 depth of pipe for the same slope.  
b) With a neat sketch, describe the purpose and construction of a drop manhole.
  4. a) In what cases natural methods of disposal systems are applied and how, discuss.  
b) Design an oxidation pond for a town with the following data:  
People = 10,000  
Sewage flow = 135 lpcd  
BOD of incoming sewage = 250mg/l  
Organic loading = 100Kg BOD/ hectare/day  
Detention time = 30 days
  5. a) With neat sketches, describe the activated sludge process.  
b) The volume of fresh sludge obtained from PST and trickling filter humus tank is 85.1m<sup>3</sup> at 98% moisture content. After sludge digestion, the moisture content reduced to 83%. What will be its volume and design a sludge digestion tank for it? Assume specific gravity remains same before and after dilution.
  6. Write short notes on (any four):
    - a) Inverted siphon
    - b) Sewage sampling
    - c) Bacteria-algal-symbiosis process
    - d) Composting of solid waste
    - e) Overland flow and rapid infiltration

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

**Subject: - Sanitary 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) Discuss the relative merits and demerits of the separate and combined system of sewerage. Also give the conditions favourable for the adoption of each one of them. Describe how time of concentration is found out graphically. [4+2+2]
- b) In a thickly built up residential area, the average surface coverage are 40% roofs and pavements having run off coefficient of 0.8 and 60% lawns and gardens having run off coefficient of 0.2. If the population density per hectare is 2000 and rate of water supply is 125 lpcd and time of concentration ( $t_c$ ) is 30 min, calculate the required size of the combined sewer. [8]
2. a) Draw a neat sketch of manhole, showing its components. Where and why drop manhole is to be provided? [6]
- b) A town discharges 120 cumec of sewage into a river having a rate of flow 1600 cumec, during lean period with a velocity of 0.1 m/sec. The 5 day BOD of sewage at the given temperature is 250 mg/lit. Find the amount of critical DO deficit and when and where it will occur in the downstream portion of the river. Assume deoxygenation constant K as  $0.1 \text{ day}^{-1}$  and coefficient of self purification f as 3.5. Saturation DO at given temperature is 9.2 mg/lit. [10]
3. a) Draw 1<sup>st</sup> stage and 2<sup>nd</sup> stage BOD curve and indicate its salient features. Define grab sample and composite sample. Describe the factors affecting self purification of river. [3+1+4]
- b) A rectangular primary sedimentation tank is to treat 1 MLD sewage per day. If detention period is 1.5 hrs, the velocity of flow is 10 cm/min, depth of sewage and sediments is 3.5m, calculate [8]
  - i) Dimension of tank
  - ii) Overflow rate of the tank
4. a) What are the principles of biological treatment? Draw the figures of any one type of grit chamber and skimming tank. What are the working principle of those units? [7]
- b) Determine the dimensions of a high rate trickling filter for the following data: [9]
  - i) Sewage flow = 3.0 MLD
  - ii) Recirculation ratio = 1.5
  - iii) BOD of raw sewage = 250 mg/lit
  - iv) BOD removal in the primary settling tank = 25%
  - v) Final effluent BOD desired = 30 mg/lit
  - vi) By what percent the diameter of the filter will have to be modified if it is to be designed as a standard rate trickling filter for the above requirements.
5. a) What is septic tank and soak pit? Describe about design procedure of septic tank and soak pit. [7]
- b) What is primary and secondary sludge? List out the necessity of sludge treatment. Assuming 30% solid matters in a sludge (containing 90% water) is composed of fixed mineral solids with sp.gr. of 2.5 and 70% composed of volatile solids with sp.gr. of 1. Find specific gravity of sludge. [2+2+5]
6. Write short notes on: (any four) [4×4]
  - a) Evapotranspiration mound
  - b) Sewage sickness
  - c) Street inlets
  - d) Solid waste and its types
  - e) Testing of sewer

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

**Subject: - Sanitary 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) Discuss the relative merits and demerits of the separate and combined system of sewerage. Also give the conditions favourable for the adoption of each one of them. Describe how time of concentration is found out graphically. [4+2+2]
- b) In a thickly built up residential area, the average surface coverage are 40% roofs and pavements having run off coefficient of 0.8 and 60% lawns and gardens having run off coefficient of 0.2. If the population density per hectare is 2000 and rate of water supply is 125 lpcd and time of concentration ( $t_c$ ) is 30 min, calculate the required size of the combined sewer. [8]
2. a) Draw a neat sketch of manhole, showing its components. Where and why drop manhole is to be provided? [6]
- b) A town discharges 120 cumec of sewage into a river having a rate of flow 1600 cumec, during lean period with a velocity of 0.1 m/sec. The 5 day BOD of sewage at the given temperature is 250 mg/lit. Find the amount of critical DO deficit and when and where it will occur in the downstream portion of the river. Assume deoxygenation constant  $K$  as  $0.1 \text{ day}^{-1}$  and coefficient of self purification  $f$  as 3.5. Saturation DO at given temperature is 9.2 mg/lit. [10]
3. a) Draw 1<sup>st</sup> stage and 2<sup>nd</sup> stage BOD curve and indicate its salient features. Define grab sample and composite sample. Describe the factors affecting self purification of river. [3+1+4]
- b) A rectangular primary sedimentation tank is to treat 1 MLD sewage per day. If detention period is 1.5 hrs, the velocity of flow is 10 cm/min, depth of sewage and sediments is 3.5m, calculate [8]
- i) Dimension of tank                      ii) Overflow rate of the tank
4. a) What are the principles of biological treatment? Draw the figures of any one type of grit chamber and skimming tank. What are the working principle of those units? [7]
- b) Determine the dimensions of a high rate trickling filter for the following data: [9]
- i) Sewage flow = 3.0 MLD                      ii) Recirculation ratio = 1.5  
iii) BOD of raw sewage = 250 mg/lit    iv) BOD removal in the primary settling tank = 25%  
v) Final effluent BOD desired = 30 mg/lit  
vi) By what percent the diameter of the filter will have to be modified if it is to be designed as a standard rate trickling filter for the above requirements.
5. a) What is septic tank and soak pit? Describe about design procedure of septic tank and soak pit. [7]
- b) What is primary and secondary sludge? List out the necessity of sludge treatment. Assuming 30% solid matters in a sludge (containing 90% water) is composed of fixed mineral solids with sp.gr. of 2.5 and 70% composed of volatile solids with sp.gr. of 1. Find specific gravity of sludge. [1+2+5]
6. Write short notes on: (any four) [4×4]
- a) Evapotranspiration mound                      b) Sewage sickness                      c) Street inlets  
d) Solid waste and its types                      e) Testing of sewer

05 TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division**  
 2065 Chaitra

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

**Subject: - Sanitary 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) Describe the systems of sanitation with their advantages and disadvantages. Why water-carrying system of sanitation is popular than conservancy system? [6]
- b) If the seven-day BOD at 20°C is 280 mg/l and one day BOD at 20°C is 35 mg/l. Calculate the rate reaction constant  $k'$  20°C and five-day BOD at 25°C. [10]
2. a) Design a combined sewer section for a 45-hectar residential area having runoff coefficient 0.40, 0.70, 0.25, 0.80, 0.10 for area of 15, 20, 25, 10 and 30% respectively with altogether 1500 population? Average rainfall duration is 21-min. Self-cleansing velocity is 0.88 m/sec. Assume water supply rate = 100 lpcd and time of concentration = 20 min. [10]
- b) With a neat sketch, describe the construction of a manhole. [6]
3. a) Suggest suitable dimensions of a circular sewage sedimentation tank for an industrial area having population of 4800. The average water demand is 150 lpcd. Assume that 70% water reaches at treatment plant. [10]
- b) What do you understand by self purification of stream? Describe the various factors affecting self purification. [6]
4. a) What will be the recirculation ratio required of a single stage trickling filter having volume of 550m<sup>3</sup> at flow of 3.7 MLD. The raw sewage has BOD of 180 mg/l. The primary treatment removes 33% BOD. The effluent BOD is to be equal or less than 35 mg/l. [10]
- b) Describe activated sludge treatment process with schematic diagram. Also describe the principle of BOD reduction in the treatment process. [6]
5. a) A raw sewage having suspended solids content of 250 mg/l is passed through primary sedimentation tank at a flow of 5 MLD. The sedimentation tank removed 55% suspended solids. Determine the volume of sludge produced per day if moisture content and specific gravity of sludge are 98% and 1.02 respectively. What will be the volume if its moisture content reduces to 81.5% after digestion? [10]
- b) Describe the various methods of solid waste composting. [6]
6. Write short notes on (any four): [4×4]
  - a) Time of Concentration
  - b) Incineration of Solid Waste
  - c) Intermittent Sand Filter
  - d) Inverted Siphon
  - e) Bacteria-Algal-Symbiosis Process

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

**Subject: - Sanitary 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 water carriage system. What are its merits and demerits? Why is it not suitable to adapt water carriage system in rural areas? [8]
- b) A sewage sample incubated for one day at 30°C has BOD of 150 mg/l. What will be its 5 day BOD at 20°C if the value of the de-oxygenation constant is 0.13 per day (base 10) for 20°C? [8]
2. a) Discuss briefly the methods of land treatment. How sewage sickness occurs? [6]
- b) Determine the volume of sludge produced in a sewage sedimentation tank for the following data: [10]
  - Flow rate = 10 million liters/day
  - Suspended solids content in raw sewage = 250 mg/l
  - Sedimentation tank removes 60% of suspended solids
  - Specific gravity of sludge = 1.02
  - Moisture content of sludge = 95%
3. a) Draw a neat sketch of manhole and describe it with necessary labeling. [6]
- b) Design a sewer for a population of 100,000 persons with water supply per capita of 120 l/d. It is expected that 80% of the water is converted into sewage. The DWF estimated will be 1/3<sup>rd</sup> of the maximum discharge in this separate sewer. The permissible slope is 1:1000 and rugosity coefficient is taken as 0.012. For the self purpose at least 0.75 m/s velocity need to be developed in the drain. [10]
4. a) Discuss the working of trickling filter with neat sketch. [6]
- b) Design a conventional activated sludge plant to treat settled domestic sewage with diffused air aeration system for the following data: [10]
  - i) Population served = 90,000
  - ii) Per capita sewage contribution = 100 l/d
  - iii) BOD<sub>5</sub> of settled sewage = 220 mg/l
  - iv) Effluent BOD<sub>5</sub> allowed = 30 mg/l
  - v) F/M ratio = 0.2
  - vi) MLSS = 3000 mg/l
5. a) Discuss the principles of oxidation pond. Why is it believed that they are better alternatives to small towns of Nepal? [8]
- ~~b)~~ Design a circular sewage sedimentation tank for a population of ~~50,000~~. The per capita sewage contribution is 80 lpcd. Assume necessary data suitably. [8]
6. Write short notes on any four of the followings: [4×4]
  - a) Construction of septic tanks
  - b) Inverted siphon
  - c) Gravity thickener
  - d) Double pit pour flush latrine
  - e) Soak pits

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

**Subject: - Sanitary 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) As a designer for a highly populated urban area how would you determine quantity of storm water? Discuss in detail. [6]
- b) If the five-day BOD at 20°C is 280 mg/l and one day BOD at 20°C is 111.80 mg/l. Calculate the rate reaction constant  $k$  at 20°C and 7-day BOD at 25°C. [10]
2. a) Determine the diameter and velocity of a circular sewer at a slope of 1 in 500 when it is running just full at a discharge of  $1\text{ m}^3/\text{sec}$ . The value of  $n$  in Manning's formula is 0.012. What will be the discharge and velocity when flowing half full for the same slope? [10]
- b) Describe the purpose and working of sludge drying bed with a neat sketch. [6]
3. a) Design a grit chamber from the maximum flow of sewage =  $40 \times 10^6$  l/d, Sp. gr. of grit = 2.7, Size of grit particle to be removed = 0.25mm, Assume temp  $T = 20^\circ\text{C}$ . Assume other necessary data suitably. [10]
- b) Describe the purpose, construction and working of a manhole. [6]
4. a) Calculate effluent BOD of two stage trickling filter for the following data: [10]  
Sewage flow =  $2\text{ m}^3/\text{min}$ ,  
BOD of sewage after primary treatment = 300 mg/l,  
Volume of both filters =  $900\text{ m}^3$  and  
Recirculation ratio for both filters = 1:5.  
Assume necessary data suitably.
- b) What do you understand by self purification of streams? Describe the factors affecting self purification of streams. [6]
5. a) The volume of fresh sludge obtained from PST and trickling filter humus tank is  $84.1\text{ m}^3$  at 97% moisture content. After sludge digestion, the moisture content reduced to 83%. What will be its volume after digestion? Also design a sludge digestion tank for it. Assume sludge digestion period as 30 days. [10]
- b) How does an oxidation pond work? Describe its construction with a neat sketch. [6]
6. Write short notes on (any four): [4×4]
  - a) Evapo-transpiration mound
  - b) Skimming tank
  - c) Catch basin
  - d) Composting of solid waste
  - e) VIP latrine

Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

6

**Subject: - Sanitary Engineering**

B.E. 812 / 90 21 A

- ✓ 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) Discuss the various methods of sewage disposal by land treatment with their merits and demerits. [8]
- b) Calculate 5-day biochemical oxygen demand of a sewage at 20°C. Its sample analysis shows 180mg/l of BOD after 3 days at 30°C. [8]
2. a) What is dry weather flow? Discuss various factors affecting quantity of dry weather flow. Justify why we need to consider peaking factor. [6]
- b) A sewage sample has suspended solid-contents of 240 mg/l. The sedimentation tank removes 65% of the suspended solids. If the water content of the sludge is 95% determine volume of sludge produced in a sedimentation tank after treating  $8.5 \times 10^6$  l of sewage. Assume specific gravity of the sludge as 1.02. [10]
3. a) With a neat sketch of describe the process of sludge thickening. [6]
- b) A newly added ward of a municipality with 40,000 populations covers an area of 50 ha. The projected surface of the area is given as follows: [10]

% of total surface	Type of surface	Runoff coefficient
25	Hard pavement	0.85
35	Roof surface	0.80
15	Unpaved street	0.30
25	Gardens and lawns	0.15

The time of concentration is 30 minutes. Use US Ministry of Health formula for the intensity of the rainfall. The average daily water consumption of the area is 180 liters per capita out of which 80% turns into waste water. The peak flow is three times the dry weather flow. Determine the discharge of the waste water from the area.

4. a) Explain principles of activated sludge process with neat sketch. Elaborate why food/micro-organism ratio is important in this process. [6]
- b) Sewage from Primary Settling Tank is discharged to Standard-rate Trickling Filter at the rate of 4 MLD having 150 mg/l of 5-day BOD. Determine the depth and velocity of the filter adopting surface loading of 2400 l/m<sup>2</sup>-day and organic loading of 160 g/m<sup>3</sup>-day. Also determine the efficiency of the Trickling Filter. Assume necessary data if necessary. [10]
5. a) What is oxidation pond? Elaborate various physical and biochemical processes that take place in oxidation pond. [6]
- b) Design a septic tank for a house in Kathmandu with 12 inhabitants. The rate of sewage disposal is 100 l/c-day. De-sludging is expected every 2 years. Make assumptions for necessary data. Draw a plan and cross section of the septic tank with designed dimensions. [10]
6. Write short notes on any four of the followings [4×4]

- |                               |                                 |
|-------------------------------|---------------------------------|
| a) VIP latrine                | b) Testing of sewer lines       |
| c) Composting of solid wastes | d) Grit chamber                 |
| e) Manhole                    | f) Self purification of streams |

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

**Subject: - Sanitary 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 sewage, sullage, sewer and garbage. Compare between separate and combined systems of sewerage. [6]  
b) Calculate the diameter and velocity in a circular sewer at a slope of 1 in 400 when it is running just full at a discharge of  $2\text{m}^3/\text{sec}$ . The Manning's coefficient  $n = 0.013$ . What will be the discharge and velocity when flowing one third full? [10]
2. a) What is dry weather flow? Discuss the various factors affecting the dry weather flow. [6]  
b) A stream saturated with DO has a flow of  $1.5\text{m}^3/\text{s}$ , BOD  $4\text{ mg/l}$  and rate constant ( $K_1$ ) of 0.3 per day. It receives an effluent discharge of  $0.5\text{ m}^3/\text{s}$  having BOD  $20\text{ mg/l}$  and DO  $5\text{ mg/l}$ . The average velocity of flow of stream is  $0.20\text{ m/s}$ . The average depth of stream is  $1.2\text{m}$ . Calculate DO deficit at  $30\text{ km}$  and  $50\text{ km}$  downstream. Assume temperature throughout  $20^\circ\text{C}$  and BOD is measured in 5 days. Take saturation DO at  $20^\circ\text{C}$  as  $9.17\text{ mg/l}$ . [10]
3. a) With neat sketches, describe the working of an activated sludge process. [8]  
b) If  $\text{BOD}_3$  at  $15^\circ\text{C}$  is  $220\text{ mg/l}$ , find  $\text{BOD}_7$  at  $25^\circ\text{C}$ . [8]
4. a) State and explain the following terms [8]
  - i) aerobic decomposition
  - ii) BOD
  - iii) COD
  - iv) anaerobic decomposition  
b) A sedimentation tank treats  $8\text{ Mld}$  containing  $200\text{ mg/l}$  of suspended solids. The tank removes 60% of the suspended solids. Compute the weight and volume of sludge produced daily if the moisture content of the sludge is (i) 95% (ii) 90%. [8]
5. a) What is oxygen sag curve? Describe the self purification of streams. [8]  
b) Calculate the BOD removal efficiency for the single stage high rate trickling filter. BOD loading is  $750\text{ g/m}^3/\text{day}$  and recirculation ratio is 0.6. [8]
6. Write notes on any four: [4×4]
  - a) Soak Pit
  - b) Pour Flush Latrine
  - c) Manhole
  - d) Composting of Solid Waste
  - e) Flushing Device

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

**Subject: - Sanitary 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) Discuss principles of VIP latrine and its construction with neat sketch. [8]  
 b) If 3 day BOD of a sewage sample is 200 mg/l at 25°C, calculate its 5 day BOD at 20°C. [8]
2. a) Describe that the time of concentration is an important factor while determining storm water discharge. Elaborate on time of concentration and time area graph. [8]  
 b) A grit chamber is provided to remove grit particles up to 0.2mm from a sewage of a town of population 800,000 producing 100 litre waste water per capita per day. Working at 20°C temperature, the specific gravity of the grits may be taken as 2.6. Determine the size of grit chamber. Assume necessary data. [8]
3. a) Describe the various methods of land treatment. [6]  
 b) Determine the size of combined circular sewer for a discharge of 1.5 m<sup>3</sup>/s running half full. Assume a gradient of 1 in 2000 and Manning's rugosity coefficient N = 0.013 (constant for all flows). In the dry season if the flow drops to 0.5 m<sup>3</sup>/s, does the flow maintain desired self-cleaning velocity of 0.6 m/s? [10]
4. a) Discuss the principles of oxidation pond. Do you agree that this method is suitable for waste water treatment in Terai towns of Nepal? Give your opinion with reasons. [6]  
 b) A single stage trickling filter receives sewage flow of 4 million litres per day containing raw sewage BOD of 300 mg/l. A primary settling tank is provided whose efficiency is 35%. Determine the recirculation ratio required to meet the maximum effluent BOD connection of 60 mg/l? The effective volume of filter is 300 m<sup>3</sup>. [10]
5. a) What are the differences between high rate trickling filters and low rate trickling filters? [6]  
 b) Determine storm water discharge for a town of 200 ha. The catchment surface and corresponding runoff coefficients are provided below. The maximum intensity of rainfall is 40 mm/hour. [10]

Type of surface	% area	Runoff coeff.
Vacant plots	40	0.15
Unpaved roads	10	0.40
Gardens and open spaces	20	0.15
Built up surface	30	0.90

It is expected that after 20 years the built up area will be 60% of the total by converting additional 30% area of vacant plots. What will be the storm water discharge at present and after 20 years?

6. Write short notes on any four of the followings: [4×4]
  - a) Street inlets
  - b) Testing of sewer lines
  - c) Sludge digestion processes
  - d) Composting of solid waste
  - e) Septic tanks

Exam.	Back		
Level	B.E.	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Sanitary 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) What are the differences between separate and combined systems of sewerage? Discuss the factors considered to select combined and separate systems. [6]
- b) A wastewater sample is taken from a sewer. The 5-day BOD was found to be 180 mg/l at 20°C which is 70% of the ultimate BOD. What will be 4-day BOD of the wastewater at 30°C? [10]
2. a) Discuss with sketch the Oxygen Sag Curve in natural streams. [6]
- b) A perennial river is receiving waste water from a town with a discharge of 200 m<sup>3</sup>/s. The river water fully saturated with oxygen is flowing at the rate of 1500 m<sup>3</sup>/s at a velocity of 0.15 m/s. If the 5-day BOD of the sewage is 250 mg/l, find out where the critical dissolved oxygen will occur in the river. The BOD of the river water is zero. The DO of the river water and wastewater are 8.0 and 0.1 mg/l respectively. The deoxygenation co-efficient is 0.1 per day and self purification constant is 5. The dissolved oxygen in the river at saturated condition may be taken as 9.17 mg/litre. Assume necessary data. [10]
3. a) List the steps followed in sludge treatment. Discuss the anaerobic digestion principle in a conventional sludge digester. [6]
- b) Design a circular sewage sedimentation tank for a population of 80,000. The rate of water supply is 150 lpcd. Assume necessary data suitably. [10]
4. a) What is land treatment of waste water? Discuss briefly the methods of land treatment. How does sewage sickness occurs? [6]
- b) Population of 100,000 is living in a town. A separate sewer system for the town is to be constructed. The water consumption rate is 125 lpcd. 80% of the water consumed is discharged as waste water. The topography do not allow the slope of the sewer line more than 1:1000. The self cleaning velocity can be achieved at 0.60 m/s. The dry weather flow may be taken as 1/3<sup>rd</sup> of the maximum discharge. Design an outfall sewer with RCC hume pipe having Manning's coefficient of 0.013. [10]
5. a) What is sloughing? Discuss the biological process that takes place in trickling filters. [6]
- b) Design a two-stage high rate trickling filter for the following data. [10]
 

Organic loading of filter	= 10,000 kg BOD <sub>5</sub> /hectares/day
Flow	= 4.5 × 10 <sup>6</sup> litres/day
BOD of sewage	= 280 mg/litre
BOD removal in primary settling tank	= 30%
Recirculation ratio	= 1.4 for both filters
Max. BOD allowed in final effluent	= 35 mg/litre

Assume an intermediate sedimentation tank. Assume appropriate data where required.
6. Write short notes to any four of the following. [4×4]
 

a) Chemical Oxygen Demand	b) Manhole with neat sketch
c) Design considerations of septic tank	d) Skimming tank
e) Working of oxidation pond with neat sketch	

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Communication English (SH651)**

- ✓ 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. Edit the following text:

[5]

My father learnt this lesson after leaving me a dozen voice mail messages none of which I listened to. Exasperated he called my sister to complain that I never returned his phone calls why are you leaving him voice mails my sister asked just text him.

2. Read the following text carefully and interpret it so as to make the meaning clear:

[5]

Today, jet-lag is a familiar hazard for the seasoned traveler. Travel across time zones plays havoc with the biological clock rhythms of the human body. For the active pilot, who is rarely in one place long enough to know if it is time for breakfast or dinner, the impact of jet-lag on his sleep is critical. Several air disasters have been partly caused by overtired pilots ignoring the natural laws of sleep. Much research is directed to finding out what these laws are and what extent pilots and astronauts disobey them. But they are laws which affect all of us, not just pilots.

3. Study the following text carefully. Prepare its note and convert it into summary.

[5+5]

I was taking tea in the rooms of a fine scholar at King's College, Cambridge, the week before the Oxford and Cambridge Rugby match, when, in order to bring the conversation or the lack of it a little nearer my own intellectual level, I asked a brilliant novelist who was present: 'Are you going to match next Tuesday?' He looked as sincerely puzzled as if I had addressed him in Gaelic. 'What match?' he asked gently. I explained to him that a football match was to take place in the following week-a match in which the fate of his beloved university would be involved, or at least seem to be involved, for about an hour and half. 'Honestly', he said, with a look of surprise, 'I hadn't heard about it. Had you?' he asked, turning to our host. Our host declared that the news came as a complete surprise to him also. Another scholar who was present, on being questioned on the matter, admitted that he had gathered in the course of a recent conversation that some important match was going to be played somewhere, but he did not know that it was to be against Oxford, or that it was a Rugby match, or that it was to be played at Twickenham, or that it was to take place on Tuesday.

It astonished one to find that men who were learned in every detail of the struggles between Athens and Sparta, between Rome and Carthage, could be indifferent to a struggle almost at their own doors-a struggle, too, in which the prizes were not the sordid gains of political warfare, but the magnificently empty honors of sport. All present were pacifists, yet bloody battles fascinated their intellects far more than the bloodless battles of the football field- the battles, so to speak, of the future. Such indifference to an exciting phase of contemporary life shocked me. I could have understood a stockbroker's being indifferent to the result of a great football match, but a university man, a fine mind strained in the humanities-that was a very different affair. I left Cambridge a little saddened over the prospects of the human race.

✓ 4. Answer any two of the following questions: [5×2]

- a. "Studies serve for delight, for ornament, and for ability." Elucidate. (Of Studies)
- b. What is the nature of the scientific attitude? (The Scientific Attitude)
- c. Point out the weaknesses of modern steam boilers. (Steam Boilers)

✓ 5. Fill up the following blank spaces selecting the correct words from the brackets: [0.5×10]

- a. He, along with his teachers, ..... playing. (is, are)
- b. The principal and accountant.....on leave. (is, are)
- c. It .....a long time since he telephoned me. (is, has been)
- d. It's high time he .....the job. (got, has got)
- e. Had it not been a hot day, we .....a lot. (had worked, would have worked)
- f. Should that happen, I .....the job. (should quit, will quit)
- g. I'll stand .....you whatever happens. (for, by)
- h. The project is running .....financial difficulties. (with, into)
- i. The passive voice of "I remember him teaching me algebra" is ..... (I remember being taught algebra/I remember to being taught algebra by him.)
- j. The passive voice of "I saw him crossing the road" is ..... (He was seen crossing the road by me/He was seen to be crossing the road.)

✓ 6. Change the following bibliographic references as indicated in the brackets: [4]

- a) Joyce, Michael. Afternoon: A story. Diskette, Watertown, Eastgate, 1987. (into APA)
- b) Kurusawa, Akira. Rashomon. Toshiro Mifune. Daiei, 1950. (into APA)
- c) Rivers, W. (1968). Teaching foreign language skills, Chicago: Chicago University. (into MLA)
- d) White, R. (1991). Process Writing. London: Longman. (into MLA)

✓ 7. Inventing necessary details, write a notice with four point agenda for the forthcoming fifth meeting of your local social club. [5]

✓ 8. Suppose you are the Chief Consultant of Bagmati bridge maintenance project. Write a progress report in memo format. [6]

✓ 9. Assume that you are asked to prepare a final report of road expansion project that you have handled. Write introduction, objectives, methodology, and conclusion giving a clear outline of the rest of the components. [10]

✓ 10. Write a proposal on the rural electrification programme that you want to launch in the near future including title page, abstract, conclusion and recommendation. [10]

✓ 11. Write a brief research article on the importance of widening of Ring Road in Kathmandu. [10]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject:** - Communication English (SH651)

- ✓ 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. Edit the following paragraph:

[5]

Then to my amazement, she gave me her phone number. That night, Mary revealed that dropping my letter jacket in front of her was a stupid thing to do. She didn't care about what sports guys lettered in, she only cherished wonderful people with substance. After I begin being myself, they quickly fell for one another so became "high school loves".

2. Read the following paragraph and comment on it. You can agree/disagree.

[5]

Most men and women, given suitable conditions, will feel passionate love at some period of their lives. For the inexperienced, however, it is very difficult to distinguish passionate love from mere sex hunger; especially is this the case with well-brought-up girls, who have been taught that they could not possibly like to kiss a man unless they loved him. If a girl is expected to be a virgin when she marries, it will very often happen that she is trapped by a transient and trivial sex attraction, which a woman with sexual experience could easily distinguish from love. This has undoubtedly been a frequent cause of unhappy marriages. Even where mutual love exists, it may be poisoned by the belief of one or both that it is sinful. This belief may, of course, be well founded. Parnell, for example, undoubtedly sinned in committing adultery, since he thereby postponed the fulfilment of the hopes of Ireland for many years.

3. Read the following passage carefully, taken down notes and write a summary.

[5+5]

As material civilization advances and the supply of available goods and services increases, man's needs correspondingly multiply. Advertising plays a key role in this never-ending process by stimulating the public's desire for certain products, and by promoting the sales thereof, until it has, in effect, created new needs, real or supposed, where there were none before. A familiar example is the motor car—once a rare and costly novelty, now an ubiquitous and relatively inexpensive necessity. More recently, the television set has undergone the same transformation. While some people would deny that television is a necessity, the fact that sets are found in majority of western homes shows that is answer, to a greater or lesser degree, the need felt by millions of people for entertainment and information.

A product, service, or commodity that the public needs, and knows it needs, tends, of course, to 'sell itself'. We might, therefore, assume that, in such cases, advertising would be of minor importance. To some extent this is true. Meatpackers, vegetable and fruit growers, and dairy operators spend less on advertising, for instance, than manufacturers of cigarettes, liquors, cosmetics, and other items of this type.

On the other hand, the competition that exists between rival brands means that the suppliers of such basic necessities as food, clothing, and housing must advertise their wares to stay in business. Significantly, the industry that spends most on advertising turns out a product which almost everyone considers a necessity: soap.

4. Answer any two of the following: [5+5]
- What questions are to be answered in order to solve growing problems of water supplies? Answer with reference to the text "Water Supplies: a Growing Problem".
  - How does the proverb 'an hour to suffer, a lifetime to live' apply to Pahom's race for land? (How Much Land Does a Man Need)
  - Is love always limited to husband and wife? Answer with reference to the text 'The Lady with the Pet Dog'.
5. Choose the correct words from the brackets and fill in the blanks: [0.5×10]
- I met him after he ..... the job. (lost, had lost)
  - Had he worked harder, he ..... the exam. (would pass, would have passed)
  - The passive voice of 'I'll see you soon' is ..... (I'll be seen soon, you'll be seen soon)
  - He parted ..... all his wealth. (from, with)
  - Neither of the two applicants ..... suitable (is, are)
  - He complains ..... severe headache. (of, about)
  - I would do this if I ..... allowed. (am, were)
  - The servant says that tea ..... ready. (was, is)
  - She kept us ..... (to wait, waiting)
  - I wish my brother ..... here. (was, were)
6. Study the following quotation and then adjust the given information for in-text citation first and next for bibliography list under APA and MLA format: [4]
- "Nature is kind of her slaves. If she forces you to eat and drink, she makes eating and drinking so pleasant that when we can afford it we eat and drink too much."
- Year of publication : 1976  
 Name of book : Nature and People  
 Place of publication : London  
 Page number : 107  
 Name of the Writer : George Bernard Shaw  
 Name of publisher : Creation Publications
7. You are named the secretary of a committee formed to distribute donated materials among victims of certain natural disaster. Assuming necessary information write a notice along with a three point agenda to call its second meeting. [5]
8. Write a brief report in memo format on damages caused by landslide in Sindhupalchowk district. [6]
9. Write a report on development of information technology in Nepal in the past five years. Show only the title page, introduction and conclusion parts of the report. [10]
10. Road accidents frequently occur in city areas of Nepal due to unplanned traffic control. You have a master plan to solve this problem. Write a proposal to the concerned ministry offering your plan. Write only statement of problem, rationale and objectives of your plan. [10]
11. Nepal is being polluted day by day. We are all becoming victims of this. Considering this, write a brief research article on the importance of introduction of green engine technology in Nepal. [10]

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Communication English (SH651)**

- ✓ 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. Edit the text given below: [5]

Hamlet had just enough life left in him to hear Goratio's promise: then whispering the words the rest in silence he sank down dead such was the end of the brave and noble prince of Denmark. He was mourned as one who would have made a splendid king, and he was carried to his burial with soldiers music and a people's mourning.

2. Read the following text carefully and interpret it so as to make the meaning clear: [5]

What is a democratic government to do in a country where people are steeped in ignorance and superstition, where there is opposition or resistance to even mild reforms from vested interests in society?

3. Study the following text carefully. Prepare its note and convert it into a summary. [5+5]

All people who speak the same language have agreed to use certain words for certain jobs and this enables them to communicate with each other. There is nothing particularly remarkable about the words themselves: they might just as well have chosen different ones. What matters is that this agreement about the use of words should be fully understood, and understood in detail, by everyone who wishes to profit by them. Let us take example of bell-ringing. By itself, the ringing of a bell means nothing. But in certain recognized contexts, it may mean different things as different as 'time for school!', 'somebody at the door!', 'that's the end of the lesson' or 'come here, please, waitress!'. We might well wonder how it is that the same noise can mean so many different things; but of course the answer is easy. The noise occurs in recognized contexts; in times and places when we know that it can only mean one thing. Thus all most anything can be used to communicate several different things.

Let us apply this to verbal signs, or words. First we can communicate just as well by using 'father', 'pater', 'Daddy', or anythings else: provided we are understood, it makes no difference. We can invent a completely new word too. Secondly, the same collection of letters can be used to communicate quite different things. The word 'port' can mean a special sort of wine, the opposite of starboard, a harbour, the various other things. The significance of any sign, therefore, depends on the context in which it is used.

4. Answer any two of the following questions: [5×2]
- What were the major contents of Einstein's four scientific papers? (What Einstein did)
  - 'A mother who is known as a symbol of love may turn into a cruel monster'. Explain this statement with reference to the text 'The Mother of a Traitor'. (The Mother of a Traitor)
  - 'Knowledge and Wisdom are the two aspects of the same coin'. Do you agree with this statement? If yes, why? (Knowledge and Wisdom)
5. Choose the correct words from the brackets: [0.5×10]
- Five and five ..... ten. (make, makes)
  - My means ..... limited. (is, are)
  - I parted ..... at the college gate. (with, from)
  - Steel is made ..... iron. (from, of)
  - I feel the room ..... (move, to move)
  - Buy that book ..... I will help you. (and, if)
  - He told me that he ..... many books. (had written, wrote)
  - I remember ..... to the Museum by my father. (to be taken, being taken)
  - I was please ..... the news of his success. (by, with)
  - Twenty ..... by five is equal to four. (divided, has been divided)
6. Change the following bibliographic references as indicated. [4]
- Giddens, A. (1990). *The Consequences of Modernity*, Cambridge: Polity Press. (into MLA)
  - Freire, P. (1972). *The Pedagogy of the Oppressed*, London: Penguin. (into MLA)
  - Lawrence, T.E. *Revolt in the Desert*. New York: George H. Dorian, 1927. (into APA)
  - Wolf, Daniel. *Lives of Notable Gay Men and Lesbians*. New York: Chelsea Publishing, 1995.
7. Suppose you are the secretary of your local Town Assembly whose tenth meeting has been held recently. Write the minutes of the same inventing the most relevant agenda. [5]
8. Imagine you are the chief consultant of a construction company which has undertaken a four-year long repair and maintenance project on Tribhuvan Highway. Write a second monthly progress report in memo-format. [6]
9. Suppose Ministry of Hydro-power and Drinking Water, Nepal has requested the qualified consultants to submit a proposal for constructing a power house at your local town. Write title page, abstract, acknowledgements, technical section and cost estimate section of your proposal. [10]
10. Write a brief research article in about 500 words on the importance of English language for an engineering student in Nepal. [10]
11. Write the cover page, introduction, discussion and conclusions of your report on the causes of road accidents on the highways giving just the outlines of the rest of the parts. [10]

02 TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division.**  
 2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Communication English (SH651)**

- ✓ 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. Edit the following passage which contains a good many errors. [5]

Alexander was born in 365 BC in Pella Macedonia established by his father, Phillip II, as the centre of the Hellenism. Hurtured on the thoughts of his tutor, Aristotle, he rose to fame like brilliant military leader. He influenced the corse of history, rightfully earning his title as Alexander the great. In 335 BC he became Millitary cheif of all the Greeks. By the time of his death in 323 BC he created an enormous empire, stretching from Adriatic sea to the Indias, and from Caucasian Mountains to Egypt. He spread the Greek spirit far and wide among nation who idolised this great man.

2. Answer any two of the following questions briefly: [5×2]

- a) Why did the mother kill her son and then herself? [The mother of a Traitor]
- b) What do you understand by 'a sense of proportion'? [Knowledge and Wisdom]
- c) What do you mean by a carburattor? [The Carburatation System]

3. Read the text given below carefully, make notes and write summary of it: [5+5]

Authority in the twentieth century is nowhere what it was. In certain spheres it has disappeared altogether. Public opinion no longer feels bound to inforce morality as it did by means of spoken disapproval and informal penalties. Fathers have ceased to rule the family, employers no longer enjoy the status of materials; the upper class have ceased to inspire imitation as models correct behavaviour ; school masters and university dons no longer dominate the minds of the young .....Things once considered inhexently wrong are tolerated where they are thought to do no manifest harm: fornication, adultery, homosexuality, abortion, nudity and erotica flourish openly where they were once legally penalized or forced to be discreetly veiled. Adolescents, who were once subject to the edicts of parental jurisdiction, live as they please, often earning as much as their fathers, and enjoying more legal rights at eighteen than their grandmothers possessed at any time during their lives.

But the decline of authority in the twentieth century has not necessarily meant a rise in liberty. For the concept of authority is not something which stands logically opposed to that of freedom, although some unreflective people may think it does. Authority is really a special kind of power which rests on the consent and belief of those who live under it. Without such free assent, there can be no such thing as authority. So freedom in this important sense is part of the very notions of authority. And when authority is removed, it is only too likely that it will be followed either by the rule of naked power or by anarchy.

4. Choose the correct words from the brackets: [0.5×10=5]

- a) The man and woman .....determined to tell the truth. (is, are)
- b) The horse and carriage.....ready. (are, is)
- c) The teacher said that we.....mortal. (are, were)
- d) I was interested ..... this book. (by, in)
- e) He helped me more than he..... you. (helps, helped)
- f) He is absent..... the class. (from, in)
- g) She cannot part..... her jewels. (from, with)
- h) Had you bought that car, you wouldn't have .....all that trouble. (had, had got)
- i) If one buys a car, it ..... money. (cost, costs)
- j) I feel the room ..... (move, to move)
5. After reading the following paragraph, compare and contrast the pollution of a city in Nepal. [5]
- The means of transportation also added greatly to air and noise pollution. Steam engines, buses and other vehicles exhaust so much smoke that life in the industrial city and town has become a victim of incurable diseases. Pure air has become a thing of past. The noise of machinery along with that of the motors, scooters and buses etc. have brought deafness to millions of people. Their normal hearing scale has suffered badly.
6. Change the following bibliographic references from MLA style into APA: [4]
- a) Lawrence, T.E. *Revolt in the Desert*. New York: George H. Dorian, 1927.
- b) Mack, John. *A Prince of our Disorder: The life of T.E. Lawrence* Cambridge: Harvard UP, 1998
- c) Tabachnick, Stephen E. Ed. *The T.E. Lawrence Puzzle*, Athens: The U. of Georgia P, 1984.
- d) Wolf, Daniel. *Lives of Notable Gay Men and Lesbians*. New York: Chelsea Publishing, 1995.
7. Write a short research article in about 500 words on the effect of the problem of transportation on tourism in Nepal. [10]
8. As a secretary of your college union, write the minutes of a recently conducted fifth meeting inventing at least five agenda. [5]
9. Suppose that you are invited to submit a proposal on establishing a company in the field of your engineering interest from a big organization in Nepal. Show the title page, abstract, objectives and conclusion parts of the proposal you have prepared. [10]
10. Suppose your project for establishing a factory related to your specific field of engineering is over. Write an outline of the project completion report including the abstract, objectives, cost and recommendations in detail. [10]
11. Imagine that you are working on a project and it is going on. Write the second monthly report of the project in a letter format. [6]

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21 TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division**  
 2068 Chaitra

EXAM.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B. Agri.	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**Subject: - Communication English (SH 601)**

- ✓ 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. After taking notes, write a summary of the following passage.

[5+5]

*Since it is essential to secure rapid and complete combustion in the cylinder of an internal combustion engine, the fuel and air mixture must be thoroughly mixed; and further, it must be in the correct proportions for all running conditions of the engine. This is accomplished by means of a device called a carburettor. In this carburettor, a stream of air blown over a jet mixes intimately with a spray of petrol drawn out of it. The jet is inserted into a choke or venturi in the intake manifold, and is supplied with petrol at atmospheric pressure.*

During the suction stroke of the piston, the pressure in the intake manifold is below atmospheric, and air is induced through the intake and over the jet. *As there is a further drop in pressure at the venturi, the pressure difference produced is large enough to draw petrol up out of the jet and atomise it. The level of the petrol in the jet is kept constant by the float and needle valve in the float chamber, which acts as a reservoir for the fuel. Above the venturi there is a throttle valve operated by the accelerator pedal, which controls the amount of mixture admitted to the cylinder.*

However, this simple form of single-jet carburettor will not give correct mixture strength for all engine speeds. The chief difficulty encountered is that, at high running speeds, the amount of petrol taken up at the jet will increase faster than the increase in air-flow. Therefore a carburettor set to give correct mixtures at low speed will give a progressively richer mixture as the speed increases. To compensate for this, a second jet is provided, fed from a well open to the atmosphere and supplied with petrol from the float chamber. *Owing to the fact that this compensating jet is larger than the main jet, it can supply petrol at a quicker rate than the main jet until the well is emptied. As the speed is increased, more and more of the petrol required is drawn from the main jet. The compensator jet can now supply only as much petrol as can pass through the small compensator orifice in the float chamber.*

Another problem to be solved is that of starting. In order to obtain the rich mixture required for starting, the throttle must be almost closed. *As the air velocity is then very low in the venturi, insufficient petrol is drawn out of the jet. This difficulty is overcome by the provision of an idler jet in the wall of the intake manifold near the throttle valve. This jet will only function when the throttle is nearly closed. When it is opened for faster running, the suction round the edge of the throttle decreases, and the idler automatically ceases to act.*

2. Answer the following questions briefly: (any three) [3×5]
- What is the importance of reading books in our life? [Of studies]
  - Write a summary of the text “ The mother of a Traitor”. [The mother of a Traitor]
  - Describe the importance of science with reference to the next ‘The scientific Attitude’. [The scientific Attitude]
  - What are the factors responsible for failure in successful communication.
3. Choose the correct words from the brackets: [0.5×10]
- Either you or I ..... supposed to do it. (are, am)
  - The government .....decided to increase the salary of their civil servants. (have, has)
  - The teacher said that we .....mortal. (are, were)
  - She says that she .....more food. (wants, wanted)
  - This notice.....altered. (has been, have been)
  - A lot of the work .....by the students. (is being done, are being done)
  - If I had enough money, I.....this car. (would have bought, would buy)
  - Unless you.....hard, you can't pass the exam. (work, don't work)
  - He died.....T.B last year. (with, of)
  - She always takes.....notes in her class. (up, down)
4. Transform the following references from APA style to MLA style: [4]
- Perkin, H.C. (1975). Air Pollution. McGraw Hill: NewDelhi.
  - Hall, Dauglas. (1989). Digital Circuits and Systems. Macmillan: Newyork.
  - Morgan, J.H. (1960). Cathodic Protection. Macmillan: Newyork.
  - Slabough, W.H. (1954). Mechanism of Filiform Corrosion. Oxford University Press: USA.
5. Write a short research article on the effect of noise pollution in urban areas in Nepal in about 300 words. [10]
6. Edit the following passage which contains a good many errors. [5]
- Aristotle the tutor of Alexander the Great was born in Stagira in Macedonia in 300 BC. Together with Plato, he is regarded as one of greatest philosophers the world knew. Aristotle was a true academic, concerned for Physics, Astronomy, Rhetoric, Literature; Political Science and History. His teachings has laid the foundation for modern scientific thought.
7. Suppose you are the secretary of a newly formed committee of Public Health Care Society. Write the minutes of the first meeting held recently inverting the agenda. [5]
8. A large number of deaths are caused by earthquakes. To minimize the loss of lives you want to do a study. Write a brief proposal to an organization sticking on objectives, procedure and rationale. [8]
9. The Minister for Road and Transport is concerned about the rapid increase in the number of road accidents on the highways. As a newly formed commission chairman, write a brief formal report investigating the causes and suggesting measures to control the road accident. [10]
10. Write a monthly progress report to be submitted to the Chief Engineer, Department of Roads on the construction of a Bagmati Bridge near Thapathali. [8]

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**Examination Control Division**

2068 Baishakh

Exam.	Regular / Back		
Level	BE	Full Marks	40
Programme	BEL, BEX, BCT	Pass Marks	16
Year / Part	III / I	Time	1½ hrs.

***Subject:* - Communication II (English)**

- ✓ 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. Transform the following sentences as indicated in the brackets: [4]
  - a) I've got a handy lap-top. (AmE)
  - b) Could you please lend me your car for an hour? (Informal English)
  - c) It's believed that insomniacs are mentally ill. (Personal English)
  - d) Open the door. (Polite English)
2. Answer any two of the following questions: [8]
  - a) How can you say that beauty is a form of power? (Beauty)
  - b) 'Mere knowledge without wisdom makes education futile'. Justify this. (Knowledge and Wisdom)
  - c) Write the description of the city under attack. (The mother of a Traitor)
3. Write a description of landscape view of the most enchanting place you have ever visited. [4]
4. Draft a note of a twenty - minutes' technical talk on the necessities of preventive measures for the devastating earthquake in Nepal. [8]
5. Assuming that you are the secretary of a social organization, write a notice including four item agenda for the eighth meeting to be held shortly. [6]
6. Imagine that you have carried out a research study on the causes and consequences of deforestation in the hilly regions of Nepal. Write title page, acknowledgements, abstract and recommendation parts of your report. [10]

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**Examination Control Division**

2066 Jestha

Exam.	Back		
Level	BE	Full Marks	40
Programme	BEL, BEX, BCT	Pass Marks	16
Year / Part	III / I	Time	1½ hrs.

**Subject: - Communication II (English)**

- ✓ 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. Transform the following sentences as instructed in brackets: [4]
  - a) What John bought last week was an old car. (spoken)
  - b) May I help you? (informal)
  - c) I beg your pardon! (BrE)
  - d) No, I don't want any more. (polite)
2. Answer any two of the following questions: [8]
  - a) What change in attitude do you think the writer wants to bring about in her readers? (Beauty)
  - b) Summarize the argument of the text 'Knowledge and Wisdom'.
  - c) Assume yourself as the mother and express your feelings towards your son. (The Mother of a Traitor)
3. How do you operate a telephone? Write a simple process description. [4]
4. Assume that you have been appointed as a Secretary of a committee formed to advise a Company to produce a handbook containing information about the conditions of services, rules and regulation, and benefits. The committee held its first meeting. Draft a three-point agenda and the minutes of the meeting. [6]
5. Write a complete manuscript of a ten-minute talk on 'importance of reference materials and their importance'. [8]
6. You are writing a report to the director of the Central Institute of Environmental Studies, as the regional representative, Kathmandu on the problem of water pollution in your region. Include the following parts only. [10]

Title Page, Abstract, Content Page and Recommendations

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Exam. Level	Regular / Back		
	BE	Full Marks	40
Programme	BEL, BEX, BCT	Pass Marks	16
Year / Part	III / I	Time	1½ hrs.

*Subject: - Communication II (English)*

- ✓ 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. Change the following sentences as indicated in brackets. [4]
  - a) One needs to express oneself more clearly. (AME)
  - b) The government is going on with its struggle against inflation. (Formal)
  - c) MM well we could have another holiday. (Written)
  - d) When will you be meeting him? (Familiar)
2. Answer any two of the following questions: [8]
  - a) How did Monna Marinna prove herself to be a citizen and a mother? (The Mother of a Traitor)
  - b) Why might it be important to understand aspects of other cultures' standard? (Customs)
  - c) What are the advantages of wisdom over knowledge? (Knowledge and Wisdom)
3. Describe the processes involved in distillation of water in about 150 words. [4]
4. Write a note for a thirty-minute technical talk on "Glaciers; one of the water resources of Nepal". [8]
5. Assume the three agendas, and write the minutes of the meeting relating to construction of a water supply scheme in your V.D.C. [6]
6. Write a report on The Damages Caused by the Kosi River including only the title page, preface and conclusion. [10]

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## Examination Control Division

2065 Shrawan

Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BEL, BEX, BCT	Pass Marks	16
Year / Part	III / I	Time	1½ hrs.

**Subject: - Communication II (English)**

- ✓ 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. Change the following sentences as indicated in brackets:

[4]

- a) Candidates are required to give their answers in their own words. (Spoken)
- b) How do you do? (Informal)
- c) You simply must read this book. (AmE)
- d) Shut the door. (Polite)

2. Answer any two of the following questions:

[8]

- a) Summarize the argument of the text 'Use and Misuse of Science'.
- b) If beauty is a source of power, why does the writer object to women's striving to attain it? (Beauty)
- c) What was the conflict in the mother's mind and how did she resolve it? (The Mother of a Traitor)

3. Prepare a note for a talk on 'Importance of PowerPoint presentation in technical communication' lasting for 30 minutes.

[8]

4. Assume that you have recently taken over as the secretary of a public limited company. You come to know that the growth of the organization has been hampered because of frequent strikes by labours. Inventing necessary details, write a notice along with a three-point agenda to call an urgent meeting.

[6]

5. Write a simple description of a 'paper clip' followed by picture illustration.

[4]

6. Prepare a cover page, preface and conclusion of a report on 'Development of Information Technology in Nepal'.

[10]

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Exam.	Regular / Back		
Level	BE	Full Marks	40
Programme	BEL, BEX, BCT	Pass Marks	16
Year / Part	III / I	Time	1½ hrs.

**Subject: - Communication II (English)**

- ✓ 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. Change the following sentences as indicated in brackets. [4]
  - a) Their house is different that ours. (BRE)
  - b) One cannot succeed unless one tries hard. (AME)
  - c) It is necessary that every member should inform himself of these rules (AME)
  - d) The congress insisted that the present law continue to operate. (BRE)
2. Answer any two of the following questions: [8]
  - a) Why might it be important to understand aspects of other cultures' standard?
  - b) Show advantages of wisdom over knowledge.
  - c) 'Is it she?' 'it is she!' what does this exchange tell us about what the people thought of her? What did they do when they saw her? Why?
3. Write a brief description of a mechanical tool that you frequently use in your field of engineering. [4]
4. Prepare a twenty minute technical talk on "Causes and effects of vehicle smoke emission at high traffic load hours". [8]
5. Assume that a body is formed to improve teaching learning situation in your campus. As the secretary of that body write a notice along with three agendas to call its first meeting. [6]
6. You are asked to prepare a report on 'Price hike in Nepal'. Write only the following parts of that report: [10]
  - a) Preface
  - b) Acknowledgements
  - c) Conclusion

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Exam.	Regular/Back		
	Level	B.E.	Full Marks
Programme	BEL, BEX, BCT	Pass Marks	16
Year / Part	III / I	Time	1½ hrs.

**Subject: - English**

- ✓ 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. Change the following sentences as indicated in brackets. [4]
  - a) The meeting will commence at 4 PM. (informal)
  - b) Would you please accept my invitation? (familiar)
  - c) My book is different than yours. (BrE)
  - d) The government is planning to enforce the rules strictly. (impersonal)
2. Answer any two of the following: [8]
  - a) Describe the effects of customs on the guests of a trader's wife and a youth from China.
  - b) Who is a better person according to Russel – a knowledgeable man or a wise man?
  - c) What was the conflict in the mother's mind and how did she resolve it?
3. Write a simple description of your campus library in about 150 words. [4]
4. Prepare thirty minute's technical talk causes and effects of air pollution in Kathmandu Valley. [8]
5. Suppose you are the coordinator of a seminar on 'Scope of Electronics Engineering in Nepal' to be held shortly in Kathmandu. Draft a letter for calling the meeting. [6]
6. You have got a contract to construct a new boy's hostel in the campus premises. Prepare the title page and write abstract and conclusion of the report that you have to send to the concerned agency. [10]

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**Examination Control Division**

2062 Poush

Exam.	Back		
Level	BE	Full Marks	40
Programme	BEL, BEX, BCT	Pass Marks	16
Year / Part	III / I	Time	1½ hrs.

**Subject: - Communication English II**

- ✓ 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. Transform the following sentences instructed in the brackets. [4]
  - a) One should always look after his money. (BrE)
  - b) At whom are you looking? (Informal)
  - c) I demand that Hari go there at once. (BrE)
  - d) The meeting will commence at 4 PM. (Informal)
2. Answer any two of the following: [2×4]
  - a) "War for the means of existence will be inevitable". Who will fight the war against whom? Explain it on the basis of the quoted statement. (The Use and Misuse of Science)
  - b) Justify the decision and action taken by Monna Morianna? (The Mother of Traitor)
  - c) What do you understand by "Concept of Culture" discuss as an anthropologist. (Customs)
3. Write a short technical talk lasting for twenty minutes on 'the causes of deforestation in Nepal'. [8]
4. At the tenth meeting of the board of directors of Narayani Pharmaceutical Laboratory Pvt. Ltd., Birgunj, the following agenda were discussed. [6]
  - 7.01 Minutes of the previous meeting
  - 7.02 Chairman's report
  - 7.03 Appointment of an auditor for the next year
  - 7.04 Purchase furniture for common room

Following the complete format prepare the minute of that meeting.
5. Imagine that you are a chairman of a five member commission formed for investigation of leakage of current at Ratna Park. Prepare a short report on the findings of the investigation. Include only the following sections: Cover Page, Acknowledgement, Abstract and Table of Contents. [10]
6. Write a simple description of a hammer in about hundred and fifty words. [4]

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Exam.	Regular / Back		
	Level	B.E.	Full Marks
Programme	BEL, BEX, BCT	Pass Marks	16
Year / Part	III / I	Time	1½ hrs.

**Subject: - English**

- ✓ 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/ Transform the following sentences as instructed in the brackets. [4]
- a) After his dad's death, Peter had to change his job. (into Formal)
  - b) The congress insisted that the present law should be continued to operate. (into AmE)
  - c) What is your name? (into Polite)
  - d) Non-stop sound of the blower made Pete's old woman hit the roof. (into Common Core)
- 2/ Answer in brief any two of the followings. [2×4]
- a) Explain the meaning, "if ethical principles deny our right to do evil that good may come, are we justified in doing good when the foreseeable consequence is evil?" (Use and Misuse of Science)
  - b) Do you support the decision taken by Monna Marianna? Support your opinion with references from the text. (The Mother of a Traitor)
  - c) What is Christian concept of "beauty"? Compare it with that of Susan Sontag's.
- 3/ Prepare a 'technical talk' on the computer and internet system in about 200 words. [8]
- 4/ Keep a short minute of a FSU meeting based on the following agenda. [6]
- a) Extra-activities programme
  - b) Launching cleaning-up campaign to keep the campus environment clean
  - c) SAARC institutional tour
  - d) Publication of a journal
  - e) Shifting of union office from Block 'A' to Block 'B'
- 5/ Imagine you are a chairperson of a five-membered commission formed for investigation the causes of the national black out for 2 days in Nepal. Prepare a short report on the findings on the investigation. Include only the following sections: [10]
- cover, acknowledgements, contents, conclusion
- 6/ Describe the location of your campus. [4]

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

**Subject: - Building Technology (CE652)**

- ✓ 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 building? Explain various types of building with sketches. [8]  
b) ✓ Explain the consideration of heat, ventilation light, sound, orientation and moisture movement in a building with sketch where necessary. [8]
2. a) ✓ What are the functions of foundation? Explain the types of deep foundation with necessary sketches. [8]  
b) ✓ What is mortar? Describe the estimation of mortar requirement. [8]
3. a) ✓ What is roof used for? Sketch out different types of roof and show their parts. [8]  
b) ✓ Describe essential elements of a stair. Define ladders, lifts and elevators and ramps. [8]
4. a) ✓ Draw a section of solid ground floor with necessary details. [8]  
b) ✓ Define shoring. What are the objectives of shoring? Describe the types of shoring with necessary sketches. [8]
5. a) ✓ Explain the process of painting works on masonry surfaces. What may be the causes of cracks occurred in a building and what are remedial measure to cracks? [8]  
b) ✓ Describe septic tank and soak pit with necessary sketches. [8]

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

**Subject: - Building Technology (CE652)**

- ✓ 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 understand by orientation of a building? How do the requirements for a building be met from the orientation? [4+4]  
b) Describe positive and negative side water proofing system. Illustrate with necessary sketch for provision of DPC for basement in ordinary soil. [2+6]
2. a) Discuss common problems with existing foundation. [8]  
b) What is first class brick work in 1:6 cement sand mortar? Calculate materials for 10 cum brick work except bricks. [3+5]
3. a) Show a flooring details of a floor (ground) that has a connection with external wall and floor finish with mosaic tiling. [8]  
b) Define shoring. Describe various types of shoring with necessary neat sketches. [8]
4. a) What do you understand by pointing works? Explain procedure of pointing work. [3+5]  
b) Why is rain water harvesting necessary in a building? Explain any method for harvesting rain waters. [4+4]
5. a) What are the factors to be considered for limiting fire spread? Clarify each point briefly. [2+6]  
b) Explain various remedial methods of causes of cracks in a building. [8]

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

**Subject: -Building Technology (EG633CE)**

- ✓ 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 sources of moisture in a building? Explain different methods for moisture control in the building with necessary figures. [2+6]  
b) What is human thermal comfort? How human body maintains the thermal balance? Describe the thermal preferences-affecting comfort. [2+2+4]
2. a) What are the general classification of foundation? What are the common problems of existing foundation? [4+4]  
b) What are the objectives of shoring? Discuss in brief about the dead shore with necessary figures? [2+6]
3. a) Define roof and its types. Describe briefly about the double timber roof with necessary figures. [4+4]  
b) Design and draw plan of a 1.2 m wide doglegged stair for a residential building with 3 m floor height. [4+4]
4. a) What are the functions of door and window? Draw elevation of battened door and glazed window having wooden members. [2+3+3]  
b) Why joints are necessary for civil construction work? Describe expansion joint in a building with neat sketches. [4+4]
5. a) What are the requirements of good partition? Describe the types of partition with the basis of loading system. [4+4]  
b) What is domestic water supply system? Discuss the types of drainage system with necessary figures. [4+4]
6. Write short note on any four of the following topics: [4x4]
  - a. General principle of electrical services
  - b. Air-Conditioning
  - c. Timbering of trenches
  - d. Brick cladding
  - e. Sound insulation

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Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Building Technology (CE652)**

- ✓ 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 requirements of ventilation? Explain moisture movement through building components. [4+4]  
b) What do you understand by thermal performance of building components? Explain the various methods of thermal insulation for exposed walls and roofs. [8]
2. a) Define foundation. Describe types of foundation with necessary sketches. [8]  
b) What are the types of flooring? Explain the process of Terrazzo finish floor. [3+5]
3. a) Draw and explain different components of timber collar beam roof with their sizes. Explain different types of roof covering for pitched roof. [8]  
b) Explain the preparation of cement sand mortar (1:6). Differentiate between random rubble, coursed rubble and Ashlar stone masonry with sketches. [4+4]
4. a) Define stair. Illustrate the elements of staircase with figure. [8]  
b) With the help of neat sketches, differentiate between solid and suspended ground floor. [8]
5. a) How do you make a brick masonry buildings earthquake resistant? Explain with sketches various measures adopted. [8]  
b) Illustrate components of the rooftop rain water harvesting system. [8]

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

**Subject: - Building Technology**

- ✓ 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 is moisture? What are the sources of moisture in a building? Describe the method of moisture control in the substructure of a RCC building? [2+2+4]
- b) What are the characteristics of audible sound? What are defects occurred due to reflected sound. Explain briefly the different methods of sound insulation. [8]

**OR**

Explain the different types of thermal insulating material. Explain the different process of insulating various building elements such as roofs, exposed walls and doors and windows.

2. a) What are the general classifications of foundation? Describe the common problems of existing foundation. [4+4]
- b) What are different elements for vertical circulation in a building? Design a RCC doglegged staircase for a residential building in a room of 4.5m × 2.3m and floor height of 3m. Assume necessary data. Give neat sketches of the plan and section. [2+6]
3. a) What are the different components of doors and windows, explain with necessary sketches. Explain the different types of doors with the help of sketches. [8]
- b) Define roof. What are the types of roof? What are the functional requirements of roof? Describe briefly the single roof and its types with necessary sketches. [8]
4. a) What are the types of joints? Why joints are important in building construction? Briefly explain the expansion joint in a building with necessary sketches? [2+2+4]
- b) What do you understand by temporary construction in the building? Describe the types of temporary construction with necessary sketches. [8]
5. a) Why cladding is important to a building? Illustrate the types of cladding with respect to construction technique. [2+6]
- b) What are internal partitions? What are the requirements for a good partition? Explain the classification of partition with respect to materials and loading systems. [2+2+4]
6. Write short notes on: [4×4]
  - a) Day light factor
  - b) Septic tank and soak pit
  - c) Types of electrical wiring
  - d) Air conditioning

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

**Subject: - Building Technology**

- ✓ 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) How does moisture movement occur in buildings? Explain the different types of condensations and their effects on building materials. [4+2+2]  
b) How do absorptive materials absorb sound? Write down the general considerations for noise control in buildings. [4+4]
2. a) What are the various causes of foundation settlement? Define underpinning and explain different methods of underpinning with neat sketches. [8]  
b) What is roof covering? Differentiate double and triple roofs with constructional details. [8]
3. a) What are the functions of openings? Explain any two types of door and window based on working operation with neat line sketches. [2+3+3]  
b) Define staircase. For a given space of 4.8m × 2.25m with floor height of 3.6m, design a RCC dog-legged staircase. [8]
4. a) Why is it necessary to provide a joint in building structure (especially cement concrete structure)? Draw a neat freehand sketch of vertical wall section showing expansion joint at foundation, plinth, lintel, floor and roof/terrace level for a typical residential building having 350mm thick brick wall. [2+6]  
b) What is temporary construction work? Differentiate between brick layer's scaffold and dead shoring with necessary sketches showing all elements. [2+3+3]
5. a) What do you mean by building finishes? Differentiate between tile hanging and stone cladding in external wall surface showing section (vertical) with neat sketches. [2+3+3]  
b) What are the types of suspended ceilings? Describe their functions and methods of construction. [8]
6. a) What are the general principles of electrical services systems? Explain wiring systems and also discuss about the safety precautions to be adopted while using electricity and its appliances. [2+3+3]  
b) What is domestic water supply system? Discuss with relevant sketches about septic tank soak pit system of sewage disposal at residential building site. [2+3+3]

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

*Subject: - Building Technology*

- ✓ 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.
- ✓ Support your answer with sketches wherever required.
- ✓ Assume suitable data if necessary.

✓ 1. Discuss about thermal comfort in building. How can we achieve thermal comfort? Explain about active and passive methods for heating and cooling. Support your answer with neat and clean sketches. [16]

✓ 2. Define foundation with its types. What are the causes of foundation settlement and how can we provide treatment for foundation settlement? [16]

OR

What is basement floor? What type of wall is appropriate for basement wall? Explain about waterproofing techniques in basement. Support your answer with neat and clean sketches.

✓ 3. Why are joints necessary in the building structures? Describe in detail the types of joints in structures and their uses. [16]

OR

Define paints. What are the ingredients of oil paints? What are the characteristics of good paints? How do you undertake painting works in new and old woodwork?

✓ 4. a) What is roof? Show the comparative advantages and disadvantages of slope and flat roof. [8]

b) Describe shoring and scaffolding. Why are shoring and scaffoldings used in building construction? [8]

✓ 5. Write short notes (any four) [4×4]

- a) Windows and its types
- b) Electrical safety in building
- c) Septic tank and soak pit
- d) Fire protection in building
- e) Plastering and pointing in building

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

**Subject: - Building Technology**

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

1. Describe briefly about renewable and non-renewable sources of energy highlighting the world scenario. Explain the different ideas to trap the solar energy in building with the concept of energy efficient design. [4+6]
2. What are the effect of moisture in building elements? Explain different methods by which we can stop moisture entering to building. [5+5]
3. What is basement floor? Explain about different water proofing method for basement with neat and clean sketches. [3+7]
4. Draw complete details of an R.C.C. dog-legged staircase for an office building leading from the ground floor to first floor. State reasons for size of the risers and treads adopted by you. The size of stair is 4.8m×3.0m×3.6m (height). [10]
5. How we can properly manage the water supply and sanitation system in building? Explain the function of septic tank and soak pit in sanitation system with the help of sketches. [4+6]
6. Why temporary construction is necessary in building construction? Differentiate between single and double scaffolding with constructional details. [4+6]
7. What is roof? Write down requirement of good roof. Explain about pitch or slope roof and mention its types with the help of sketches. [4+6]
8. Write short notes on (any four) [2.5×4]
  - a) Lifts and escalators
  - b) Electrical wiring system in building
  - c) False ceiling
  - d) Cladding
  - e) Construction joints
  - f) Underpinning
9. Define the safe bearing capacity and ultimate bearing capacity. Explain the methods to improve bearing capacity of soil. [3+7]

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

**Subject: - Building Technology**

- ✓ 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.
- ✓ Support your answer with sketches wherever required.
- ✓ Assume suitable data if necessary.

1. Explain briefly human thermal comfort. What are the thermal factors affecting thermal comfort. How human body maintains thermal balance. Explain your statement with neat and clean sketch. [16]

**OR**

What do you understand by Energy Conscious Design? Describe briefly the design consideration of Energy Conscious Design. Also describe the renewable and non-renewable energy, their sources and their respective examples.

2. Define stair. What are the functional requirements of good staircase? Design a dog-legged staircase for a public building in a room of 5.0m×4.0m and floor to floor height 3.0m. Assume necessary data. Give neat and clean sketch to support your design. [16]
3. What do you know about the methods of soil exploration? Define safe bearing capacity of soil and describe briefly the methods of improving bearing capacity of soil. [16]

**OR**

Define underpinning. Describe its necessity. What are the operations to be carried out before underpinning? What are the necessary precautions to be taken whilst underpinning? Describe briefly the methods of underpinning.

4. What is shoring? Illustrate the necessity of shoring. Describe the types of shoring. Support your answer with neat and clean sketch giving the names of different parts. [16]

**OR**

Define roof. What are the types of roof? What are the functional requirements of roof? Describe briefly the single timber roof and its types with necessary figures.

5. Write short notes (any four) [4×4]
- a) Windows and its types with clean sketches
  - b) Ceiling: their types and fixing details
  - c) Plastering and its types
  - d) Water distribution system and its design
  - e) Joints in structures and their necessity
  - f) Painting on metal and masonry surface

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

**Subject: - Building Technology**

- ✓ 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**.
- ✓ Support your answer with sketches wherever required.
- ✓ Assume suitable data if necessary.

Moisture is the main problem in the building: Please illustrate the effects of the moisture in the building. Describe the main sources of moisture and explain how it moves through the building component with sketches. [16]

**OR**

Define thermal comfort? Describe thermal factors affecting human comfort. Explain thermal balance of a building. Give neat and clean sketch whenever necessary.

2. Define staircase. Illustrate ideal requirements of the stair. Describe the different types of stair by shape in plan with neat sketches. Design an open-well staircase for a public building in a hall of 6.0m × 3.5m and ceiling height 3.0m. The thickness of the floor slab is 120mm. Assume necessary data. Give neat and clean sketch (plan and section) to support your design. [16]
3. What do you understand by temporary construction in the building? Describe the types and requirements of temporary constructions with necessary figures. [16]
4. Define paint and varnishes used in the building. Illustrate the constituents of an oil paint. Describe the painting procedures on; new and old woodworks, metal works and cement surfaces. [16]

**OR**

Define roof and its types. Illustrate the functional requirements of a roof. Describe briefly single and double timber roof with necessary figures.

5. Write short notes (any four): [4×4]
  - a) Basement and retaining wall
  - b) Cladding: its types and functions
  - c) Septic tank and soak pit
  - d) Doors and its types
  - e) Partition wall and its types
  - f) Wiring systems

Exam.	Regular/Back		
	Level	B.E.	Full Marks
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

**Subject: - Building Technology**

- ✓ 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.
- ✓ Support your answer with sketches wherever required.
- ✓ Assume suitable data if necessary.

1. Write briefly on the thermal performances of the building sections. Define transmittance and find the transmittance of a composite wall that consists of 110mm brickwork (1/2 brick) as outer leaf, cavity of 25mm, thermocole insulation of 25mm, 110mm brickwork as inner leaf. There is 12mm thick plaster on external side of outer leaf and internal surface of the inner leaf. The conductivities of the brickwork, cavity, thermo Cole insulation and plaster are 1.15, 0.026, 0.034 and 0.72 W/m°C respectively. The internal and external surface conductances are 8.12 and 10.0 W/m<sup>2</sup>°C. Draw a neat sketch of thermal gradient of this composite wall. [16]

**OR**

Describe human thermal comfort and the thermal factors affecting human comfort. How does human body maintains the thermal balance. Explain sun and thermal balance of human body with necessary sketch. Illustrate briefly the thermal preferences.

2. Define staircase. Mention ideal requirements of the stair. Describe the different types of stair by shape with neat sketches. Design a dog-legged staircase for a residential building in a lobby of 4.5m×3.0m and floor height 3.0m assume necessary data. Give neat and clean sketch to support your design. [16]
3. Describe briefly the causes of foundation settlement and also the effects resulted in the structure from the unequal settlements. Explain the reasons for not preferring black cotton soil in the foundation? [16]

**OR**

What is underpinning work? Why does it necessary in the structure? Write down the sequences of operation and the methods of underpinning.

4. What is construction joint in the structure? Illustrate the positions of construction joints in beam, column and slab. Describe the methods of joining new concrete to old one in the structure. [16]

5. Write short notes (any four): [4×4]

- a) Retaining wall and forces acting on it
- b) Energy conscious building and its design considerations
- c) Partition walls: their types and functions
- d) Pointing: its types and procedure
- e) Water supply and its distribution system
- f) Noise and its effects

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

**Subject: - Building Technology**

- ✓ 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.
- ✓ Support your answer with sketches wherever necessary.

1. Moisture is the great problem in the building, write down the effects of the moisture in the building. What do you understand by Moisture control in the building? Describe briefly the different methods of moisture control for different sources of moisture. Explain your statement with neat and clean sketch where ever necessary.

**OR**

What is natural and artificial lighting in the building? Define day light factor with necessary figure and formulae. Calculate the internal illumination of your class room having day light factor 2.0% and outdoor illumination 7000 lux.

2. What do you understand by the temporary construction? Illustrate the conditions of applying shoring in the structure. Describe in detail the types of shoring with neat and clean sketches.

**OR**

Describe briefly on formwork for excavation and different methods used in timbering of trenches for firm and loose soil. Define formwork for reinforced concrete construction and its principal requirements. Illustrate sketches where ever necessary.

3. Define roof and its types. Illustrate the functional requirements of a roof. Describe briefly single, double and triple timber pitched roof with necessary figures.

**OR**

Describe the joints in the structure. Illustrate the types of joints. Explain briefly the expansion and construction joints and their probable positions in the structure.

4. What are the functional requirements of good staircase? Mention the types of staircase (by shape) with neat sketches. Design a open-well staircase for a public building in a room of 5.5m×3.5m and floor height 3.6m. Give neat and clean sketch of plan, sectional elevation and necessary details.

5. Write short notes (any four)

- a) Cement Plastering: its types and procedure of application
- b) Ceiling: its uses, requirements and types
- c) Cladding: its types and functions
- d) Septic tank and soak pit
- e) Window and its types
- f) Painting on old wood works and cement surfaces
- g) Passenger lift and freight lift

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

**Subject: - Irrigation and Drainage Engineering (CE654)**

- ✓ 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. Justify the need of irrigation development in Nepal. Define cropping intensity and irrigation intensity. [3+2]
2. The base period, intensity of irrigation and duty of various crops under a canal irrigation system are given in the table below. Find the reservoir capacity if the canal losses are 18% and reservoir losses are 14%. [8]

Crop	Base periods (days)	Duty at the field (Ha/Cumecs)	Area under the crop (hectares)
Rice	120	850	3000
Wheat	120	1700	4500
Sugarcane	360	750	5400
Vegetables	120	650	1200
Cotton	200	1300	2200

3. Draw a typical cross section of a canal in partial cutting and partial filling and label at least five different canal elements on it. [5]
4. a) Sides of an irrigation canal with the following design parameters are well protected. What will be the stable depth and bed width of such a canal?  
 $Q = 5 \text{ m}^3/\text{s}$ ,  $d_{50} = 3 \text{ cm}$ ,  $i = 1 \text{ in } 500$
- b) The slope of a channel in alluvium is  $1/6000$ . Find the channel section and the maximum discharge which can be allowed to flow in it. Take  $f = 1.0$ . [5]
5. A diversion weir with a vertical drop to be designed for an irrigation system has the following data: Design flood =  $4000 \text{ m}^3/\text{s}$ ; Natural width of the source river =  $300 \text{ m}$ ; Bed material = Coarse sand, Bligh's  $C = 12$ ; Lacey's  $f = 1.2$ ; Height of weir above low water =  $3.0 \text{ m}$ ; Top width of the crest =  $2.0 \text{ m}$ . Fix the length of the floor according to Bligh's principle and design the length of floor and depth of cutoffs using Khosla's seepage theory. Compute the thickness of the floor at key points. Make suitable assumptions if necessary. Draw a neat sketch of the designed weir.
6. What is meant by river training works and what are the different objectives served by it. What are the underlying principles behind the determination of spur spacing. Draw L and X - section of a typical spur. [1+2+2]
7. Describe the functions of different regulating structures used in an irrigation system. Design the crest and cistern of a drop structure (Sarda type) for a discharge of  $9 \text{ cumecs}$  and a drop height of  $1.2 \text{ m}$ : FSL u/s and d/s =  $105.7 \text{ m}$  and  $104.5 \text{ m}$ ; Bed Level u/s and d/s =  $104.2 \text{ m}$  and  $103.0 \text{ m}$ ; Bed Width u/s and d/s =  $8 \text{ m}$ ; Side Slope of Channel =  $1:1$ . [5]

8. Determine bed and water levels at four critical locations of the canal water way at transition of Syphonic Aqueduct designed with the following data.

Canal

Full supply discharge =  $40 \text{ m}^3/\text{s}$

Full supply level =  $151.8 \text{ m}$

Side slope =  $1.5:1$

Depth of water =  $1.5 \text{ m}$

Bed level =  $150.00 \text{ m}$

Bed width =  $32 \text{ m}$

Drainage

Maximum flood discharge =  $520 \text{ m}^3/\text{s}$

High flood level =  $150.6 \text{ m}$

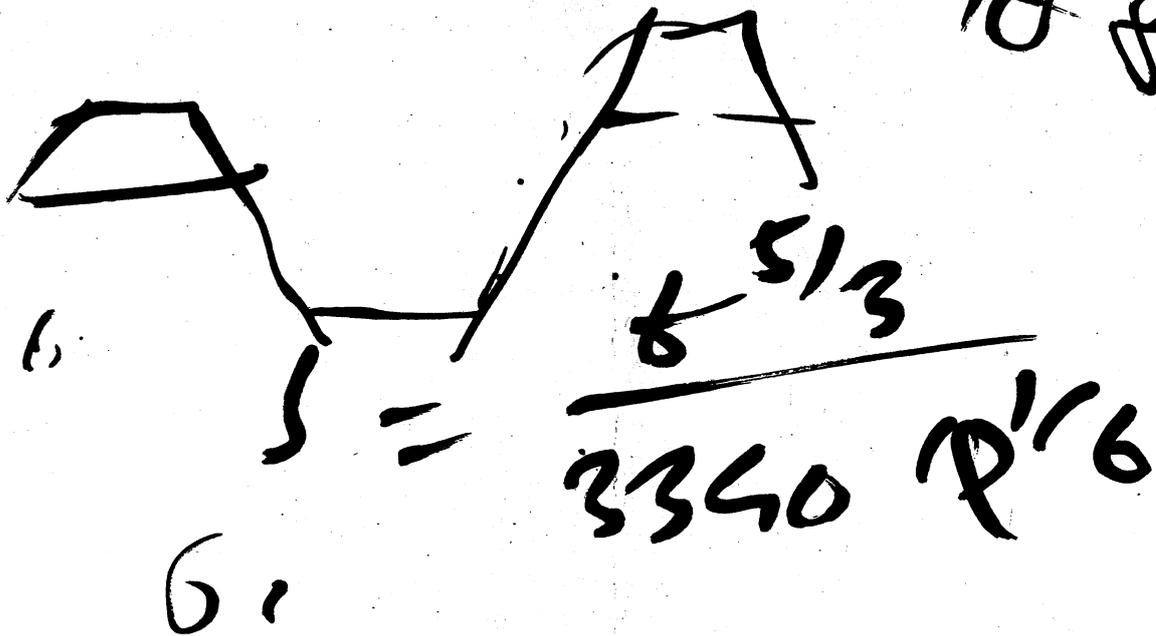
Bed level =  $148.2 \text{ m}$

Normal ground level =  $150.00 \text{ m}$

9. List out the main effects and preventive measures of water logging. Estimate the rate of internal drainage discharge in lps/ha from bunded rice fields of Terai area. The 3-day design rainfall of 10 years frequency in that area has been estimated as  $400 \text{ mm}$ . Make suitable assumptions for removing excess water from the field of Terai.

[4+6]

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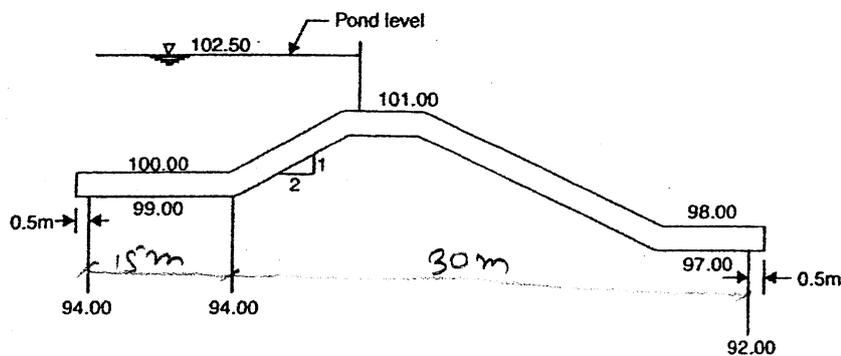
$$M = 28$$

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

**Subject: - Irrigation and Drainage Engineering (CE654)**

- ✓ 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. Writing various methods of surface irrigation, discuss the suitability of drip and sprinkler irrigation. [5]
2. A minor commands 400 ha of irrigable area. It is proposed to consider wheat crop in the whole command area. The kor period for the wheat is considered 3 weeks. The kor depth has been assessed to be 10 cm. In this period 2.75 cm of rainfall is normally expected with such an intensity that 50% of this could be taken as superfluous (surface runoff). Considering 10% conveyance loss find out (a) duty of the canal water at the field head and (b) discharge of the minor at upstream head. [8]
3. Explain the components of a canal irrigation system. [5]
4. A stable channel is to be designed for a discharge of  $40 \text{ m}^3/\text{s}$  and the silt factor of unity. Calculate the dimensions of the channel using Lacey's regime equations. What would be the bed-width of this channel if it were to be designed on the basis of Kennedy's method with critical velocity ratio equal to unity and the ratio of bed-width to depth of flow the same as obtained from Lacey's method. [4+6]
5. Sketch the hydraulic gradient line for the weir profile, shown below, considering the case of no flow at pond level. Slope correlation for the slope (2:1) is 6.5 percent. Also compute the value of the exit gradient. [12]



6. The launching apron of a guide bank is laid in a width equal to 1.8 times the depth of scour below original bed. If a scour slope of 3:1 is to be maintained with thickness 1.5 t, find the thickness of apron before it get launched. Draw neat sketch of designed structure. [8]
7. a) Write down the functions of head-regulator and cross-regulator. [4]
- b) Why is the provision of drop structures required in an canal irrigation system. Explain with appropriate sketches. [4]
- c) Mention various types of canal outlet and describe in brief. What is flexibility of outlet? [4]

8. a) Following data are obtained at the crossing of a canal and a drainage. [6]

Canal data:

$Q = 20 \text{ m}^3/\text{s}$ , depth of water = 1.5 m and FSL = 151.50 m, Bed width = 12 m, side slope (H:V) = (1.5:1)

Drainage data:

$Q = 200 \text{ m}^3/\text{s}$ , HFL = 150.7 m, Bed level = 148.5 m and Ground level = 150.0 m

Design the following components of siphon aqueduct.

- i) Drainage waterway                      ii) Canal waterway  
iii) Transition                                iv) Uplift
- b) Explain different types of cross-drainage structure with necessary sketch. [4]
9. Determine the drainage rate in l/s/ha required to meet the following conditions for healthy growth of rice paddies in bonded filed in Terai of Nepal. [10]

Initial water level in field = 50 mm

Maximum water level is 400 mm which may persist for up to one day.

Depth in excess of 250 mm may persist for up to 2 days.

No rain follows the design rainfall for several days.

Neglect ET and deep percolation losses.

Design 3 day rainfall is 400 mm.

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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: - Irrigation Engineering (EG724CE)**

- ✓ 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 following terms (8)
  - a. GCA
  - b. NCA
  - c. Cropping Intensity
  - d. Cropping Pattern
  
- b. Write down the steps for calculating irrigation requirement for Rice crop (4)
- c. The field capacity of soil is 40%, Permanent wilting point is 20%. Density of soil is 1.29m/cc. effective root depth is 90cm. ETCrop is 10mm/day. Calculate the irrigation interval if the readily available moisture is 75% of available soil moisture capacity. (4)
  
2. a. Using Lacey's basic equation, establish a relationship between R, Q and f (6)
- b. Design a canal using Kennedy formulation with following data  
 Q = 10 cumec, Manning roughness coefficient = 0.0245, slope of bed = 0.0002, m = 1 and side slope of canal 0.5:1 (H:V) (6)
- c. Write down the importance of canal lining. (4)
  
3. a. Define groynes and explain different types of groynes (8)
- b. Explain different types of flood control measures (4)
- c. Explain different stages of rivers (4)
  
4. Calculate the uplift pressure at key points of Piles in Fig 1. Also check the thickness of the floor at A, B location and exit gradient. The safe exit gradient is 0.2 (16)

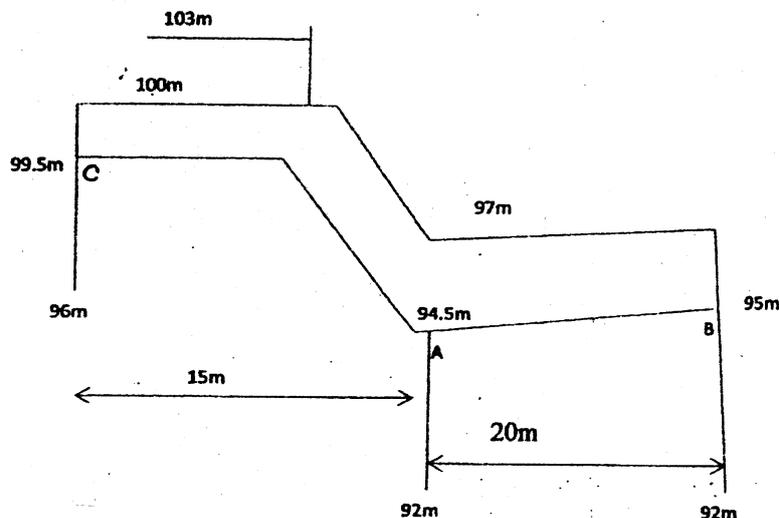


Fig. 1

5. a) Write down the cause and effects of water logging. Also explain method of reclamation of water logged area.

(6)

b) Derive the expression for subsurface drainage spacing

(5)

c) Write down the design criteria of surface drainages

(5)

6. Write short notes

(4x4)

a. Types of Irrigation Method

b. operation and Maintenance of Irrigation system

c. Modular and non modular outlets

d. Different types of Cross Drainage works

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Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Irrigation and Drainage Engineering (CE654)**

- ✓ 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. Write down sowing time, harvesting time and average delta of five principal crops of hills of Nepal. [5]
2. a) Write down the steps for calculating irrigation requirement for Rice crop. [5]  
 b) The field capacity of soil is 60%, permanent wilting point is 25%, Density of soil is 1.2gm/cc, effective root depth is 120cm, ET crop is 9mm/day. Calculate the irrigation interval if the readily available moisture is 85% of available soil moisture capacity. [3]
3. Neatly draw the component of canal and explain it. [5]
4. Explain sediment transport and tractive force approach in canal design. [10]
5. Draw a neat sketch of the general layout of a diversion head works and cross sections of under sluices, canal head regulator and weir with all details. [3+3+3+3]
6. Following hydraulic data near a proposed bridge site are obtained.  
 Maximum discharge =  $4000\text{m}^3/\text{s}$   
 Highest flood level = 205.0m  
 River bed level = 200.00m  
 Average diameter of river bed material = 0.1mm  
 Design the following components of a guide bund and neatly sketch it. (i) Length of guide bund (ii) Thickness of pitching of the slope (iii) Length of launching apron (iv) thickness of launching apron. [8]
7. a) Design crest, length and thickness of impervious floor of a vertical drop structure for the data given below:  
 Discharge =  $1.8\text{m}^3/\text{s}$ ; Bed level U/S = 205.05m  
 Side slope of channel = 1:1; Bed level D/S = 204.35m  
 FSL U/S = 205.95m; Bed width U/S and D/S = 1.5m  
 Top width of crest = 0.5m (for initial assumption); Cd = 0.415 sp.gr. of masonry drop structure = 2.2; Bligh's coeff = 6.0. [8]  
 b) Describe with neat sketches the functions of distributory head regulator and cross regulator in a canal project. [4]
8. Design a syphon aqueduct (Drainage water way, Canal water way, Bed levels and Transitions) if the following data at the crossing of canal and drainage are given. [10]
  - Discharge of canal = 50 cumecs
  - Bed width of canal = 32m

- Full supply depth of canal = 1.80m
- Canal bed level = 200.0m
- Side slopes of canal = (1.5H:1V)
- High flood discharge of drainage = 400 cumecs
- High flood level of drainage = 200.60m
- Bed level of drainage = 198.0m
- General ground level = 200.20m

9. Design a surface drainage for a field of 40ha area in Terai with following data. Design maximum yearly precipitation for three consecutive days = 50mm, longitudinal slope of channel 1:400, Manning roughness coefficient 0.025, Maximum water level is 300mm which may persist for up to one day and depends in excess of 200mm may persist for up to 3 days. Assume other suitable values if necessary.

[10]

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

**Subject: - Irrigation 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) "Irrigation shall be given top priority for the overall development of our country". Justify this statement. [5]
- b) What do you mean by crop water requirement? Explain the factors affecting the crop water requirement. [5]
- c) After how many days will you supply water to soil (clay loam of 1.5 g/cc dry density, Field capacity = 25% and PWP = 13%) in order to ensure efficient irrigation of the crop for which daily consumption use of water is 10 mm. Take 75cm of root zone depth. [6]
2. a) Discuss, with suitable sketch, various methods of surface irrigation system. [5]
- b) A field channel has a culturable command area of 2000 hectares. The intensity of irrigation for gram is 30% and for wheat is 50%. Gram has a kor period of 18 days and kor depth of 12cm, while wheat has a kor period of 15 days and a kor depth of 15 cm. Calculate the discharge of the field channel. [6]
- c) Showing the position of a fish ladder, write its necessary in headworks. [5]
3. a) Prove that the wetted perimeter is directly proportional to square root of the design discharge. [4]
- b) Design an irrigation channel with side slope 0.5H: 1V to carry a discharge of 50 m<sup>3</sup>/s at a slope of 1 in 5000. Take kutter's n = 0.0225 and C.V.R (m) = 0.9. [8]
- c) Draw cross section of an irrigation canal in cutting and filling showing major elements. [4]
4. a) Discussing sediment problems in an irrigation headworks, write any two methods of controlling sediment entry to the irrigation canal. [4]
- b) Design a 1.5 Sarda type fall for a canal having a discharge of 12 cumecs with the following data. [12]
  - Bed level u/s = 103.0m
  - Side slopes of canal = 1:1
  - Bed level d/s = 101.5m
  - Full supply level u/s = 104.5 m
  - Bed width u/s and d/s = 10m
  - Soil = Good loam
  - Bligh's Coefficient = 6

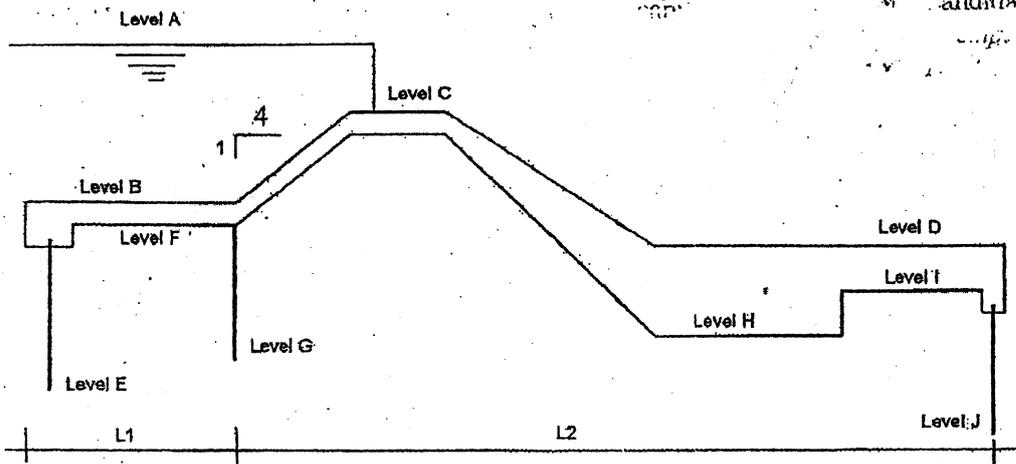
5. a) For the following irrigation headworks and respective data, [7+3]

Compute the pressure at the intermediate pile section

Floor and pile interface

Bottom end of pile

Check the exit gradient of the hydraulic structure. The safe exit gradient of the soil is  $1/6$ .



Reference Point	Level, masl	Reference Point	Level, masl
A	160	F	142
B	143	G	139
C	146	H	140
D	142	I	141
E	138	J	135

$L_1$  and  $L_2$  are 30m and 60m respectively. Correction factor for slope is 3.3. Use analytical method. Make suitable assumption if necessary.

- b) What is outlet? Write down the requirements that an outlet should fulfill. Distinguish clearly between non modular and semi-modular outlet. [1+2+3]
6. a) What is water logging? Write down causes, effects and preventive measures of water loggings. [1+2+2+3]
- b) With neat sketch (plan and section), show the river training works for a bridge. What is a launching apron? How is it designed? [4+4]

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

**Subject: - Irrigation Engineering**

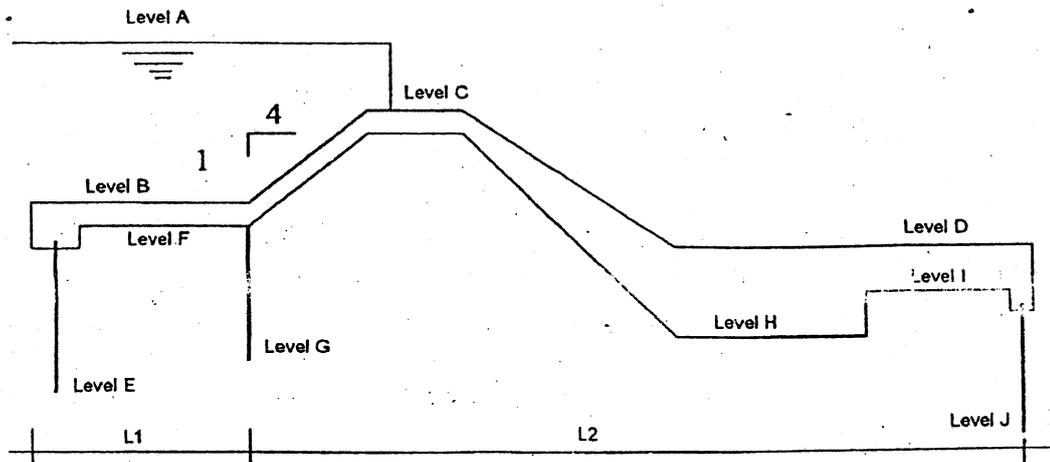
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ **Necessary chart is attached herewith.**
- ✓ Assume suitable data if necessary.

1. a) Calculate the design discharge of canal at 0, 1, 2 and 3 km from headworks. The GCA at the head of the canal is 40000 ha and after each km it is reduced by 6000 ha. Of this command, the CCA is only 70%. The intensity of irrigation for Wheat and Rice is 40% and 25% respectively. Assume total loss below 3km = 0.4 m<sup>3</sup>/s; channel losses per km = 4% of discharge at beginning of each km; Kor period for wheat and Rice is 4 and 3 weeks respectively. Kor depth for wheat and rice is 14 and 20cm respectively. [9]
- b) What are the factors to be considered in fixing canal alignment? Discuss the types of canals and their suitability in planning of irrigation system. [7]
2. a) Find the spacing of the tile drains for an area having average annual rainfall of 1400mm, if 1% is to be drained in 24 hours. From ground level, depth of impervious stratum = 9m; depth of drains = 2m and depth of highest position of the water table = 1m. Coefficient of permeability may be taken as 0.001 cm/sec. [8]
- b) An irrigation canal passing through the alluvium soil ( $d_{\text{mean}} = 0.50\text{mm}$ ) carries a discharge of 64 m<sup>3</sup>/s. What major principle you apply while designing such a canal? Find out the principal dimension and bed slope of the canal and draw a sketch of the designed section. [1+6+1]
3. a) The cross drainage structure across an irrigation channel has following data: [12]

Parameters	Canal	Drainage
Discharge (m <sup>3</sup> /s)	125.0	64.0
FSL/HFL (downstream) m	298.00	304.0
Bed Level (downstream) m	294.00	300.00
Bed width (m)	40.0	80.0
Side slope (H:V)	1:1	0:1

- Fix the waterway of the canal and drainage designing a suitable type of cross drainage structure and find out the bed level of the drainage structure at the upstream end.
- b) Write with explanation of three major functions of undersluice constructed in an irrigation headworks and mention its design criteria. [2+2]
  4. a) Calculate the thickness of a 7m long launching apron of loosed stones for a shank portion of guide bund at a bridge site of a river having design flood of 8000 m<sup>3</sup>/s and flood depth of 5m. Assume that average diameter of river bed material at flood time is 0.3mm. [9]
  - b) Define river training works. Enumerate three major objectives of river training works. Write down two basic purposes of spur installation. [2+3+2]

5. a) Discuss the advantages and disadvantages of sprinkler and drip irrigation. [6]
- b) For the following irrigation headworks and respective data, [6+2+2]
- Compute the pressure at the end pile section.
    - floor and pile interface
    - bottom end of pile
  - Check whether the floor thickness provided at the end is sufficient or not?
  - Check the exit gradient of the hydraulic structure. The safe exit gradient of the soil is  $1/6$ .



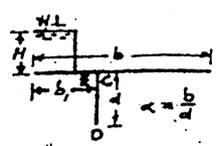
Reference Point	Level, masl	Reference Point	Level, masl
A	160	F	142
B	143	G	139
C	146	H	140
D	142	I	141
E	138	J	135

$L_1$  and  $L_2$  are 20m and 60m respectively. Use analytical method or Khosla's curve (attached herewith). Make suitable assumptions if necessary.

6. a) Explain the working of a non-modular outlet. What are the advantages and disadvantages of this type of outlet? [3+3]
- b) Explain soil moisture tension, osmotic pressure, field capacity, wilting point and available moisture. [3]
- c) Describe the status of irrigation development in Nepal. [4]
- d) Write a short note on institutional aspects of irrigation system management. [3]

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Sheet pile not at end



$$\phi E = \frac{1}{\lambda} \cos^{-1} \left( \frac{\lambda-1}{\lambda} \right)$$

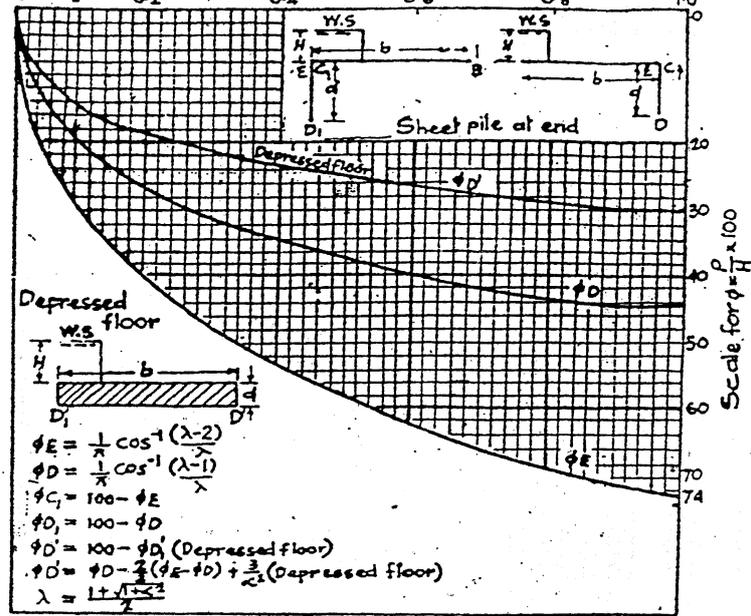
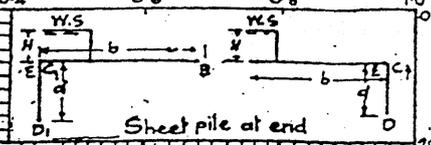
$$\phi C = \frac{1}{\lambda} \cos^{-1} \left( \frac{\lambda+1}{\lambda} \right)$$

$$\phi D = \frac{1}{\lambda} \cos^{-1} \left( \frac{\lambda-1}{\lambda} \right)$$

To find  $\phi E$  for any value of  $\lambda$  and base ratio  $\frac{b}{H}$  read  $\phi C$  for base ratio  $(1 - \frac{b}{H})$  for that value of  $\lambda$  and subtract from 100  
 Thus  $\phi E$  for  $\frac{b}{H} = 0.4$  and  $\lambda = 4$ , = 100 -  $\phi C$  for  $\frac{b}{H} = 0.6$   
 and  $\lambda = 4 = 100 - 29.1 = 70.9\%$

To get  $\phi D$  for values of  $\frac{b}{H}$  less than 0.5 read  $\phi D$  for base ratio  $1 - \frac{b}{H}$  and subtract from 100  
 Thus  $\phi D$  for  $\frac{b}{H} = 0.4$  and  $\lambda = 4$   
 = 100 -  $\phi D$  for  $\frac{b}{H} = 0.6$  and  $\lambda = 4$   
 = 100 - 44.8 = 55.2

Values of  $\frac{1}{\lambda} = \frac{1}{b}$



$$\phi E = \frac{1}{\lambda} \cos^{-1} (\lambda - 2)$$

$$\phi D = \frac{1}{\lambda} \cos^{-1} (\lambda - 1)$$

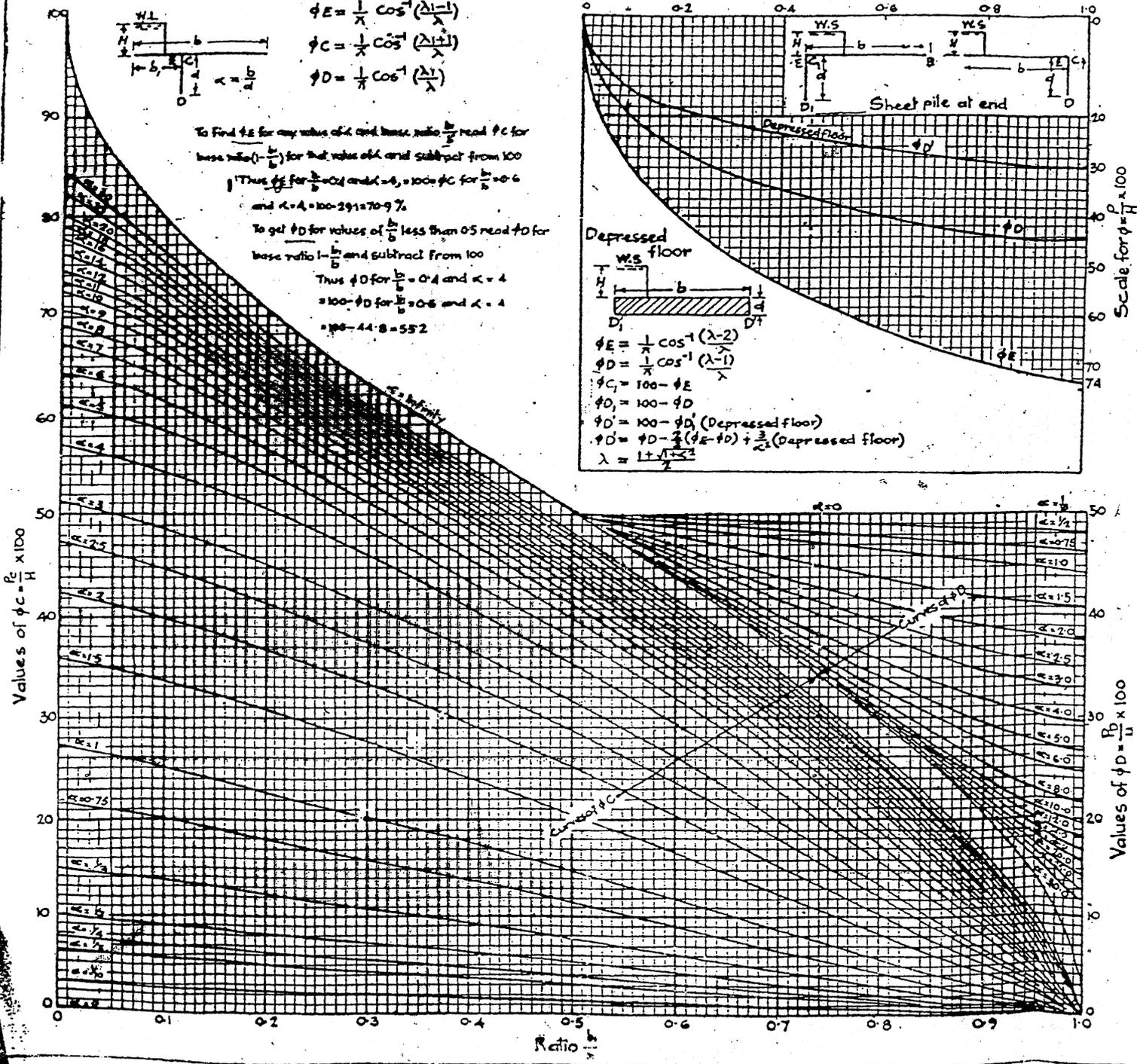
$$\phi C = 100 - \phi E$$

$$\phi D = 100 - \phi D$$

$$\phi D' = 100 - \phi D' \text{ (Depressed floor)}$$

$$\phi D = \phi D - \frac{1}{2} (\phi E - \phi D) + \frac{1}{2} \text{ (Depressed floor)}$$

$$\lambda = \frac{1 + \sqrt{1 + \frac{H^2}{b^2}}}{2}$$



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

**Subject: - Irrigation 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) With the help of a neat sketch, describe the components of a canal system used in irrigation project. [4]
- b) Explain the terms duty, delta and their relationship. [4]
- c) Draw the crop coefficient curve for rice crop. An irrigation project has 6000 ha of CCA and ETo is 150 mm/day, effective rainfall is 30mm/month and the overall efficiency of the project is 30%. Calculate the irrigation demand in cumec. [3+5]
2. a) From the data given below, design a stable irrigation canal, ensuring the stability of particles at bed as well as sides. [10]  
Discharge = 20 m<sup>3</sup>/s  
Bed slope = 0.001  
Particle size = 4cm  
Side slope = 30°  
Angle of repose of soil = 38°
- b) With the help of neat sketches, explain how silt excluders and silt ejectors control the bed load in an irrigation system. [6]
3. a) Write with definition sketch, how do you determine the pressure along the foundation of the structure and ensure safety against uplift pressure using Bligh's creep theory. [6]
- b) Draw four (4) simple Khosla's profiles for a weir of complex profiles. What corrections Khosla suggested to accommodate such simplifications? [3+3]
- c) Write down the advantages and disadvantages of sprinkler and drip irrigation. [4]
4. a) Design the following components of a guide bund for a river discharge of 6000 m<sup>3</sup>/s and silt factor as 1.1. Take HFL = 150m, Bed level = 145m. [5+3]
  - i) Length of guide bund
  - ii) Thickness of pitching
  - iii) Width of launching apron
  - iv) Depth of launching apronUsing the design data, draw the followings:
  - A) Plan of guide bank
  - B) Section at shank and
  - C) Section at u/s curved head
- b) Write down the five objectives of river training works. [4]
- c) Write down different types of canal maintenance. [4]

5. a) The annual rainfall in Biratnagar is 2000mm. Find the spacing of sub-surface drains if 2% of average annual rainfall is to be drained in 2 days. [6]

Given:

Depth of impervious stratum from the top of soil surface = 12m

Position of drain is 2m below the top soil surface and the depth of highest position of water table below the top soil surface = 1.5m

Permeability,  $K = 1 \times 10^{-4}$  m/s

- b) Explain different types of outlets used in irrigation projects. Define proportionality and flexibility of such outlets. [4+2]
- c) Draw a neat longitudinal section through a head regulator of an irrigation head works showing all components. [4]
6. a) Find out the waterway, bed level and FSL of a suitable cross drainage structure for the following data given below. The structure should be flumed to achieve economy. [10]

Parameters	Canal	Drainage
$Q_{\max}$ (m <sup>3</sup> /s)	30	200
B (m)	20	80
Bed level at d/s	200	198
FSL / HFL	202	201

Assume Manning's rugosity coefficient as 0.014 for concrete.

- b) Explain with plans and sections of any two types of fall structures used in irrigation canals. [3+3]

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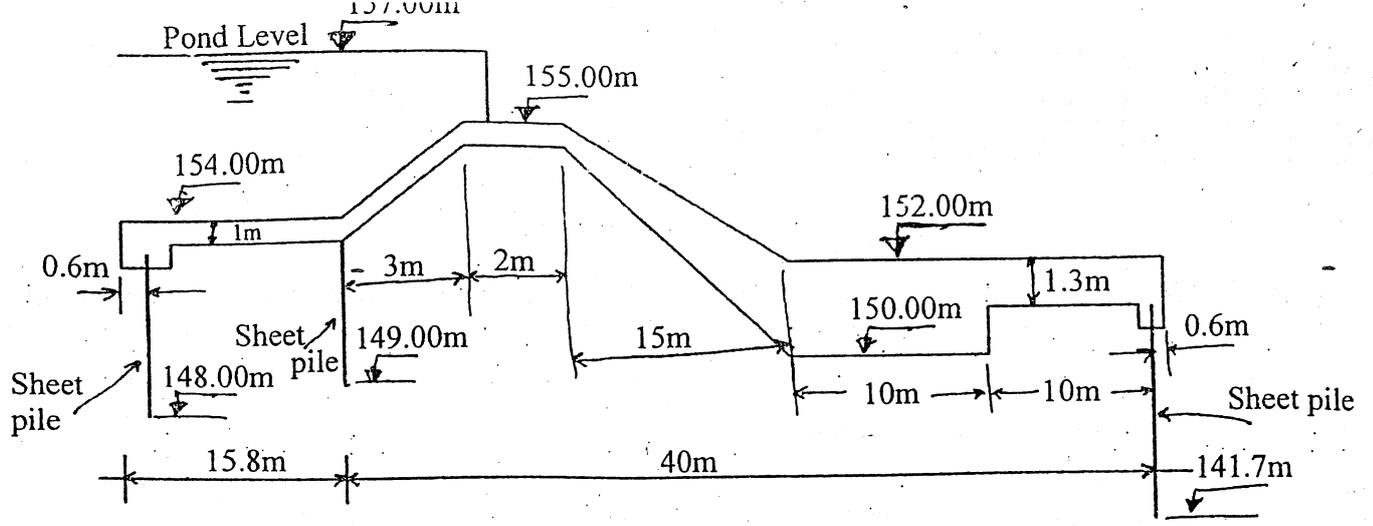
Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Irrigation 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.
- ✓ Necessary figure is attached herewith.
- ✓ Assume suitable data if necessary.

1. a) Explain different types of irrigation methods. [8]
- b) Write the definition of potential evapotranspiration and write down the steps for calculation potential evapotranspiration by Penman methods with all associated formula. [8]
2. a) Explain different types of canal alignments. [5]
- b) What is water logging? Write down its causes, effects and preventive measures of water loggings. [6]
- c) Explain different types of irrigation efficiencies. [5]
3. a) Enumerate different methods of flood control measures. Explain the functions of spur and their types with the help of sketches. [3+3]
- b) Design a guide bund for a flood discharge of 7000 cumecs, the high flood depth is 5m and the silt factor is 1.1. [6]
- c) Explain different methods of irrigation system maintenance. [4]
4. a) An irrigation canal carrying a discharge of 40 m<sup>3</sup>/s has to be constructed in alluvial soil. If the mean diameter of the soil is 0.5 mm, design a suitable section and bed slope of such a canal. [8]
- b) Draw a neat sketch of cross-sections of a canal in cutting, filling and balanced mode, showing all features. [8]
5. a) Design a canal drop structure for the data given below: [8]
 

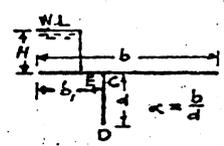
Q	= 5 m <sup>3</sup> /s
FSL, upstream	= 110.5 m
FSL, downstream	= 109.5 m
Normal Depth, u/s and d/s	= 1.5 m
Bed width	= 3.0 m
Bligh's coefficient, C	= 7
- b) Drawing neat sketches, explain how silt excludes and silt ejectors control the bed load in an irrigation system. [8]
6. Find out the corrected pressure at upstream, downstream and intermediate key points of a hydraulic structure founded on permeable foundation as given below. Use factor for slope correction as 4%. Assume suitable data if necessary. Also calculate the exit gradient and plot the hydraulic gradient line. [16]



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PLATE NO 1

Sheet pile not at end



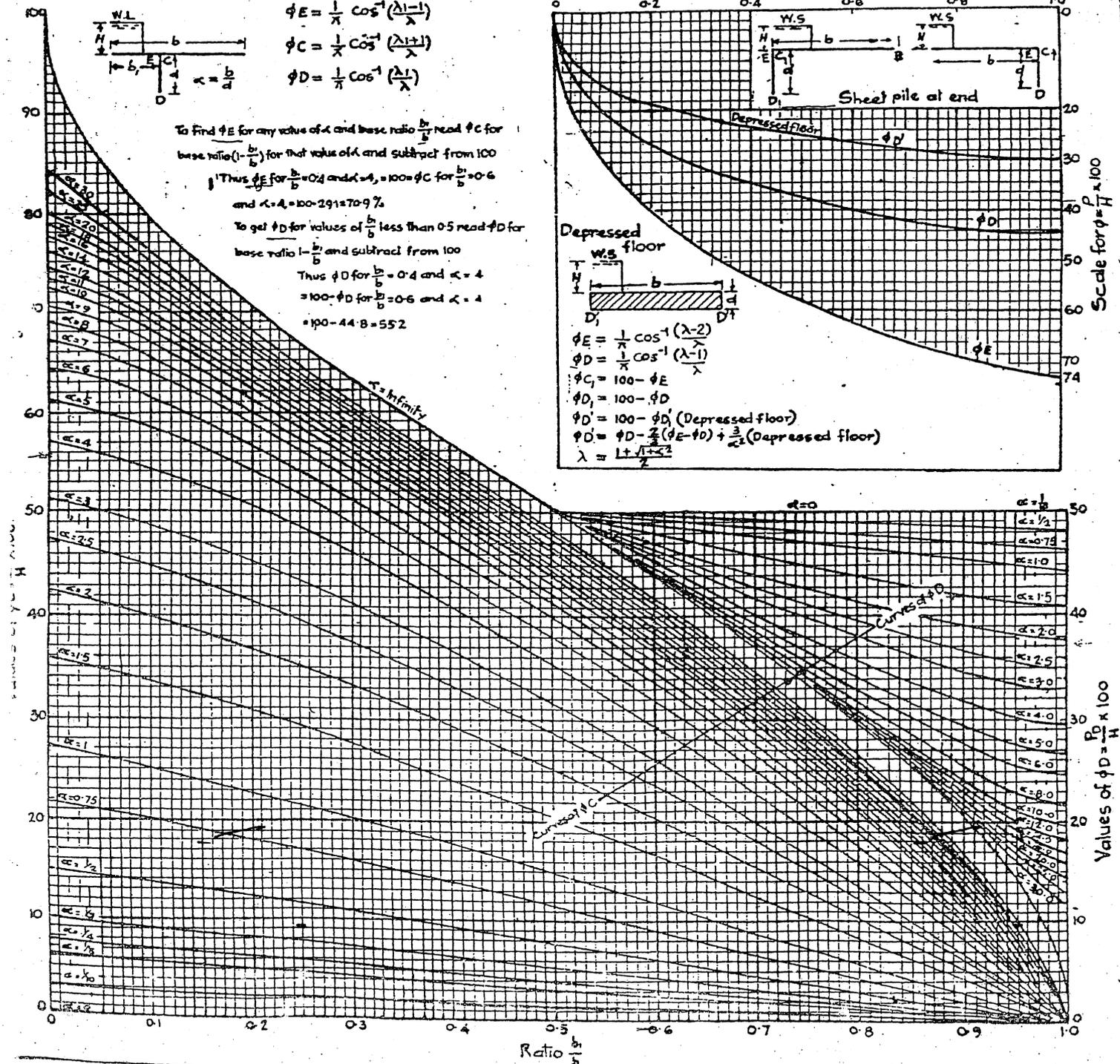
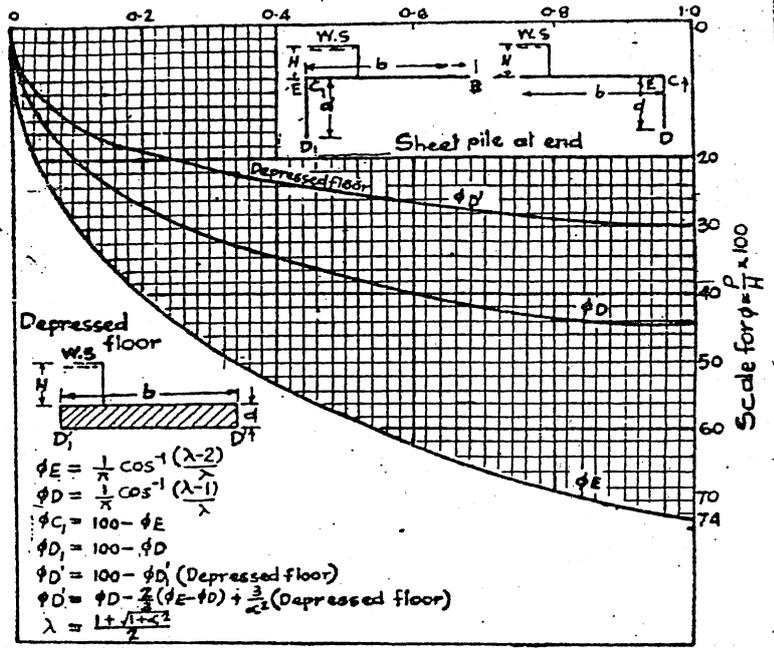
$$\phi E = \frac{1}{\lambda} \cos^{-1} \left( \frac{\lambda - 1}{\lambda} \right)$$

$$\phi C = \frac{1}{\lambda} \cos^{-1} \left( \frac{\lambda + 1}{\lambda} \right)$$

$$\phi D = \frac{1}{\lambda} \cos^{-1} \left( \frac{\lambda - 1}{\lambda} \right)$$

To find  $\phi E$  for any value of  $\lambda$  and base ratio  $\frac{b}{d}$ , read  $\phi C$  for base ratio  $(1 - \frac{b}{d})$  for that value of  $\lambda$  and subtract from 100  
 Thus  $\phi E$  for  $\frac{b}{d} = 0.4$  and  $\lambda = 4$ ,  $= 100 - \phi C$  for  $\frac{b}{d} = 0.6$  and  $\lambda = 4 = 100 - 29.1 = 70.9\%$   
 To get  $\phi D$  for values of  $\frac{b}{d}$  less than 0.5 read  $\phi D$  for base ratio  $(1 - \frac{b}{d})$  and subtract from 100  
 Thus  $\phi D$  for  $\frac{b}{d} = 0.4$  and  $\lambda = 4$   
 $= 100 - \phi D$  for  $\frac{b}{d} = 0.6$  and  $\lambda = 4$   
 $= 100 - 44.8 = 55.2$

Values of  $\frac{1}{\lambda} = \frac{d}{b}$



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

**Subject: - Irrigation 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) Describe the various types of fall structures and their components with neat sketches. [8]

b) A sandy loam soil holds water at 140 mm/m depth between FC and PWP. The crop has a root depth of 30cm and CWR (Crop Water Requirement) equal to 5 mm/day. The cropping area is equal to 60 ha in which allowable depletion of water is 35% and irrigation application efficiency equal to 40%. Determine: (i) Allowable depletion depth between irrigations (ii) Frequency of irrigation (iii) Net application depth of water (iv) Volume of water required. [8]

2. a) Following corrected  $\phi$  values were computed from Khosla's curves in a barrage placed on permeable foundation. [8]

U/S sheet pile	$\phi_{E1} = 100\%$ ,	$\phi_{D1} = 90\%$ ,	$\phi_{C1} = 85\%$ ,
Intermediate pile	$\phi_{E2} = 80\%$ ,	$\phi_{D2} = 70\%$ ,	$\phi_{C2} = 65\%$ ,
D/S sheet pile	$\phi_{E3} = 55\%$ ,	$\phi_{D3} = 45\%$ ,	$\phi_{C3} = 0\%$ ,

Distance between the U/S and intermediate piles is 20m and that between the intermediate and D/S piles is 40m. Assuming that the floor is horizontal throughout, draw the HGL for the subsoil flow. If the net head is 10m, determine the thickness of D/S floor at a distance of 20m and 30m away from the intermediate sheet pile. Assume  $G$  for the floor material equal to 2.2. The symbols has usual meanings.

b) Derive an expression which determines spacing 'S' between subsurface tile drains capable of lowering the water table at a depth of 'b' from the impervious layer. The centre of the drains is located at height 'a' from the impervious layer and 'Q<sub>D</sub>' is the design flow per meter length of drain. [8]

3. a) Design syphon of a syphon aqueduct for the following data: [12]

Canal:  $Q = 50\text{m}^3/\text{s}$ ; FSL = 201.80m; CBL = 200.00m; B = 36m; z (side slope) = 1.5  
 Drainage:  $Q_{\text{max}} = 450\text{m}^3/\text{s}$ ; HFL = 200.50m; DBL = 198.00m; GL = 200.00m

Assume that the aqueduct will be made of RCC having flumed width of 18m. Assume other data suitably, if necessary.

b) Design a canal to carry a discharge of  $18\text{m}^3/\text{s}$ , using Lacey's theory. Take silt factor = 1.5 and side slope = 0.5:1. [4]

4. a) Determine the length and thickness of launching apron for the straight portion of a guide bund in a river: Design flood =  $5000\text{m}^3/\text{s}$ ; av. dia. of bed material = 1mm; HFL = 225.00m; River bed level = 222.00m. [8]

b) Differentiate among, semi-theoretical, Kennedy's, and Lacey's approaches of canal design. [8]

5. a) Why irrigation and drainage are necessary in the development of agriculture? Discuss about the suitability of irrigation methods in the different topography of Nepal. [4+4]

b) Describe various methods of aligning main canal with appropriate sketches. Explain functions of non-modular and semi-modular outlets with neat sketches. [4+4]

6. Write short notes on four of the following: [4×4]

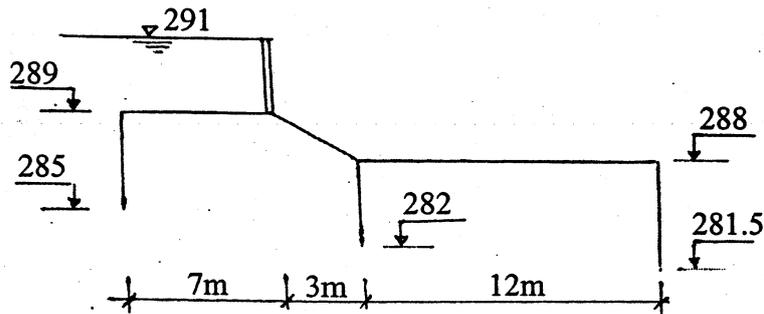
- a) Irrigation system planning
- b) Stages of rivers and their meandering process
- c) Specific design consideration for hilly irrigation canals
- d) Problems of sprinklers
- e) Considerations for local materials in designs

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

**Subject: - Irrigation 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 how will you justify the economics of canal lining for the existing canal. [8]
- b) Describe with the help of a diagram various forms of soil moisture available to that plant. [8]
2. a) What are the purposes of guide bunds? Explain with plan and sectional views at critical locations design of components of guide bunds. [2+8]
- b) Design a regime canal to carry a discharge of 90 cumecs. The average particle size of bed and bank material of the canal is 0.2cm. [6]
3. a) Explain the importance of drainage system. What are different types of drainage system adopted in agricultural land? [7]
- b) Define canal outlet. What are the criteria for judging the performance of modules? [5]
- c) Differentiate between silt exculder and silt extractor. [4]
4. Using Khosla's theory (Analytically), calculate the uplift pressure percentage at key points and also mention the floor thickness required at the d/s floor of canal head regulator as shown in figure below. [16]



5. a) Design a fall for a canal having a discharge of 12 cumecs for the data given below.

Full supply level u/s and d/s = 204 and 202.5

Bed level u/s and d/s = 202.5 and 201

Bed width u/s and d/s = 8m

Drop height = 1.5m

Side Slope of canal = 1:1

Bligh's creep coefficient = 8

- b) Define intensity of irrigation. [2]
6. Write short notes on: [4x4]
  - a) Maintenance of irrigation system
  - b) Sub surface irrigation
  - c) Canal escape
  - d) Types of spur.

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

**Subject:** - Irrigation 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 different types of surface and subsurface irrigation methods. [10]  
b) With following data: [6]  
FC = 80%, PWP = 35%, root depth = 60cm, soil density = 1.5gm/cc, ETc = 5mm/day, application efficiency = 80% and RAM = 70% AMC, where the abbreviations have usual meanings.
  - i) Calculate available moisture contents
  - ii) Calculate readily available moisture contents
  - iii) Calculate depth of irrigation at the outlet of the field
  - iv) Calculate irrigation interval
2. a) Using Lacey's basic equation, establish a relationship between R, Q and f, where symbols have usual meanings. [8]  
b) Design a canal using Kennedy formulation with following data [8]  
Q = 10 cumec, Manning roughness coefficient = 0.0245, slope of bed 0.0002, m = 1 and side slope of canal 0.5:1 (H:V).
3. Canal Data: [16]  
Discharge = 20m<sup>3</sup>/s, Depth of water 1.5m and FSL = 251.5m  
Drainage data:  
Discharge = 200m<sup>3</sup>/s, HFL = 250.7m. Bed Level = 248.5m and Ground level = 250.0m  
From above data, design following components of siphon aqueduct.
  - a) canal waterway
  - b) drainage waterway
  - c) afflux and head losses through siphon barrel
  - d) uplift on drainage slab
4. a) Write down the causes and effects of water logging. Also explain methods of reclamation of water logged area. [6]  
b) Derive the expression for subsurface drainage spacing. [5]  
c) Explain different types of outlets used in irrigation projects. [5]



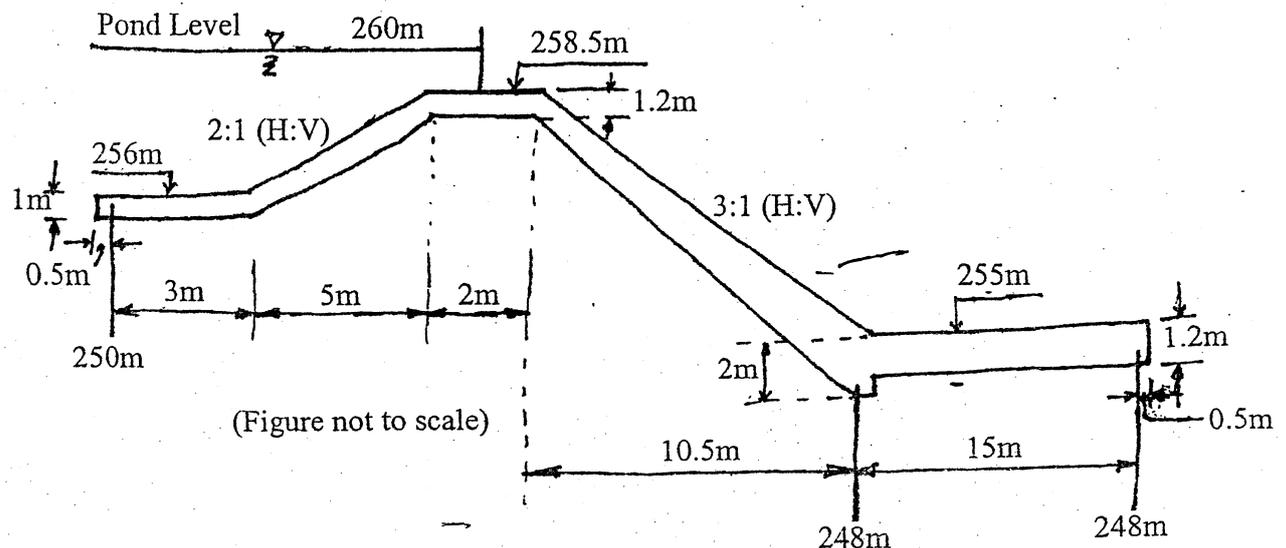
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Irrigation 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) Describe about the components of head works with neat sketches. [8]
- b) Determine the discharge at the end of the irrigation channel. CCA at outlet = 400 ha; Intensity of irrigation for rabi = 65%; Intensity of irrigation for kharif = 30%; outlet discharge factors for rabi = 1500 ha/cumec and for kharif = 800 ha/cumec. Assume losses in conveyance = 6% of the outlet discharge. [8]
2. a) Make critical comparisons among semi-theoretical approaches, Kennedy and Lacey's approaches of canal design. [8]
- b) Write down the steps for crop water requirement calculation. [5]
- c) Enlist the various types of lining applied in irrigation canal. [3]
3. a) Why river training is necessary? Describe the various methods of river control. [8]
- b) Design the length and thickness of launching apron for the straight portion of a guide bund in a river: [8]
 

Design flood = 7000 m<sup>3</sup>/s  
 Average diameter of river bed material = 1mm  
 River bed level = 111.00; HFL = 114.00  
 Provide a neat sketch of designed apron.
4. Using Khosla's method, obtain the residual seepage pressures at the 'key' points for the weir profile shown below. Also calculate the value of the exit gradient. Consider the case of no flow at pond level. Also draw the subsoil HGL. [16]



5. a) Design an aqueduct for the following data. Draw a neat sketch of designed aqueduct showing all dimensions and parameters. [12]

Canal:  $Q = 35 \text{ m}^3/\text{s}$ ; FSL = 200.00; CBL = 198.5; B = 22m; side slope 1.5:1

Drainage:  $Q = 350 \text{ m}^3/\text{s}$ ; HFL = 196.5; DBL = 193.5; GL = 199.0;  $f$  (Lacey's) = 1

Assume flumed width of canal = 12m and depth in transition = canal depth.

- b) How the bed load is controlled at head works? [4]

6. Write short notes on the following [4×4]

- a) Drip and sprinkler methods of irrigation
- b) Soils for agricultural purposes
- c) Institutional aspects of irrigation system management
- d) Design of drainage of irrigated land

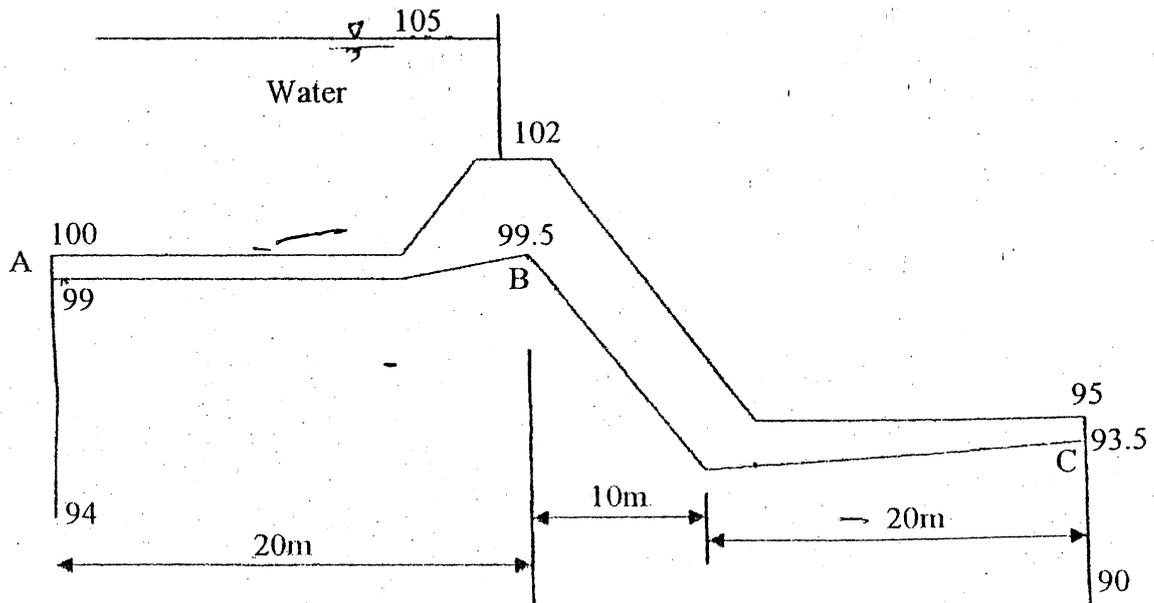
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Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Irrigation 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 following terms [8]
  - i) GCA
  - ii) CCA
  - iii) NCA
  - iv) Cropping Intensity
  - v) Cropping Pattern
- b) Write down the steps for calculating irrigation requirement for rice crop. [4]
- c) The field capacity of soil is 40%, permanent wilting point is 20%, density of soil is 1.2 gm/cc, effective root depth is 90cm, ET crop is 10 mm/day. Calculate the irrigation interval if the readily available moisture is 75% of available soil moisture capacity. [4]
2. a) Write down the concept of Kennedy and Lacey's Slit theory. [8]
- b) Prove that  $P = 4.75 (Q)^{0.5}$ , using Lacey's theory. [4]
- c) Design a canal to carry a discharge of 20 cumecs, using Lacey's theory. Take silt factor = 1.5 and side slope is 0.5:1. [4]
3. a) Enumerate conditions of application of C/D works with neat sketches. [6]
- b) How the bed load is controlled at head works? [4]
- c) Explain the procedures for design of a fall structure. [6]
4. Calculate the uplift pressure at key points of two piles in figure below. Also check the thickness of the floor at A, B, C locations and exit gradient. The safe exit gradient is 0.2. [16]



5. a) What are the causes and effects of water logging? Discuss various preventive measures to control water logging problems. [8]
- b) Discuss design criteria of a guide bund showing neat plan views and sectional views at critical locations. [8]
6. Write short notes [4×4]
- a) Types of Irrigation Method
  - b) Operation and Maintenance of Irrigation System
  - c) Modular and Non-modular Outlets
  - d) Structural Measures of Flood Control

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

**Subject: - Irrigation 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.

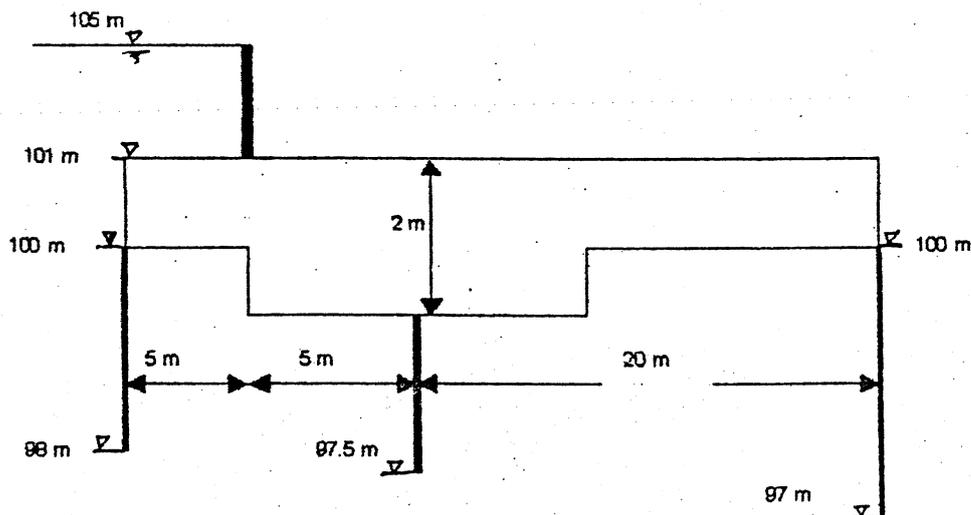
1. Design following components of a vertical fall [16]

- a) crest level
- b) crest width
- c) cistern elements
- d) floor length and floor thickness using Bligh's creep theory

With the data given below

- a) full supply discharge = 1.0 m<sup>3</sup>/s
- b) drop = 1.0m
- c) full supply depth = 0.75m
- d) bed level U/S and D/S = 100m/99m
- e) bed width = 3.0m
- f) Bligh's coefficient = 6.0

2. Check the thickness and exit gradient from Khosla theory. The safe exit gradient is 0.2. [16]



3. a) Illustrate various form of soil moisture and write down the factor affecting crop water requirement. [10]

b) Using Lacey's Regime equations, prove that [6]

$$R = 1.35 \left( \frac{q^2}{f} \right)^{\frac{1}{3}}$$

Where R = Scour depth, q = specific discharge, f = silt factor

4. a) Write down the advantage and disadvantage of surface and sub surface irrigation. [4]  
 b) Establish a relationship between duty and delta. [4]  
 c) Calculate the discharge required at the outlet for wheat and rice crop using following data. [8]

Crop	command area (Ha)	kor period	kor depth
Rice	5000	18	19
Wheat	3500	26	15

5. a) Explain the causes and effects of water logging. Describe different methods of reclamation of water logged areas. [4+4]  
 b) Define river training works. Enumerate different methods of river training works. Explain the design of different components of a guide bank. [1+2+5]
6. Write short notes on: [4×4]
- Methods of flood control
  - Operation and maintenance of irrigation systems
  - Classification of irrigation outlets
  - Status of irrigation development in Nepal

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

**Subject: - Irrigation 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) What are the factors which must be determined during the planning stage of a irrigation project? [4]
- b) Design a siphon-aqueduct with the following data: [12]
  - Canal – discharge  $30\text{m}^3/\text{s}$ ; bed width 23m; depth of water 1.7m; bed level 230.00; side slope 1.5:1
  - Drainage – high flood discharge  $800\text{m}^3/\text{s}$ ; high flood level 231.25; bed level 227.60; general ground level 230.00
2. a) Compare Kennedy's and Lacey's silt theories. Why Lacey's theory is superior than Kennedy's theory? [6]
- b) Design a regime channel by Lacey's theory for  $40\text{m}^3/\text{s}$  discharge and silt factor 0.9. [10]
3. a) Determine the field capacity of the soil from following data: [8]
  - depth of root zone = 1.5m
  - present water content = 5%
  - dry density of soil =  $1600\text{kg}/\text{m}^3$
  - water applied to the soil =  $7000\text{m}^3$
  - water loss due to evaporation = 10%
  - area of the plot = 1 hectare
- b) Determine the length and thickness of launching apron for the straight portion of a guide bund in a river. [8]
  - design flood =  $8,000\text{m}^3/\text{s}$
  - average diameter of river bed material = 1mm
  - river bed level = 125.00
  - highest flood level = 128.50
4. a) Derive an expression for balancing depth in designing canal section. [8]
- b) Find the spacing of tile drains with following data: [8]
  - annual rainfall = 900mm
  - drainage coefficient = 0.012
  - depth of impervious layer below GL = 9m
  - depth of tile drains below GL = 1.6m
  - depth of highest position of water table below GL = 1.2m
  - coefficient of permeability =  $0.012\text{cm}/\text{sec}$
5. a) Why under sluice is provided in head works? How does it work? [4]
- b) What are the silt controlling devices? Explain briefly. [4]
- c) Following data were observed in a canal fall: FSL of canal = 115m; Bed level of canal = 112m; Bed width of canal = 15m; Design discharge =  $30\text{m}^3/\text{s}$ ; Side slope of canal = 2:1; Length of rectangular crest of the fall = 10m (Broad crested weir). Calculate the crest level of the fall. [8]
6. Write short notes on any four of the following: [4×4]
  - a) Canal outlets
  - b) Safety against piping and uplift
  - c) Crop-water requirement
  - d) Design of lined canals
  - e) Irrigation methods
  - f) Operation and maintenance of irrigation systems

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

**Subject:** - Engineering Economics (CE655)

- ✓ 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 Engineering Economics. Write down the principles of Engineering Economic Analysis. [4]
2. ✓ What is nominal and effective interest rate? Evaluate FW at the end of 15 years with 10% interest rate compounded monthly of a cash flow of Rs. 50,000 at the beginning of each year for first 10 years. [3+5]
3. ✓ Define IRR. Find IRR and ERR of the following project.  $MARR = \epsilon = 15\%$ . [2+6]

Year	0	1	3	4	5
Cash flow	-50	-10	30	40	50

4. ✓

	Machine A
Initial Investment	Rs. 6000
Annual Benefits	Rs. 3000
O & M Cost	Rs. 1000
Salvage Value	Rs. 1500
MARR	10%

- a) Evaluate both type of BCR (FW Formulation). Take Useful life = 10 years. [4]
- b) Evaluate both type of Payback Period. If Useful life = 5 years. (Take Standard payback period = 3 years) [4]
- c) Explain the factors affecting determination of MARR. [4]
5. a) ✓ Use Repeatability assumption to select the best project from the following three projects. [6]

Project	A	B	C
Initial Investment	100000	200000	250000
Annual Expenditure	25000	20000	15000
Useful Life, Years	3	5	7
Salvage Value	40000	50000	60000
MARR	14%		

- b) ✓ Explain about the Sunk Cost, Economic life and reasons for replacement of an asset. The Annual Equivalent Cost of defender and challenger are given in the table below. What is the best replacement strategy? Use  $MARR = 10\%$ . The planning horizon of the project is 8 years. [8+4]

End of year (n)	1	2	3	4	5	6
(AEC) <sub>D</sub>	5400	5200	5500	5700	6200	6600
(AEC) <sub>C</sub>	7700	6200	5700	5600	5680	5900

6. a) For the improvement of a manufacturing plant, following three alternatives are being considered. The estimated investments and the corresponding increment in income are also given as below. Draw decision tree diagram of the situation and decide on the best alternative using FW formulation. MARR = 15%. Life of the Project is 6 years. [6]

Alternatives	Investment Cost	Sales		Annual Income
		High Success	Probability = 0.4	
A	1000000	Medium Success	Probability = 0.5	500000
		Low Success	Probability = 0.1	300000
				125500
B	600000	High Success	Probability = 0.2	400000
		Medium Success	Probability = 0.5	250000
		Low Success	Probability = 0.3	100000
C	400000	High Success	Probability = 0.5	200000
		Medium Success	Probability = 0.1	125000
		Low Success	Probability = 0.4	50000

- b) Perform sensitivity analysis of the following project over a range of 10 to 50 percent in (i) initial investment and (ii) MARR using PW formulation. Assume  $S_v = 0$ . Draw sensitivity diagram also. *Rs 100000, income = Rs 40000, useful life 6 yrs* [6]
7. What do you mean by depreciation? Explain about the causes of it. Explain about any three methods of depreciation calculation that are used commonly. A machine purchased for Rs. 60,000 by expecting useful life of 10 years. Calculate the depreciation amount for each year by using deciding balance method when rate of depreciation is 20% per year. [6+6]
8. Define Constant dollar amount and Actual dollar amount. Suppose you borrowed Rs. 100000 from a bank to buy a bike and you have promised to pay Rs. 5500 per month for two years. What is the inflation free interest rate you are supposed to pay if average inflation rate is 0.75% per month? [2+4]

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04 TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**

2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BEX, BCT, B.Agri.	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Engineering Economics (CE655)**

- ✓ 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. Scarcity is an emerging issue in engineering field. How does the study of economics help to engineers in decision making process? Discuss. [5]
2. What is effective and nominal interest rate? Evaluate FW at the end of 10 years with 8% interest rate compounded continuously of a cash flow of Rs. 500 at the beginning of each year for first 5 years. [2+4]
3. Initial Investment = Rs. 100,000 [6+5+5]  
Salvage Value = 0  
Annual O&M Cost = Rs. 20,000  
Useful Life = 5 years  
Annual Benefit = 60,000 at the end of first year, thereafter decreases by 4,000 each year for the remaining years.  
a) Draw U/B diagram.  
b) Evaluate conventional BCR using PW formulation. Take salvage value = 10,000.  
c) Evaluate Discounted Payback Period. Take standard (cut off) Payback Period = 3 years.
4. Use IRR method to select best project. MARR = 12%. [8+4]

	A	B	C	D
Initial Investment	1100	1500	2750	2000
Annual Income	500	700	1200	950
Useful Life	4	4	4	4
Salvage Value	250	500	800	1000
MARR	✓ 15%			

Select the best combination if A, B and C are mutually exclusive.

5. Explain about the reasons for replacement of asset. The Annual Equivalent Cost (AEC) of the defender and challenger are given in the table below. What is the best replacement strategy? Use MARR = 12%. The planning horizon of the project is 8 years. [4+8]

End of Year (n)	1	2	3	4	5	6
(AEC) <sub>D</sub>	5300	5250	5400	5750	6200	6550
(AEC) <sub>C</sub>	7700	6150	5700	5600	5675	5800

6. What are the sources of risk in engineering projects in Nepal? A real-state developer seeks to determine the most economical height for a new office building which will be sold after five years. The relevant net annual revenues and net resale values are as given below.

[4+8]

	Height	
	4 Floors	5 Floors
First Cost	125,000,000	200,000,000
Annual Revenues	19,910,000	37,815,000
Net Resale Value	200,000,000	300,000,000

The developer is uncertain about the interest rate  $i$  to use, but is certain that it is in the range of 5 to 30%. For each building height, find the range of values of  $i$  for which that building height is the most economical. Draw sensitivity diagram to support your answer.

7. An asset has installed value of 45,000.  $S_s = 0$ . It is classed as a 5 year property. Determine approximate MACRS depreciation schedule. Over 6 years it is estimated to generate revenue of Rs. 23,000 per year with annual operating cost 7300. Required rate of return = 15% after tax. Tax rate = 40%. Evaluate after tax IRR with annual worth method.

[6+6]

8. The annual fuel cost required to operate a small solid waste treatment plant are projected to be Rs. 200000 without considering any future inflation. The best estimate indicates that the annual inflation free interest rate  $I'$  will be 6% and the general inflation rate,  $f$ , will be 5%. If the plant has the remaining useful life of four years, what is the present equivalent of its fuel costs? Use actual dollar analysis.

[5]

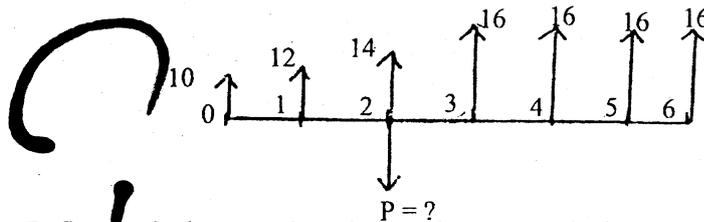
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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BEL, BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Engineering Economics (CE655)**

- ✓ 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 roles of engineers in making economic decision with appropriate examples. [4]
2. a) If you deposit Rs.10000 in a saving account now which gives 10% nominal interest rate, what will be the amount after 5 years if interest is compounded (i) semi-annually (ii) Monthly [2]
- b) Find the value of P if  $i=10\%$ . Use gradient formula also. [4]



3. a) Define equivalent worth and rate of return method. How much rupees should you deposit now in a bank account that gives 8% interest per year if you wish to draw Rs.10,000 per month for 10 years? [2+4]
- b) What is the different between financial and economic analysis? Determine both type of B/C ratio from the following cashflow. [2+4]
  - Initial investment = 3,00,000
  - Annual revenue = 85,000
  - Annual costs = 15,000
  - Salvage value = 20% of initial investment
  - Useful life = 6 years
  - MARR = 10%
- c) Compute IRR by using trial and error process of the following project. Determine also investment decision. [4]
  - Initial investment = 25,000
  - Annual revenue = 8,000
  - Salvage value = 5,000
  - Useful life = 5 years
  - MARR = 20%
4. a) Select the best proposal using ERR ( $\epsilon=25\%$ ,  $MARR=20\%$ ) [4]

EOY	0	1	2	3	4	5	6
Proposal A	-6400	2620	2900	3020	3100	3100	2600
Proposal B	-7550	2050	4060	4000	3900	3900	3400

- b) State and explain about the cases of mutually exclusive, contingent and independent projects with example. Compare the following projects by using repeatability assumption when MARR is 12% [4+4]

Project	A	B
Initial investment	2,00,000	3,00,000
Annual revenue	25,000	30,000
Annual costs	7,000	9,000
Useful life year	6	8
Salvage value	10,000	20,000

5. The new machine costs 10,000 operating cost 2200 in first year, then increases by 20% per year. Market value is 6000 after one year and will decline by 15% each year  $N = 5$  years. If required, old machine can work another 3 years. Market value now is 5000 and will decline by 25% each year. Immediate overhauling to restore to operable condition costs 1200. Operating costs 2000 in the first year increases by 1500 per year thereafter.  $MARR = 15\%$  [8+4]

- i) Find the economic service life of this machine (new)  
 ii) AEC of defender is as followings:

(AEC)

N	1	2	3	4
AEC	5380	5203	5468	5845

When should the old machine be replaced with the new machine.

6. a) Explain decision free Analysis: [4]  
 b) Calculate break-even hours of operation per year to become cost equal and recommended economic pump if it is to be operated 5 hours daily at full load. [8]

	KHASA Pump	SARVO Pump
Capacity	100 hp	100 hp
Purchase cost (Rs.)	5,00,000	10,00,000
Tax per year (Rs.)	10,000	15,000
Maintenance cost per year (Rs.)	36,500	29,200
Efficiency	80%	90%
Life year	5	5
Salvage value	20 % of purchase cost for both	
MARR	20% per year	
Electricity cost	Rs. 10/kwhr	

7. a) Define depreciation. What are the causes for it? If a machine costing of Rs. 1,50,000 is purchased by expecting salvage value Rs.40,000 at the end of 6<sup>th</sup> year. Calculate depreciation amount for each years by [2+5]

- i) SOYD  
 ii) Declining balance

- b) Suppose an equipment purchased for Rs.10,00,000. It is expected to generate income of Rs. 3,50,000 per year during 5 years and corporate income tax rate is 25% per year. Under the recovery periods depreciation are as follows. [6]

Year	1	2	3	4	5
Depreciation amount	1,00,000	2,00,000	2,00,000	2,00,000	1,00,000

Calculate ATCFs and determine profitability (IRR) when MARR is 15% by using PW method.

8. Evaluate the PW of the following project: [5]

Initial investment = Rs. 1,00,000 → in constant dollers  
 Annual sales income = Rs. 40,000 → in constant dollers  
 Annual labour cost = Rs. 3,000 → in constant dollers  
 Annual material X = Rs. 2,000 → in constant dollers  
 Annual material Y = Rs. 1,000 → in constant dollers  
 Salvage Value = 20% of initial investment - in constant dollers

Inflation rate for sales income, labour cost, materials X, material Y and salvage value are 5%, 8%, 0%, 6% and 3% respectively for the project period. Take market interest rate = 20% project life is 4 years.

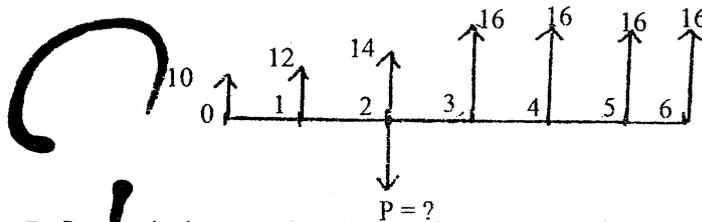
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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BEL, BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Engineering Economics (CE655)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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- ✓ Assume suitable data if necessary.

1. Explain the roles of engineers in making economic decision with appropriate examples. [4]
2. a) If you deposit Rs.10000 in a saving account now which gives 10% nominal interest rate, what will be the amount after 5 years if interest is compounded (i) semi-annually (ii) Monthly [2]
- b) Find the value of P if  $i=10\%$ . Use gradient formula also. [4]



3. a) Define equivalent worth and rate of return method. How much rupees should you deposit now in a bank account that gives 8% interest per year if you wish to draw Rs.10,000 per month for 10 years? [2+4]
- b) What is the different between financial and economic analysis? Determine both type of B/C ratio from the following cashflow. [2+4]
  - Initial investment = 3,00,000
  - Annual revenue = 85,000
  - Annual costs = 15,000
  - Salvage value = 20% of initial investment
  - Useful life = 6 years
  - MARR = 10%
- c) Compute IRR by using trial and error process of the following project. Determine also investment decision. [4]
  - Initial investment = 25,000
  - Annual revenue = 8,000
  - Salvage value = 5,000
  - Useful life = 5 years
  - MARR = 20%
4. a) Select the best proposal using ERR ( $\epsilon=25\%$ , MARR=20%) [4]

EOY	0	1	2	3	4	5	6
Proposal A	-6400	2620	2900	3020	3100	3100	2600
Proposal B	-7550	2050	4060	4000	3900	3900	3400

- b) State and explain about the cases of mutually exclusive, contingent and independent projects with example. Compare the following projects by using repeatability assumption when MARR is 12% [4+4]

Project	A	B
Initial investment	2,00,000	3,00,000
Annual revenue	25,000	30,000
Annual costs	7,000	9,000
Useful life year	6	8
Salvage value	10,000	20,000

5. The new machine costs 10,000 operating cost 2200 in first year, then increases by 20% per year. Market value is 6000 after one year and will decline by 15% each year  $N = 5$  years. If required, old machine can work another 3 years. Market value now is 5000 and will decline by 25% each year. Immediate overhauling to restore to operable condition costs 1200. Operating costs 2000 in the first year increases by 1500 per year thereafter.  $MARR = 15\%$  [8+4]

- i) Find the economic service life of this machine (new)  
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(AEC)

N	1	2	3	4
AEC	5380	5203	5468	5845

When should the old machine be replaced with the new machine.

6. a) Explain decision free Analysis: [4]  
 b) Calculate break-even hours of operation per year to become cost equal and recommended economic pump if it is to be operated 5 hours daily at full load. [8]

	KHASA Pump	SARVO Pump
Capacity	100 hp	100 hp
Purchase cost (Rs.)	5,00,000	10,00,000
Tax per year (Rs.)	10,000	15,000
Maintenance cost per year (Rs.)	36,500	29,200
Efficiency	80%	90%
Life year	5	5
Salvage value	20 % of purchase cost for both	
MARR	20% per year	
Electricity cost	Rs. 10/kwhr	

7. a) Define depreciation. What are the causes for it? If a machine costing of Rs. 1,50,000 is purchased by expecting salvage value Rs.40,000 at the end of 6<sup>th</sup> year. Calculate depreciation amount for each years by [2+5]

- i) SOYD  
 ii) Declining balance

- b) Suppose an equipment purchased for Rs.10,00,000. It is expected to generate income of Rs. 3,50,000 per year during 5 years and corporate income tax rate is 25% per year. Under the recovery periods depreciation are as follows. [6]

Year	1	2	3	4	5
Depreciation amount	1,00,000	2,00,000	2,00,000	2,00,000	1,00,000

Calculate ATCFs and determine profitability (IRR) when  $MARR$  is 15% by using PW method.

8. Evaluate the PW of the following project: [5]

Initial investment = Rs. 1,00,000 → in constant dollars  
 Annual sales income = Rs. 40,000 → in constant dollars  
 Annual labour cost = Rs. 3,000 → in constant dollars  
 Annual material X = Rs. 2,000 → in constant dollars  
 Annual material Y = Rs. 1,000 → in constant dollars  
 Salvage Value = 20% of initial investment - in constant dollars

Inflation rate for sales income, labour cost, materials X, material Y and salvage value are 5%, 8%, 0%, 6% and 3% respectively for the project period. Take market interest rate = 20% project life is 4 years.

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03 \* TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division**

2069 Poush

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BEL,BEX BCT.	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Engineering Economics (CE655)**

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

1. a) What are the principles of engineering economics? How does it help to decision making process?
- b) Differentiate between simple interest and compound interest. How many deposits of Rs.50, 000 each should make per month so that the future amount will be Rs. 20, 00,000 if the bank interest rate is 10% per year?
2. a) An equipment costing of Rs.5,00,000 is estimated to have life of 10 years and expected annual revenue is Rs.1,10,000 with annual cost of Rs.20,000. Determine the investment decision from PW, AW, and FW method to this equipment when salvage value is Rs.1, 00,000 and MARR is 12%.
- b) Use IRR method to evaluate following project when MARR is 20%.

End of year	cash flow
0	-60,000
1	20,000
2	40,000
3	50,000
4	50,000
5	70,000

3. a) Determine both types of B/C ratio by using FW formulation:

Initial investment (Rs.)	2,50,000
Annual revenue(Rs.)	50,000 at the end of first year and increasing by Rs. 30,000 for each year
Annual O&M cost (Rs.)	30,000
Salvage value (Rs.)	50,000
Useful life year	5
MARR	15%

- b) Recommend the best project from the following information by using repeatability assumption when MARR is 12%.

Project	A	B
Initial investment (Rs.)	4,00,000	7,00,000
Annual revenue (Rs.)	1,75,000	2,50,000
Annual cost (Rs.)	25,000	35,000
Salvage value (Rs.)	40,000	70,000
Useful life(year)	6	8

4. a) What do you mean by replacement analysis? Determine the choice between defender and challenger with following information from AEC approach when useful life is 5 years and MARR is 10%.

Item	Defender	Challenger
Initial investment(Rs.)	25,00,000	35,00,000
Annual cost(Rs.)	10,00,000	7,50,000
Salvage value(Rs.)	5,00,000	12,00,000

- b) Define economic service life of an asset. From the following information find the economic service life of an asset.

Initial investment(Rs.)	50,000
Annual operating cost (Rs.)	10,000 for the first year and increasing by 15% over the previous year
Salvage value (Rs.)	Declining each year by 20% from the previous year's salvage value
Useful life (year)	7
MARR	15%

5. a) Perform sensitivity analysis of the following project over a range of  $\pm 30\%$  in i) initial investment ii) net annual revenue iii) useful life year. Draw also sensitivity diagram.

Initial investment(Rs.)	5,00,000
Net annual revenue (Rs.)	1,20,000
Salvage value(Rs.)	80,000
Useful life (year)	6
MARR	10%

- b) If the cost of 25 watt CFL bulb is Rs.260 whereas the cost of 100 watt Filament bulb is Rs.35 but these bulbs have equal lighting power. Which bulb do you prefer in your use and why? When electricity cost is Rs.11 per unit (kw-hr).
6. a) What do you mean by depreciation and what are its causes? A machine purchased for Rs. 50,000 by expecting useful life of 10 years. Calculate its depreciation amount for each year by using declining balance method when rate of depreciation is 20% per year.
- b) Write short notes on
- MACRS for depreciation
  - Inflation and CPI
  - Market interest rate and inflation free interest rate.

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03 TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division.**  
 2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BEL, BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Engineering Economics (CE655)**

- ✓ 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 engineering economy. Enlist the principles of engineering economy. [1+3]
2. Ramesh, a Civil Engineer is planning to place a total of 20% of his salary, which is Rs. 250000. per year now, each year in mutual fund. He expects 7% salary increase each year for next 15 years. If the mutual fund will average 10% annual return, what will be the sum-amount at the end of 15 years? If salary increases by Rs 25000 per year. What will be the amount? [4+4]
3. a) From the following cashflow [4]

EOY	0	1	2	3	4	5
Cash flow	-3000	800	1000	1100	1210	1464

Calculate both type of payback period. MARR = 10%.

- b) Equipment costs 2,50,000 and has salvage value of 50,000 at the end of its expected life 5 years. Annual expenses will be 40,000. It will produce a revenue of 120,000 per year. MARR = 20%. = ε [4+4+4]
  - i) Evaluate IRR using AW formulation.
  - ii) Evaluate both type of B/C ratio with FW formulation.
  - iii) Find ERR.

4. From the following information select the best project.

	Project A	Project B
Initial Investment	35,000	50,000
Annual Revenue	16,450	25,000
Annual costs	3,000	13,830
Useful life	4 years	8 years
Salvage value at the end of useful life	0	0

MARR = 10%

When service period required is:

- i) 4 years by FW method [4]
  - ii) 8 years by IRR method with PW formulation [8]
5. What is the economic service life of an asset? Find the economic service life of a new electric lift truck which costs \$ 20,000, have a operating cost of \$1000 in the first year and have salvage value of \$12,000 at the end of the first year. For the remaining years,

operating costs increase each year by 10% over the previous years operating costs. Similarly the salvage value declines each year by 20% from the previous years salvage value. The lift truck has a maximum life of 7 years. An overhaul costing of \$3000 and \$5000 will be required during the fifth and seventh year of service respectively. The firm's required rate of return is 15% per year.

OR

A firm has a contract to provide printing service to IOE for next 8 years. It can provide the service using its old printing machine (the current defender) or the newly bought machine (the challenger). After the contract work neither the old machine nor the new machine will be retained. Considering the annual equivalent costs of the old machine and new machine as follows, what are their economic service life? And what is the best replacement strategy? [2+10]

Number of years (n)	Annual equivalent cost (Rs)	
	Old machine	New machine
1	515,000	750,000
2	510,000	615,000
3	550,000	586,000
4	596,000	583,000
5	644,000	590,000

6. a) Calculate breakeven volume of a cable manufacturing company from the following data: Total cost = Rs. 1,200,000; Variable cost = Rs. 400,000 Income from sales = 15,00,000. at production of 5000 unit. [4]

b) A proposal is described by the following estimates:  $P = \$20000$ ,  $S = 0$ ,  $N = 5$  and net annual receipts = \$7000. A rate of return of 20 percent is desired on such proposals. Construct a sensitivity graph of the life, annual receipts, and rate of return for deviations over a range of  $\pm 20$  percent. To which element is the decision most sensitive? [8]

7. a) Define depreciation and list out important methods of calculating depreciation deductions. [4]

b) A machine costs Rs 15000. Its useful life is 5 years and salvage value is Rs 900. Compute the annual depreciation allowances and resulting book values using double declining balance depreciation methods. [8]

8. a) Define inflation. List out its effects. If the inflation rate is 5% per year and the market interest rate is 13% per year. What is the implied interest (inflation free) rate in inflationary economy? [1+1+2]

OR

A series of five constant dollar (or real dollar) income (beginning with \$5000 at the end of the first year) are increasing at the rate of 7% per year for five years. Inflation free interest rate is 5% and inflation is 8%. Is it feasible investment if investment cost is \$20,000? [4]

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

**Subject: - Engineering Economics**

- ✓ 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) "Engineers play the important role in making the economic decision". Do you agree with this statement? Discuss. [6]

b) The information given below shows the records of a manufacturing company comparing the actual data with the data from the standard cost card. Calculate all the variances. Also indicate the favorable and adverse variances. [10]

	Production (Units)	Direct Material (Kg.)	Direct Material cost (Rs.)	Working Days	Fixed Overheads (Rs.)	Variable overheads (Rs.)
Standard	10	50	10000	12	5000	25000
Actual	8	45	9000	10	6000	20000

2. a) Mr. Kumar has inspected his yearly household expenses for the last 10 years. Cost averages were steady at Rs 100000 per year for the first 5 years, but have increased consistently by Rs 15000 per year for each of the last 5 years. Calculate total present worth in year zero. Use gradient formula. [8]

b) Use discounted payback period method to select the best option: [8]

	Initial Investment	Annual Income	Useful Life	Salvage Value
Option A	Rs. 1000000	Rs 15000	10 yrs	Rs 20000
Option B	Rs 150000	Rs 20000	12 yrs	Rs 40000

3. a) Find the IRR of the following cash flow of a project. If MARR = 20%, comment on the acceptability of the project. Show investment balance diagram. [8]

End of Year	Net Cash flow in RS.
0	-20000
1	+8000
2	+17000
3	+19000
4	+18000
5	-10000

b) Three mutually exclusive alternatives are to be compared by the rate of return method and are describe below. MARR is 10%. Salvage value is 20% of first cost. Which option has the highest IRR and what is it? Recommend the best alternative. [8]

	X	Y	Z
First cost, Rs.	70,000	60,000	100,000
Annual income, Rs.	15000	10000	18000
Economic life, years	8	8	8

4. a) The total purchase price of a three room set furniture is Rs. 50000. However after a down payment of Rs 10000, two year series-end of month payment of 2200 will have to be made. Determine the nominal and effective interest rate. [3+3]

- b) Find the acceptability of a project using both types of B/C ration. (Use AW method) [10]

Initial investment = Rs. 180000	Annual Benefits = 53000 at the end of first year and decreases by Rs. 2000 each year
Annual Expenses = Rs. 16000	Salvage value = Rs. 40000
Useful life = 10 years	MARR = 10%

5. a) Select the best project from the following two projects. (Use Repeatability and PW method). [8]

	Project A	Project B
Initial Cost (Rs)	150000	180000
Annual Expenses (Rs)	35000	31000
Annual Revenues (Rs)	8500	10500
Salvage Value (Rs)	50000	80000
Useful Life	6 years	9 years
MARR	15%	

- b) Two types of power converters, alpha and beta are under consideration for a specific application. An economic comparison is to be made at an interest rate of 12% and the following cost estimates have been obtained. Select the best option by calculating present worth of both the projects if it will be operated for 4 years only. [8]

	Alpha	Beta
Purchase price Rs	750000	2000000
Annual operating cost, Rs.	200000	100000
Estimated service life, years	5	9
Salvage value, Rs.	0	400000

6. a) Following table shows the demand of meat when the price is shown in Rs. Make the hypothesized regression equation and find the consumption if the price is set to be Rs. 35 per kg. [6]

SN	Price of meat per kg	Consumption in kg
1	25	80
2	38	70
3	28	78
4	30	73
5	27	78
6	40	68
7	42	65
8	32	74

- b) The purchase of a rental property is being considered in a neighborhood where real estate prices are increasing rapidly. The following estimates have been developed for a preliminary before-tax analysis: [10]

First cost, Rs	Annual income from rent, Rs.	Annual Maintenance, Rs.	Investment Period	Resale value	MARR
140000	30000	7500	6 yrs	1,50,000	10%

Construct sensitivity chart for joint variation within a  $\pm 30\%$  range of annual income and MARR. Indicate the acceptance and rejection zones.

7. Write short notes on: (any four) [4×4]

- a) Drawbacks of IRR method  
 b) Capital recovery cost  
 c) Decision tree analysis  
 d) Declining balance method of depreciation  
 e) Methods of demand analysis

Exam.	Back		
	Level	BE	Full Marks
Programme	BCE, BEL, BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs

**Subject: - Engineering Economics**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
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1. a) Differentiate between nominal and effective interest? Calculate both nominal and effective annual interest if you deposit now, Rs 1,00,000 and you can draw Rs 1000 per month for ever. [6]
- b) A machine cost Rs 20 million with no salvage value. Rs 8 million revenues per year can be gained. Given: useful life = 4 years. Tax rate = 50%, MARR = 10%. Use straight line depreciation method to evaluate (i) PW (ii) IRR [10]
2. a) Explain decision tree analysis. [6]
- b) Select the best project using IRR method. Useful life of all projects are 15 years. MARR = 10%. [10]

Particulars	Project A	Project B	Project C
Initial investment	7500,000	5500,000	4000,000
Annual revenue	960,000	720,000	600,000
Salvage value	7500,000	5500,000	4000,000

3. a) What are the drawbacks of IRR method? How does ERR method eliminates some of these drawbacks. [6]
- b) Perform cost variance analysis. [10]

	Standard (Rs)	Actual (Rs)
Production (Units)	9,000	8,000
Direct Labour (Hours)	72,000	60,000
Direct Labour cost (Rs.)	756,000	600,000
Fixed overhead cost (Rs.)	900,000	810,000
Variable overhead cost (Rs.)	684,000	630,000

4. a) Explain the methods for assessing risk/uncertainty. [6]
- b) Perform sensitivity analysis over a range of  $\pm 30\%$  in (i) initial investment (ii) annual net revenue (iii) useful life. [10]

Initial investment = Rs. 100,000	Salvage value = Rs 10,000
Annual benefits = Rs 25,000	Annual expenses = Rs 3,000
Useful life = 10 years	MARR = 10%

Draw sensitivity diagram and interpret the result.

5. a) Evaluate the modified B/C ratio for the problem in Q 4(b). [6]  
 b) Select the best project. Required study period is 5 years. [10]

	Project P	Project Q
Initial Investment(Rs.)	5,00,000	3,50,000
Annual net revenue (Rs.)	2,00,000	1,75,000
Salvage value(Rs.)	50,000	35,000
Useful life (Years)	6	5
MARR	10%	10%

6. a) Define engineering economics. Explain capitalistic OR Socialistic economy. [6]  
 b) Evaluate ERR. MARR = 10% E=8% [8]

EOY	0	1	2	3	4	5
Cash inflow	-	+40,000	+150,00	+120,000	+800,000	+200,000
Cash outflow	-480,000	-80,000	-50,000	-500,000	-200,000	-400,000

- c) What are the elements of cost? [2]
7. Write short notes: (any 4) [4x4]
- Sources of uncertainty
  - Market research
  - Continuous compounding
  - Job and process costing
  - Statistic approach to demand analysis

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

**Subject - Engineering Economics**

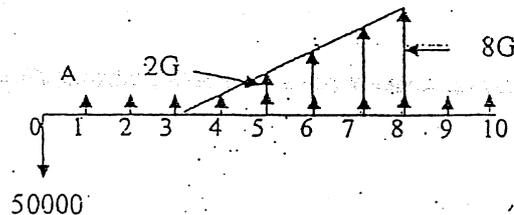
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Define economic system. Write advantages of socialistic economy. [1+3]
- b) Explain overhead cost and opportunity cost. [4]
- c) The following information has been obtained from the records of a manufacturing company using standard costing system. [8]

	Estimated	Actual
Production Units	1	600
Cement (bags)	5	3,600
Cement Cost (Rs.)	3,500	2,16,000
Skilled Labour (mason) Days	2	900
Skilled Labour (mason) Cost Rs.	300 per day	325 per day
Fixed Overhead (Rs)	10,000	15,000

Find all the variances (Including all its components)

2. a) Mr. Basnet purchases a car which cost Rs. 20,00,000. He pays 40% as down payment. Remaining amount will be paid on installment basis and wishes to pay Rs. 25,000 per month for next five years. What annual interest rate will he be paying? At the end of 3rd year, what lump sum amount should he pay to clear all his dues? [4+4]
- b) Find the value of A and G if  $i = 10\%$ .  $A = 3G$  [8]



3. a) Describe any two drawbacks of IRR. [4]
- b) Use ERR method to evaluate the project with following cash flow.  $MARR = e = 10\%$ . [6]

Year	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>
Cash flow	-8,00,000	2,00,000	2,00,000	-50,000	4,00,000	4,00,000

- c) A preliminary estimate of a multipurpose hydropower project produced the following data. [6]

Initial Investment	Annual Power sales	Annual irrigation benefit	Annual recreational benefit	Annual operation and maintenance	Life of the project	Salvage value
Rs. 50 crore	Rs. 8 crore	Rs. 1 crore	Rs. 2 Crore	Rs. 1.5 crore	50 yrs	Rs. 40 crore

Give your suggestion to the government about the implementation of the project. Take  $MARR = 8\%$ .

4. a) Recommend which one is best out of the following three mutually exclusive projects. Study period is 10 years. MARR = 12%. [8]

Project	A	B	C
Initial Investment	5,00,000	6,00,000	7,00,000
Annual Revenues	1,50,000	1,50,000	1,70,000
Annual cost	25,000	25,000	25,000
Salvage value	1,00,000	1,00,000	70,000
Useful life	4	6	8

- b) Define capitalized worth. How much money should Mr X should deposit now in a bank which gives 12% interest annually, so that he can draw (i) Rs 3000 per month plus Rs. 20,000 annually and Rs. 50,000 in every five years for infinite period. [2+6]
5. a) Explain mutually exclusive and independent projects. [4]
- b) Select the best alternative using incremental IRR methods. Useful life is 10 years and salvage value is 25% of initial investment. MARR = 10%. [12]

Project	A	B	C	D
Initial Investment	600	500	800	700
Annual Revenues	150	125	175	160
Annual Cost	40	25	30	35

6. a) What will be the impact of change in value of present worth of the following project if changes occurs in (i) initial investment (ii) net annual income and (iii) Useful life by  $\pm 25\%$ ? Draw necessary graph also. [10]

Initial Investment	Rs. 4,00,000
Net Annual income	Rs. 50,000
Useful life	12 years
MARR	15%

- b) Based on the following data, forecast the demand of CFL for next five years. [6]

Year	2007	2008	2009	2010
Demand (Nos.)	1,00,000	1,25,000	2,00,000	3,00,000

7. Write short notes on: (any four) [4×4]
- Taxation system in Nepal
  - Methods of calculating depreciation
  - Decision tree analysis
  - Market Research
  - Factors affecting demand

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Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BCE, BEL, BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Engineering Economics**

- ✓ 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 the terms, socialistic economy and cash flow diagram. [4]

b) In the standard card, it is observed that one unit of product 'X', requires fixed overhead of 2 hrs at the rate of Rs. 15/hr. During the month of February, 800 units are produced at the actual fixed overhead of Rs. 18/hr in 1800 hours. Budgeted fixed overhead is Rs. 30,000. Perform cost variance analysis. [6]

c) Evaluate both type of B/C ratio using PW. [6]

Initial cost = Rs. 25 lakh

Salvage value = Rs. 5 lakh

Useful life = 10 years

Annual benefits = Rs. 10 lakh

Annual O & M = Rs. 5 lakh

MARR = 8%

2. a) Explain incremental analysis or break-even analysis. [4]

b) Select the best project using, ERR method. MARR = 18%. E = 12%. [8]

Year	0	1	2	3	4	5
Project A	-40,000	-38,000	+35,000	+35,000	+35,000	+35,000
Project B	-60,000	+25,000	+40,000	-50,000	+50,000	+75,000

c) Fixed cost = Rs. 60 million, Variable cost/unit = Rs. 50,000, Selling price/unit = Rs. 8,000. Find BEP volume. What would be the effect on profit/loss when  $S_p$  increases by 20%. [4]

3. a) How much money should Mr Ram deposit now in a bank so that he and his successor can draw Rs 5000 bimonthly for infinite period? Interest rate is 12 % per year. [6]

b) Select the best combination of the project where A is independent and B is contingent on C. [10]

Project	A	B	C
Initial Investment	40,000	70,000	50,000
Annual Revenues	15,000	20,000	20000
Annual cost	2,500	3,500	0
Useful life (Yrs.)	8	8	8

The Investment is limited to Rs. 120,000. MARR = 10%.

4. a) Panchakanya has recorded the sales of its products in different years as below. Forecast the sales for year 2020. [8]

Year	2001	2002	2003	2004	2005	2006	2007
Sales (Rs. in Million)	500	550	575	675	650	700	780

- b) Write short notes on any two: [2×4]

- i) Advantages of Payback Period
- ii) Depreciation Methods
- iii) Job and Process Costing

5. a) Explain repeatability and cotermination assumptions. [8]

b)

Project	Initial Investment (NRs.)	Annual Revenue (NRs.)	Annual Expenses (NRs.)	Salvage Value	N	MARR
P	5000	3000	2000	1000	8 year	12%
Q	3500	2000	800	350	4 year	12%

Select the best (i) if study period is 10 years (ii) using capitalized worth method. [8]

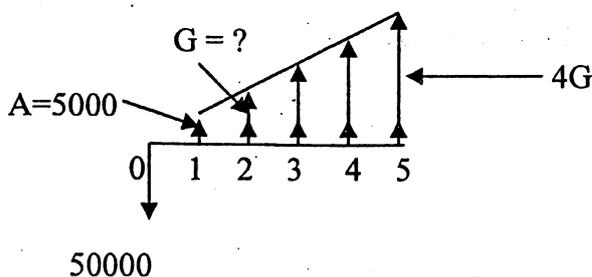
6. a) Explain tax and depreciation or decision tree. [4]

- b) A machine costs Rs. 20 million and expect to save Rs. 4 million/year, Tax rate = 50%, MARR = 10%. Evaluate the PW. [4]

- c) Perform sensitivity analysis over  $\pm 30\%$  is initial cost and useful life. Draw sensitivity diagram and interpret the result for the problem no 1(c). [8]

7. a) Define 'Capital Recovery Cost'. Mr. Fox purchased a motorbike which cost Rs. 2,00,000. He pays 30% as down payment. Remaining amount will be paid on installment basis and wishes to pay Rs. 10,000 per month for 20 months. What annual interest rate is he paying? [2+6]

- b) Find the value of G if  $i = 10\%$  [8]



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

**Subject: - Engineering Economics**

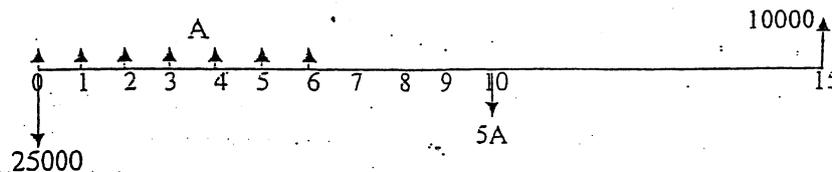
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Define economic system. Discuss briefly on the characteristics of capitalistic economy. [2+2]
- ✓ b) What are the elements of cost? Discuss briefly on the prime cost and overhead costs. [2+2]
- c) The following information has been obtained from the records of a manufacturing company using standard costing system [8]

	Standard	Actual
Production (Unit)	3000	2500
Working days	27	25
Fixed overhead variance	14000	12500
Variable overhead variance	10000	11000

Find all the variances (Including all its components).

2. a) Find the value of A if  $i = 15\%$  [8]



- b) Mr. X receives a loan of Rs 120,000 from a bank at an interest rate of 12 % per year.
  - i) He wishes to repay the loan in monthly installment with Rs. 3000 per month. How many installments are necessary to complete his payment? [4]
  - ii) What annual interest rate is he paying if the Bank asks him to pay Rs 5000 per month for 30 times. [4]
3. a) A construction company needs an equipment which costs Rs 10,00,000 and has salvage value of Rs. 1,00,000 at the end of 10 years. The equipment supplier is also willing to provide the equipment on hire for Rs 1,25,000 per year for 10 years. What will you do? Purchase or Hire. MARR = 12% [6]
- b) Find IRR of the following project with initial investment of the Rs 5,00,000 and Salvage value of Rs 1,00,000 at the end of 5 year. The Annual benefit and Operation and Maintenance cost are as following. [10]

End of Year	Benefit	Operation and Maintenance
1	105000	5000
2	115000	10000
3	125000	15000
4	135000	20000
5	145000	25000

Draw unrecovered investment balance diagram also

4. a) From the following four mutually exclusive projects recommend the best one using Payback Period, ERR and BCR methods. The study period is 5 years and  $MARR = e = 15\%$ . [16]

Project	A	B	C	D
Initial investment	500000	400000	700000	600000
Net annual revenue	125000	110000	170000	135000

Salvage Value is 20 % of the initial investment.

5. a) What is breakeven value? Discuss with suitable example. [6]  
 b) Nepal Airlines is planning to purchase a Jet plane. The estimate on two types of plane under consideration are; [10]

Project	Plane A	Plane B
First investment cost	25,00,00,000	30,00,00,000
Annual O & M	1,50,00,000	1,00,00,000
Useful Life	4 years	6 years
Salvage value	5,00,00,000	6,00,00,000
MARR = 12 %		

Which plane is the best one if it is believed that the plane will be used for i) 4 years and ii) infinite period?

6. a) Define the concept of certainty, Uncertainty and Risk. [4]  
 b) Perform sensitivity analysis of a following project over a range of  $\pm 30\%$  in i) Initial investment ii) Net annual cash flow using annual worth formulation. [6]

Initial Cost	Rs. 5,00,000
Annual revenue	Rs. 75,000
Annual maintenance cost	Rs. 10,000
Useful life	10 years
Salvage value	Rs. 50,000
MARR	10%

7. c) Following data shows the demands for fish when the prices are as shown. Calculate the hypothesized regression equation. What shall be the demand if the price is set to be Rs. 60 per kg? [6]

S.N	Price per kg.	Quantity (tones.)	S.N	Price per Kg.	Quantity (tones.)
1	64	65	5	82	51
2	53	75	6	59	65
3	67	56	7	67	63
4	52	69	8	71	55

7. Write short notes on any four [4x4]  
 a) Job and process costing  
 b) Drawbacks of IRR  
 c) Depreciation  
 d) Factors affecting demand  
 e) Methods of demand analysis

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BEL, BEX, BCT	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Engineering Economics**

- ✓ 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**.
- ✓ Take MARR = 10% if not specified.
- ✓ Draw necessary cash flow diagrams.
- ✓ Assume suitable data if necessary.

1. Select the best project.

[16]

	Project A	Project B
Initial investment (Rs.)	3,50,000	5,00,000
Annual revenues (Rs.)	1,90,000	2,50,000
Annual expenses (Rs.)	64,500	1,38,000
Useful life (years)	4	8
Salvage value at the end of useful life	0	0

Use

- a) Repeatability assumption
  - b) Study period is 4 years
  - c) Infinite project life
2. a) Recommend the best using ERR method  $i = 20\%$

[12]

ERR	Project	End of the cash flows (in Rs. '000)						
		0	1	2	3	4	5	6
28.3%	A	-640	262	290	302	310	310	260
26.4%	B	-680	-40	392	380	380	380	380
28.5%	C	-755	205	406	400	390	390	324

- b) Recommend the best using payback period for the problem no. 2(a).
3. a) Explain the mutually exclusive project, independent projects and contingent with suitable examples.
- b) Forecast the sales for year 2010.

[4]

[6]

[10]

Year	2000	2001	2002	2003	2004	2005	2006	2007
Sales Rs. '000	416	287	307	268	378	523	457	587

4. a) Calculate variance for the following:

[8]

	Standard	Actual
Production units	9,300	10,500
Direct labour hours	102,300	136,500
Fixed overhead (Rs.)	21,483,000	28,392,000
Variable overhead (Rs.)	15,345,000	17,199,000

- b) Perform sensitivity analysis over  $\pm 30\%$  (varying in increment of 10%) in (i) initial investment (ii) annual net revenue (iii) useful life. Draw sensitivity diagram and interpret the result. [8]

Initial investment = Rs. 20,000  
 Useful life = 10 years  
 Revenues/Year = Rs. 6,000  
 Expenses/Year = Rs. 2,000

5. a) Find the required annual receipts 'A' for the following investment proposal:- [8]

Initial investment = Rs. 10,00,000  
 Salvage value = Rs. 1,00,000  
 O & M expenses/year = Rs. 50,000.

End of year	1	2	3	4	5
Benefits	A+70,000	A+80,000	A+90,000	A+100,000	A+110,000

- b) Find the modified B/C ratio for the problem no. 5(a). [8]

6. a) Explain the economic system. [8]

- b) Find IRR and show the unrecovered investment balance in the graphical and tabular form. [8]

Investment (First) Cost = Rs. 2,50,000  
 Revenues/Year = Rs. 1,00,000  
 Expenses/Year = Rs. 30,000  
 Salvage Value = Rs. 50,000  
 Useful life = 5 years

7. a) Explain the uncertainty and its sources. Differentiate between nominal interest rate and effective interest rate. If monthly interest rate is 1%, what will be the quarterly interest rate? [4+4]

- b) Explain tax and depreciation with suitable examples. Find BEP volume for the following project: [4+4]

Fixed cost = Rs. 24 lakh  
 Selling price = Rs. 800 per unit  
 Variable cost = Rs. 500 per unit

What would be effect on BEP, when fixed cost increases by 10% and variable decreases by 20%?

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8

03      TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2072 Ashwin

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

*Subject: - Transportation Engineering (CE653)*

- ✓ 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. Explain the components of transportation system. What are the objectives of road planning?
2. Mention engineering surveys to be carried out for highway location. Explain Preliminary Survey for Highway location in brief.
3. Derive an expression for finding the superelevation required if the design coefficient of friction is 'f'. List the design steps of superelevation.
4. A vertical summit curve is to be designed when two grades +1/60 and -1/45 meet on a highway. The stopping sight distance and overtaking sight distance required are 210 m and 600 m respectively. But due to site condition, the length of vertical curve has to be restricted to a maximum value of 750m if possible. Calculate the length of summit curve needed to fulfill the requirements of:
  - i) Stopping sight distance
  - ii) Overtaking sight distance or at least intermediate sight distance. Discuss the result
5. Define transition curve and its necessity in horizontal alignment. Describe the different methods of designing the length of transition curve.
6. A six lane highway has a curve 350 m long and 550 m radius. The stopping sight distance and overtaking sight distance are 200 m and 400 m respectively. Find out the setback distance from the inner edge of the road to the obstruction for both cases.
7. Define highway drainage system. Describe the causes of moisture variation in subsurface soil. Explain with neat sketches how the subsurface drainage is provided to lower the water table and control of seepage flow.
8. What are the design and construction problems that are associated with hill roads? Enumerate the merits and demerits of River Route and Ridge Route.
9. What are the different types of bituminous materials used in road construction? Explain briefly the test procedure of Los Angeles abrasion value of aggregate.
10. What are the desirable properties of bituminous mixes? Briefly explain the ductility test of bitumen and its engineering application.

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

**Subject: - Transportation Engineering (CE653)**

- ✓ 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 the objectives of road planning? Explain the major road patterns developed in modern urban areas.
  2. ✓ Explain the factors that affect the selection of highway alignment.
  3. ✓ Derive an expression for finding the superelevation required if the design coefficient of friction is 'f'. Describe briefly the various methods of providing superelevation with sketches.
  4. ✓ What are the curve resistance and grade compensation? Describe the disadvantages of heavy camber.
  5. ✓ A vehicle moving in a horizontal curve at a design speed of 65 kmph, develops a centrifugal ratio of 1/5. The deflection angle at curve is 48°. Calculate:
    - a) radius of circular curve
    - b) length of transition curve by rate of change of centrifugal acceleration criteria
    - c) total length of composite curve
  6. ✓ The driver of a vehicle travelling at 65 kmph down a grade required 12m more stopping sight distance to stop than the driver travelling at same speed up the same grade. If the coefficient of friction between tire and pavement is 0.38. Determine the percent grade and stopping sight distance up the grade.
  7. ✓ Classify highway drainage. What are the requirements of highway drainage?
  8. ✓ Describe different types of retaining walls used in road construction. List out the basis of its selection.
  9. ✓ Explain the materials used in different layers of the road pavement. Describe the desirable properties of road aggregates for pavement works.
  10. ✓ What are the tests to be conducted on road binders for its suitability on road construction? Describe the test procedure to determine the softening point of bitumen.

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

**Subject: - Transportation Engineering (CE653)**

- ✓ 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 briefly, the classification of transportation system. [8]
2. What are the requirements of highway alignment? Explain the importance of map study in highway survey. [8]
3. What are the functions of transition curve? Derive an expression for the length of transition curve to be introduced between the straight and circular path on a horizontal curve from two criteria. [8]
4. Describe the factors which control the geometric elements of road and discuss the reasons for providing an additional width of carriageway on horizontal curve. [8]
5. A four lane carriageway has a curve of 220 m length and 400 m radius. The safe stopping sight distance and overtaking sight distance are 152 m and 300 m respectively. Calculate the minimum set-back distance from the inner edge of the road to the edge of the obstruction to ensure safe visibility for the both cases of sight distances if the width of the pavement per lane is 3.75 m. [8]
6. Design the length of valley curve with a descending grade of 1/35 and ascending grade of 1/45. The design speed is 80 kmph. Determine the RL of beginning, lowest and end point of curve if the RL of PVI is 212.36 m so as to fulfill both comfort condition and head light sight distance for night visibility. Also determine the apex distance and mid ordinate of the curve. Assume coefficient of friction = 0.35, Rate of change of centrifugal acceleration = 60 cm/sec<sup>3</sup>. [8]
7. Why drainage is an important part of highway design? What are the causes of moisture variation in sub-grade soil? [8]
8. Sketch different types of hill road cross-sections. Discuss hill road drainage structures. [8]
9. Define bitumen premixes. Explain the Marshall design method for the Asphalt concrete. [8]
10. Explain briefly the desirable properties of sub-grade soil. Explain the test procedure of the penetration value of bitumen. [8]

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

**Subject: - Transportation Engineering (CE653)**

- ✓ 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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Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Transportation Engineering- I (CE653)**

- ✓ 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 Explain the road classification system based on Nepal Road Standard. Why road transportation is considered the most feasible in our country?
- 2 What are the requirements of an ideal highway alignment? Describe the information needed to be collected during reconnaissance survey.
- 3 Discuss the design controls for the geometrics of road and governing factors which affect the stopping sight distance.
- 4 Define super elevation, and derive the expression for super elevation. List the design steps of super elevation.
- 5 The angle of intersection between two straights is  $137.23^\circ$ . The spiral angle for each transition curve is  $8.35^\circ$ . Calculate the length of transition curve, combined length of curves and length of tangent if the radius of the curve is 325 m.
- 6 An ascending gradient of 3.75% meets with descending gradient of 3.25%. Calculate the chainage and elevation of beginning of the curve, end of the curve, highest point of the curve and 90 m left from the point of vertical intersection if the chainage and elevation of PVI are 1+ 225.00 and 875.62 m respectively. The radius of curve provided is 8000 m.
- 7 What are the causes of moisture variation in sub-grade soil? What are the factors to be considered in designing sub-surface drainage system to check seepage flow?
- 8 Discuss the road side structures to be provided for the road way stability. Explain how you will stabilize landslides along the road.
- 9 Define bitumen premixes. Explain the Marshall design procedure for the bituminous premixes.
- 10 What are the desirable properties of sub-grade soil? Explain the method of Los Angeles abrasion test on aggregate.

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

**Subject: - Transportation Engineering I**

- ✓ 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 is transportation planning? Why the development of public transportation should be given preference over the development of private transportation? [8]  
b) What are the different stages of surveying for highway alignment? List out the various components of economical appraisal. [8]
2. a) Classify the highway curves. What type of effects will take place when the vehicle negotiates a horizontal curve without super elevation? Also give reasons. [8]  
b) Calculate the length of transition curve using the following data: [8]
  - i) Design speed = 65 kmph
  - ii) Radius of circular curve = 220m
  - iii) Allowable rate of introduction of super elevation (Pavement rotated about centre line) = 1 in 150
  - iv) Pavement width including extra widening = 7.5m
3. a) Explain PIEV theory. Derive an expression for determining the stopping sight distance at level ground. [8]  
b) A summit curve is to be provided at the intersection of two gradients +1.5% and -2%. What is length required (i) For stopping sight distance of 200m (ii) For overtaking sight distance of 600m? What is the vertical distance between the point of vertical intersection and curve in either case? [8]
4. a) Describe the different types of retaining walls used in road construction. Mention the basis of its selection. [8]  
b) What do you mean by penetration value of bitumen? Describe step by step procedure for the determination of penetration value of bitumen in the laboratory. [8]
5. a) Explain the different types of erosion control and energy dissipating measures used in highway drainage system. [8]  
b) Explain different measures that are taken to stabilize the formation and cross slopes in hill road construction. [8]
6. Write short notes on: [4×4]
  - a) Requirements of highway alignment
  - b) Extra widening
  - c) Road classification system
  - d) River route

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

**Subject: - Transportation Engineering I**

- ✓ 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 is transportation planning? Explain philosophical elements of a long term transport planning. [8]
- b) Mention the stages of highway survey. Describe the information to be collected during reconnaissance survey. [8]
2. a) What is an overtaking sight distance? Derive an expression for overtaking sight distance with neat sketch. [2+6]
- b) Calculate the length of a transition curve required for a road with carriageway width of 7.0m on a straight portion, if the design speed is 65kmph. Assume that the road is passing through a rolling terrain. The radius of the horizontal curve is 200m and pavement is rotated about the centre line. Assume suitable data if necessary. [8]
3. a) Define PIEV theory. Derive an expression to determine the extra widening. [2+6]
- b) A valley curve divided by a descending gradient of 1 in 30 meeting an ascending gradient of 1 in 25. Design the length of valley curve to fulfill both comfort condition and head light sight distance required for a design speed of 80Kmph. Assume allowable rate of change of centrifugal acceleration is  $0.6\text{m/sec}^2$  and stopping sight distance is 160m. [8]
4. a) What is penetration value of bitumen? Describe the procedure for the determination of penetration value in laboratory. [2+6]
- b) What are the causes of soil erosion? Describe preventive measures of soil erosion and energy dissipation. [8]
5. a) Classify the cross drainage structures as per NRS. Describe the suitability of construction of pipe, box, slab and arch culverts. [8]
- b) List various test carried out on road aggregates. Explain the procedure for determination of Los Angeles abrasion test. [8]
6. Write short note on: (any four) [4×4]
  - a) Bitumen emulsion
  - b) Un-submerged and submerged conditions for minor bridge
  - c) Retaining structures
  - d) Hill road drainage
  - e) Curve resistance and grade compensation

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

**Subject: - Transportation Engineering I**

- ✓ 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) Why is Macadam Road superior to Telford Construction? Make sketches of those road sections. Write down the scope of Highway Engineering. [8]
- b) What are the types of road patterns in urban areas? Explain them briefly with the help of neat sketches. [8]
2. a) List out important factors which control the geometric elements of roads. Calculate safe stopping sight distance for the design speed of 50 kmph for: (i) two-way traffic on a two lane road (ii) two-way traffic on a single lane road. Assume appropriate data for calculation. [2+3+3]
- b) Derive the expression for the length of transition curve to be introduced between the straight and the circular path on a horizontal alignment from two criteria. [8]
3. a) What are the basic design controls for valley curves? How the length of valley curve is calculated from different criteria? [8]
- b) Define PIEV theory. A National Highway passing through a rolling terrain has a horizontal curve of radius of 200m. Find out the length of a transition curve assuming suitable data. [2+6]
4. a) Briefly describe the special structures constructed in hill roads. Make the sketch of drainage system layout in hill roads. [8]
- b) Write down the steps for the design of longitudinal drains of a road to drain off the surface water. Classify cross drainage structures as per NRS. [8]
5. a) Explain with neat sketches the phenomenon of lowering of the water table, control of capillary and vapour rise to strengthen the sub-grade of a road embankment. [8]
- b) Write down the tests carried out on road aggregates and describe their significance. [8]
6. Write short notes on: (any four) [4×4]
  - a) Penetration test on bitumen
  - b) River crossing alternatives
  - c) Super elevation in hill roads
  - d) Resistance to vehicular motion
  - e) Selection of an ideal alignment

Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Transportation Engineering I**

- ✓ 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) Derive the expression for the length of transition curve from two considerations. [8]  
 b) Due to drainage problem, the inner edge cannot be lowered and a super elevation of  $e$  is to be introduced. Explain, how the two way slope of  $n$  can be gradually converted to a one way slope of  $e$  where  $e > n$  with a neat sketch. Given the road width is  $W_m$  and the transition curve length is  $L$  m. [8]
2. a) A 30<sup>th</sup> hourly volume is generally accepted as the design volume of traffic, why? What are the other design controls for the geometrics of road? Discuss in brief. [8]  
 b) At a deviation point with deviation angle equal to  $10^\circ 50'$  and radius of horizontal circular curve of 400m, a symmetrical spiral-circular curve with 120m long spiral could not be introduced. Prove it. Give suggestions for other possible solutions. [8]
3. a) Derive an expression for minimum permissible radius of valley curve from two considerations. [10]  
 b) Outline the various reasons requiring grade compensation. [6]
4. a) A 300m line ascending section of a double lane road with two way traffic road with 4% grade meets with a 300m long descending section with 3% grade. Design the vertical curve to meet the visibility requirement. Design speed is 100 kmph. The braking efficiency is 90%. Calculate the formation levels of main points on curve at a distance of 50m from PVI on either sides, at the highest point of the formation lines and at the beginning and end section of road, given the final formation level of the road at a distance of 25m right from PVI as 120.105. [8]  
 b) Enumerate the various types of consistency tests on bituminous binders. Why do we need different types of consistency tests? How is the ductility test carried out? What is the significance of this test? [8]
5. a) The table below gives the sieve analysis results of three gravel quarries under investigation. Calculate the mixing properties; to meet the given gradation specification. [10]

Sieve size mm	Percentage passing given sieve size			Specification
	Quarry A	Quarry B	Quarry C	
25.4	100	100	100	100
12.7	100	100	95	90-100
4.76	100	100	55	60-75
1.18	100	65	30	40-55
0.30	100	25	23	20-35
0.15	75	18	9	12-22
0.075	40	5	3	5-10

- b) Draw neat sketches and describe different types of hill roads cross section. [6]
6. Write short notes on: [4x4]
  - a) Air resistance
  - b) Hairpin bend
  - c) Historical development of road
  - d) Control of seepage flow

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

**Subject: - Transportation Engineering I**

- ✓ 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) Compare the main features of Telford and Macadam construction. Why Macadam is known as the pioneer of modern roads? [6+2]  
b) Name the various steps to be followed for a highway alignment location. Describe the works to be carried out and data to be collected during final location survey. [2+6]
2. a) What is lining o drains and when is it necessary? What are the causes of moisture variation in subgrade soil? How do you control excess moisture in subgrade soil due to subsurface sources of water? [2+2+4]  
b) Explain in brief about petroleum bitumen, cutback bitumen, and bitumen emulsion. How do you perform softening point test of bitumen and what is the use of this test? [4+3+1]
3. a) The centre line of a two lane road has an elevation of 320.00m. The camber of the pavement is 3.0% and cross-slope of shoulder is 5%. Calculate the elevation of pavement at centre of lane, edges of pavement and at road edge if [8]  
i) Straight line camber is to be provided.  
ii) Parabolic camber is to be provided.  
Take with of lane 3.5m and shoulder width as 1.5m.  
b) Define extra widening and its causes of providing and derive an expression of extra widening. [1+2+5]
4. a) What do you mean by tractive resistance, explain it is brief? [2+6]  
b) Calculate the minimum setback from centre line of road for a curve of radius 500m for a six lane road to ensure safe visibility. The stopping right distance is 200m, lane width is 3.5m and the curve length is 100m and not extra width is to be provided. [8]
5. a) Explain stopping sight distance and derive its expression. [2+6]  
b) A two lane pavement 7m in width in hilly region has a curve of radius 60m, the design speed is 40 kmph. Determine the length of transition curve, total curve length and total tangent length if the deflection angle of the curve is 60°. Take superelvation = 0.07, extra width = 1.2m, 1:N = 1:60. Assume that the rotation of pavement is about centre line. [4+2+2]
6. Write short notes on any four: [4×4]
  - a) Los Angeles Abrasion Test
  - b) Retaining Wall
  - c) Breast Wall
  - d) Slab culvert and its elements
  - e) Typical cross-section of hill roads
  - f) Modes of transportation

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

**Subject: - Transportation Engineering I**

- ✓ 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, describe the historical development of roads and road construction in Nepal. What is the current state of affair in road construction situation in Nepal? What are government's plans regarding this issue? [4+2+2]
- b) Define and describe the terms region, band, corridor and alignment with respect to the map study for highway route identification. [2+2+2+2]
2. a) Due to drainage problem, the inner edge cannot be lowered and a super elevation of 'e' is to be introduced. Explain with the help of a neat sketch, how do you obtain one way slope, e, from two way slope, n, where  $e > n$ . Given the road width is W m and the transition curve length is L m. [8]
- b) The centre line of a double lane road has an elevation of 320.50m as recorded from longitudinal profile. The camber is 2.5% and cross fall of shoulder is 5%. Calculate the elevation of road surface at the centre of lane, edges of pavement and road edges if (i) straight line camber is provided (ii) parabolic camber is provided. Take the shoulder width 1.5m and lane width 3.5m. [8]
3. a) Define extra widening. State the objectives of pavement widening on horizontal curves. Write down the formulate for total extra widening. What are the methods of providing extra widening on horizontal curves? [1+2+2+3]
- b) A transition curve needed to connect a circular section with a straight section of a highway. If the design speed of highway is 90 kmph and radius of the circular section is 300m. Determine the length of transition curve for comfort and for introducing super elevation at your suitably selected desirable rate. The width of pavement at straight section is 7m and length of the wheel base of the design vehicle is 6.1m. [8]
4. a) Define highway drainage. What are the requirements of a good highway drainage system? Explain how the surface water is collected and disposed off in rural, urban and hill roads. [1+3+4]
- b) Determine the actual grade along the centre line of the inner most and outer most lanes of the road with 15m wide carriage way long the circular curve of radius 75m if the grade along the centre line of the road is 5%. Do not consider the extra widening. The deflection angle at that point is  $45^\circ$ . [8]
5. a) What are the design and construction problems of hill road? How do the temperature, rainfall, pressure and geology of the region affect the selection of hill road alignment? [4+4]
- b) Describe in brief road rapids, drop structures, causeways and inverted siphons. Give sketches where ever possible. [2+2+2+2]
6. a) Distinguish between Aggregate Impact Value, Aggregate Abrasion Value and Aggregate Crushing Value. Why is it necessary to determine flakiness and elongation indices of an aggregate sample? [6+2]
- b) What do you mean by bituminous mixes? Describe in brief Marshall Stability Test for determining optimum binder content in bituminous mixes. [2+6]

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

*Subject: - Transportation Engineering I*

- ✓ 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) Describe different modes of transportation. Explain briefly the advantage and disadvantage of road transportation. [8]  
b) Define highway alignment. Explain the factors controlling highway alignment. [8]
2. a) What is overtaking sight distance? Derive an expression for overtaking sight distance with neat sketch. [8]  
b) A descending section of a road with 3% grade meets an ascending section with 4% grade. Design the vertical curve. The stopping sight distance requirement is 120m. Calculate the formation levels of main points on curve and at a distance of 30m both sides from the point of vertical intersection (PVI). The reduce level of PVI is 243.154m. Assume other data suitably. [8]
3. a) Derive an expression for finding minimum radius of valley curve with night visibility. [6]  
b) At a certain section of road there is an intersection point (IP) with an angle of  $45^{\circ}30'$  turning right. The minimum permissible radius is 200m. The distance between starting point and IP and IP to end point are 500 and 350m respectively. Calculate the elements of circular curve and chainages of main points of curve assuming the chainage of starting point is to be 20 + 416.60. [8]
4. a) Explain with neat sketches different typical types of cross sections in hill road. [8]  
b) Explain briefly about the route location in hill road design. [8]
5. a) Discuss the causes of moisture variation in sub-grade soil. Why drainage structures are important in road construction. [8]  
b) Explain with sketches how the surface water is collected and disposed off in the hill roads. [8]
6. a) Describe Marshal method of bituminous mix design procedure. [8]  
b) Enlist the various tests on road aggregates. Explain briefly the test procedure of crushing value of the aggregate. [8]

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

**Subject: - Transportation Engineering I**

- ✓ 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) Discuss in detail the classification of roads as per Nepal Road Standard (NRS) on the basis of traffic flow and service flow. [4+4]
  - b) Discuss the different pattern of Urban Network Planning with neat sketches. Explain briefly, the use of ring road helps to address the problem of city core congestion with neat sketches. [4+4]
  2. a) Define stopping distance. Enumerate the various factors affecting stopping distance. Explain the relationship between the stopping distance and stopping sight distance. [1+4+3]
  - b) The centre line of a double lane road has an elevation of 315.5m as recorded from longitudinal profile. The camber is 3.0% and the lane width is 3.5m. Find the elevation of the road at the edges of the pavement and the center of lane if (i) straight line camber is provided, (ii) parabolic camber is provided. [8]
  3. a) Define transition curve. Mention the need of introducing transition curve in horizontal alignment. Derive the different methods of designing the length of transition curve. [1+2+5]
  - b) How much should be the outer edges of the pavement to be raised with respect to the centre line on a two lane road designed for mix traffic at a speed of 80 km/hr on a horizontal curve of radius 200m if the super elevation is obtained by rotating the pavement with respect to the (i) centre line, and (ii) inner edge. [8]
  4. a) Why do we need to compensate grade in horizontal curves? Give three reasons. [4]
  - b) Design the total length of valley curve at the junction of a descending gradient 2.5% and the ascending gradient of 3.5% if the design speed is 80 kmph, so as to fulfill both comfort condition and head light sight distance for night driving. Locate the lowest point and determine its elevation if the elevation of beginning of the curve is 415.5m. Assume other suitable data if necessary. [12]
  5. a) Define highway drainage system. Describe the causes of moisture variation in subsurface soil. Explain with neat sketches how the surface drainage is provided to lower the water table, and control of seepage flow. [1+3+4]
  - b) What are the design and construction problems that are associated with hill roads? Enumerate the merits and demerits of river route and ridge route. [4+4]
  6. a) What do you mean by crushing value of aggregates? Describe the step by step procedure for determining crushing value of aggregates? Suggest the ranges of crushing value for aggregates in lower and in surface layers of the road pavement structures. [1+5+2]
  - b) Explain in brief about natural bitumen, cutback bitumen, bitumen emulsion and tar with their importance. [2+2+2+2]
  7. Write short notes on (any four): [4×4]
    - a) Telford Construction
    - b) Culverts
    - c) Hair Pin Bend
    - d) Aqueducts and Inverted Syphon
    - e) Factors Controlling Highway Alignment

Exam.	Back		
	Level	B.E.	Full Marks
			80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Transportation Engineering I**

- ✓ 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 briefly the various forms of urban road network system. How it is possible by the provision of Ring Road to minimize the congestion in the city core areas. [8]
  - b) What are the factors that controls the selection of highway alignment? Explain. [8]
2. a) What do you mean by super-elevation? Explain briefly in what conditions this super-elevation can be provided. [6]
  - b) The radius of horizontal circular curve is 100m. The design speed is 60 kmph. The coefficient of lateral friction is 0.17. [10]
    - i) Calculate the super elevation if full lateral friction is called into play.
    - ii) Calculate the coefficient of friction needed if no super elevation is provided.
3. a) Explain briefly the overtaking sight distance and the stopping sight distance. [6]
  - b) The speeds of overtaking and overtaken vehicles are 60 kmph and 30 kmph respectively on a two-way traffic road. If the acceleration of the overtaking vehicle is 3.6 kmph per second. [10]
    - i) Calculate the safe overtaking sight distance.
    - ii) Determine the minimum length of the overtaking zone.
4. a) What are the application of tangents, circular curves and transition curves in a horizontal alignment of a road. [8]
  - b) Calculate the length of the transition curve and the required shift, if the design speed is 60 kmph, the radius of the circular curve is 220m. And allowable rate of change of centrifugal acceleration is 60 cm/sec<sup>3</sup>. Allowable rate of change of super elevation is 1 in 120. The pavement width including extra widening is 7.2m. [8]
5. a) What are the general tests in order to quality the aggregate in highway construction? Explain briefly. [6]
  - b) Bitumen is a very important material for road construction. Explain what tests you will perform in order to judge the quality of the bitumen before using it in road construction. [10]
6. a) Describe the various types of retaining structures helped by neat sketches. [8]
  - b) What is the function of energy dissipating structures in a highway drainage system? [8]
7. Write short notes on: (any four) [4×4]
  - a) Classification of roads in Nepal
  - b) Tar and Bitumen emulsion
  - c) Retaining wall and Breast wall
  - d) Surface and sub-surface Drainage System
  - e) Los Angels Abrasion Test
  - f) Aquaducts and Inverted Siphon
  - g) Hair Pin Bends

01 TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division**  
 2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time "	3 hrs.

**Subject: - Design of Steel and Timber Structure (CE651)**

- ✓ 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.
- ✓ IS 800-2007, IS 875-1987, IS 883-1994 and Structural Steel Section Book is allowed to use.

1. a) Explain about grade and classification of structural steel as per Indian Standard. [8]  
 b) Design a single angle to carry a tension of 100 kN. The end connection is to done using M20 bolts of product Grade C and property class 4.6. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [12]
2. a) What are the basic assumptions of Working Stress Design method? [4]  
 b) Design column to carry an axial load of 1200 kN. The column is effectively held in position but not restrained against rotation at both ends. Design the column using two channels placed toe to toe if center to center distance between connections is 6 m. Design the column using lacing and Fe 410 steel. [16]
3. a) The building is to be constructed in core city area for a 50 years life, the size of the building is over 30 m. The height of the building is 36 m and is classified as 1<sup>st</sup> category building. Determine the wind pressure at the site and force on the truss. [10]  
 b) What do you mean by safety and serviceability requirements of steel structures? Explain it. [4]  
 c) Design a slab base for a column ISHB 350@ 710.2 N/m subjected to an factored axial compressive load of 1000 kN. Concrete pedestal of grade M20. [6]
4. a) Design a simply supported I-section to support the slab of a hall 9m×24m with beams spaced at 3 m c/c. The thickness of the slab is 100 mm. Consider a floor finish load of 0.5 kN/m<sup>2</sup> and live load of 3 kN/m<sup>2</sup>. The grade of the steel is E250. Assume that an adequate lateral support is provided to the compression flange. [12]  
 b) Design a built up salwood column fabricated with 50 mm thick and 250 mm width planks to carry an axial load of 925 kN. The effective length of the column is 3.5 m. Take  $E = 12700 \text{ N/mm}^2$ ,  $f_{cp} = 10.6 \text{ N/mm}^2$  constant  $U = 0.6$  and  $q = 1$ . [8]

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01 TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division**  
 2072 Magh

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

**Subject:** - Design of Steel and Timber Structure (CE651)

- ✓ 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: 800-2007, Steel Tables, IS: 883-1994 and IS: 875-1987 are allowed.
- ✓ Assume suitable data if necessary.

1. a) Design a suitable bolted bracket connections of a 12 mm thick bracket plate to the flange of a ISHB 300 @ 577 N/m to carry a vertical factored load of 600 KN at an eccentricity of 300 mm from face of column. Consider the eccentric load not lying in the plane of bolted joints. Use M24 of grade 4.6. [12]
- b) Find the ultimate design strength of angle 100×100×10 mm in tension which is connected to a gusset 12 mm thick through 100 mm leg using M20 bolts of product Grade C and property class 4.6 in single line. Assume that the bolt threads are outside the shear plane. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [8]
2. a) Design a built up column 10 m long to carry a factored axial compressive load of 1000 kN. The column is restrained in position but not in direction at both ends. Design the column with connecting system as lacing with bolted or welded connection. Use two channel back to back. Assume steel of grade Fe 410, E250 C and bolts toe to toe grade 4.6. [12]
- b) Design a slab base for a column ISMB 350 @ 52.4 kg/m to carry a service load of 850 KN. Assume Fe410 grade steel and M25 concrete. [8]
3. a) Design a simply supported beam of span 3.5 m subjected to a factored bending moment of 470 KN-m and factored shear of 180 KN. The beam is laterally unsupported. Steel grade of Fe 410. Check for web bucking, web crippling and maximum deflection is required. [14]
- b) Design a built up salwood column fabricated with 50 mm thick and 250 mm width planks to carry an axial load of 925 kN. The effective length of the column is 3.5 m. Take  $E = 12700 \text{ N/mm}^2$ ,  $f_{cp} = 10.6 \text{ N/mm}^2$  constant  $U = 0.6$  and  $q = 1$ . [6]
4. a) The bottom chord of a truss is subjected to an axial pull of 400 KN. The length of joint available is only 300 mm. Design the tension member using a single equal angle section with requirements of LUG ANGLE if necessary. Use M20 bolts of 4.6 grade and steel as Fe410. [12]
- b) The building is to be constructed in core city area for a 50 years life. The size of the building is over 30 m. The height of the building is 36 m and is classified as 1<sup>st</sup> category building. Determine the wind pressure at the site and force on the truss. [8]

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

**Subject: - Design of Steel and Timber Structure (CE651)**

- ✓ 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: 800-2007, IS: 875 (II) IS: 1730-1989 and IS: 809-1989 (Steel tables); IS: 883-1995, (Timber) are allowed.
- ✓ Assume suitable data if necessary.

1. a) ✓ In truss ISA  $90 \times 90 \times 12$  mm is subjected to the factored tension load of 100 kN. It is to be connected to a gusset using fillet welds at the toe and back. Find the length of welds required so that the centre of gravity of the welds lies in plane of the centre of gravity of angle. Fe410 [10]
- b) ✓ Find the ultimate load carrying capacity of 2 ISA  $100 \times 100 \times 8$  mm in tension which is connected to both sides of gusset plate 12 mm thick using M16 bolts of property class 5.6 in single line. One shear is in shaft and another is in thread. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [10]
2. a) ✓ A hall measuring  $15 \text{ m} \times 6 \text{ m}$  consists of beams spaced at 3 m c/c. R.C.C. slab of 110 mm is cast over the beam. The imposed load is  $4 \text{ kN/m}^2$ . The beam is supported on 250 mm wall. Design intermediate beam and check for shear, deflection and lateral stability. [15]
- b) ✓ Write about factor of safety and partial safety factors used in steel structures. [5]
3. a) ✓ Design a built-up column of the effective length of 5 m to carry an axial load of 900 kN using two channels and single lacing. Design the connections using bolt. The grade of the steel is Fe410. [14]
- b) ✓ Explain about elements of plate girders, web and flange splices of plates. [6]
4. a) ✓ A timber column  $225 \times 225$  in cross section having an unsupported length of 3 m. Assuming the column to be of sal wood of selected grade, find the safe axial load. [8]
- b) ✓ Find the design wind pressure on a sloping roof of span 10 m and pitch  $\frac{1}{4}$ . The height of the eaves is 6 m above ground. The building is situated in Madras and its permeability is normal. [6]
- c) ✓ Design a slab base for a column SC220 to transfer an axial load of 1000 kN. Take Fe410 grade steel and M30 for concrete. [6]

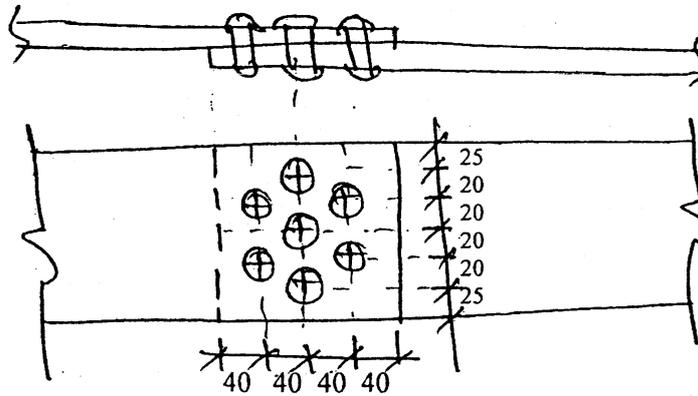
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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

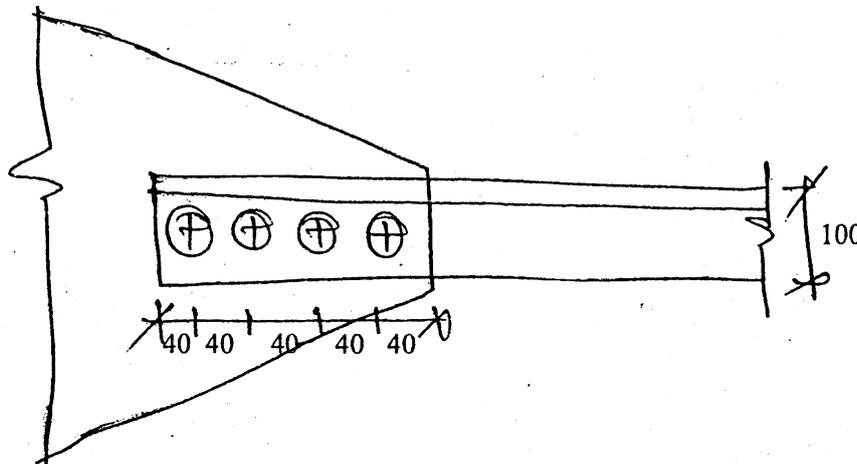
**Subject:** - Design of Steel and Timber Structures (CE651)

- ✓ 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:800-2007, IS1730-1989 and IS809:1989 (Steel tables); IS883-1995 (timber) are allowed.
- ✓ Assume suitable data if necessary.

1. a) Two plates of 16 mm thick are jointed by M16 bolts of property class 8.6 in a triple staggered lap joint as shown. Show how the joint will fail and calculate efficiency of the joint. Assume Fe410 grade of plate. [10]



- b) Longer leg of a ISA 100 × 75 × 8 is connected to a gusset plate of thickness 10 mm by M16 bolts of property class 8.8 as shown. If Fe410 grade steel is used, determine the design tensile strength of the angle. [10]



2. a) Design a simply supported I section to support a moment of 700 kNm. The beam is laterally supported and grade of steel is Fe410. [14]
- b) What do you mean by structural steel? Explain classification of structural steel sections. [6]
3. a) Design a bridge compression member using two channels placed back to back to carry a factorial load of 1200 kN, if effective length of column is 8.5 m. Also design the single racing system using tie bar. [5+7]
- b) Explain about design steps of column bases. [8]
4. a) A high rise building is to be constructed in Kathmandu at city area for a 50 year life, the size of building is over 30 m. The height of building is 36 m and it is classified as 1<sup>st</sup> category building. Determine the wind pressure at the site and force on truss members. [10]
- b) Design a 5 m long rectangular box column built by 60 mm thick deodar planks to carry an axial load of 350 kN. [10]

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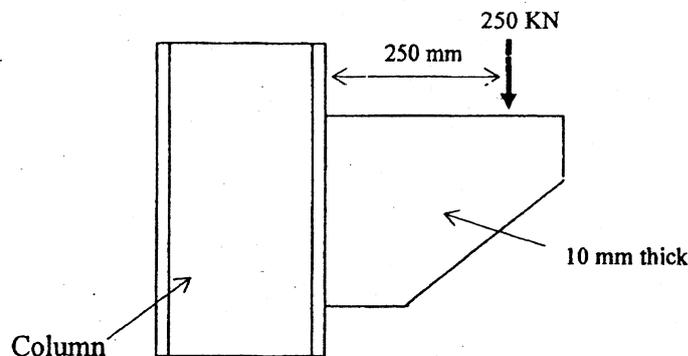
01 TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division**  
 2071 Magh

<b>Exam.</b>	<b>OLD Back (2065 &amp; Earlier Batch)</b>		
<b>Level</b>	BE	<b>Full Marks</b>	80
<b>Programme</b>	BCE	<b>Pass Marks</b>	32
<b>Year / Part</b>	III / II	<b>Time</b>	3 hrs.

**Subject:** - Design of Timber and Steel Structures (EG662CE)

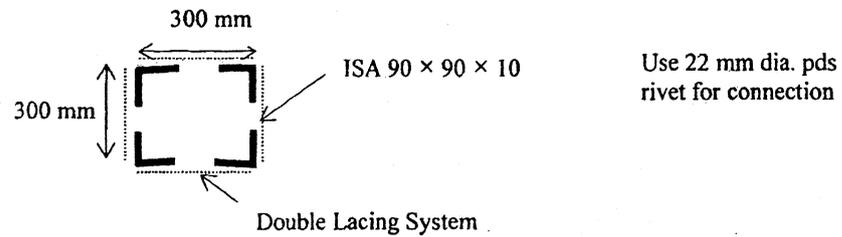
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.
- ✓ IS 800 - 1984, IS 875 - 1987, IS 883 - 1994 and Structural Steel Section Books are allowed to use.

1. a. Design welded connection between flange of column and a bracket using fillet and but weld loaded as shown in figure. [12]



- b. Design a fillet welded channel section to act as a tension member carrying an axial tension of 350 kN [8]
2. a. Design a column splice for column sections ISSC 250 and ISSC 220 carrying a load of 500 kN. [7]
- b. Design a simply supported beam with a clear span of 5m for bending and shear. Beam carries a uniformly distributed load of 40 kN/m inclusive of self-weight and a point load of 60 kN at mid span from sub beam. The beam is laterally unsupported. [13]

3. Find load carrying capacity of the column made up of four rolled steel angle sections ISA  $90 \times 90 \times 10$  as shown in fig. Take height of the column 11m, one end of the column fixed, other end hinged and no sway condition. Also design lateral bracing of column using double lacing system. [20]



4. a. Design a timber column of Sal species to carry the axial load of 45 KN. Unsupported length of column is 3m. [10]
- b. What are the different factors, which govern the design of beam? Specify the types of timber columns according to their slenderness ratio. How the slenderness ratio is defined in solid, built-up and spaced column. [10]

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

**Subject: - Design of Steel & Timber Structure (CE651)**

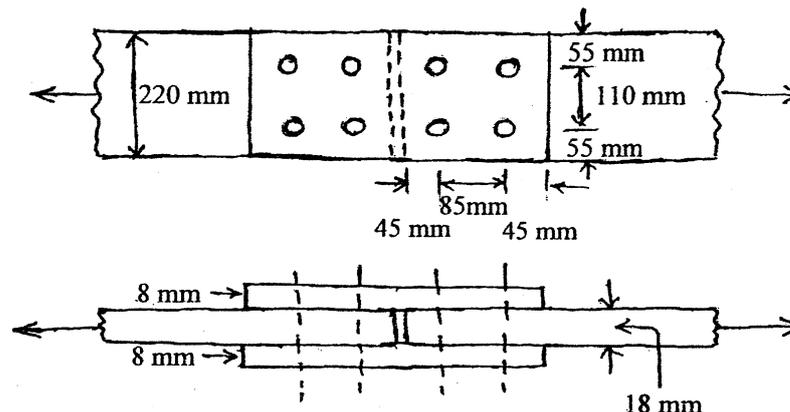
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ All questions carry equal marks.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Show the results with sketches when and where required.
- ✓ IS 800 : 2007 (Code of Practice for general construction in steel), Steel section book, IS 875 and IS 883 : 1994 (Design of Structural Timber in Building) are allowed to use.
- ✓ Assume suitable data if necessary.

1. a) A bridge compression member is built using two channels ISLC 400 @ 45.8 kg/m placed toe to toe. The effective length of the member is 8.0 m. The width over the backs of two channels is 40 cm. The channels are properly connected by lacings. [12]
  - i) Calculate the safe load for the member.
  - ii) Design the lacing systems using M16 properly class 4.6 grade bolts.
- b) Design the base plate for the column ISHB 450 to carry a factored load of 1400 kN. Take E250 grade of steel and M20 grade of concrete. [8]
2. a) A office hall of clear dimension 18 m × 6 m is provided with 12 cm thick RC slab over rolled steel beams 3 m c/c. A wearing coat of 2 cm thick lime concrete is provided over RC concrete slab. The compression flange would be supported throughout its length by providing grooves in slabs. Design an intermediate beam with the following data. [14]
 

Live load = 5.5 kN/m<sup>2</sup>

Unit wt. of cement concrete = 25 kN/m<sup>3</sup>

Unit wt. of lime concrete = 18 kN/m<sup>3</sup>
- b) Find the design wind pressure on a sloping roof of span 10 m and pitch 1/4. The height of the eaves is 5 m above ground. The building is situated in Delhi and its permeability is normal. [6]
3. a) Two 18 mm thick steel flats are spliced by two 8 mm thick plates with four M18 high strength bolts of property class 10.9. Determine the ultimate design load carrying capacity of the connection (i) if slip is permitted at the ultimate load and (ii) if slip is not permitted at ultimate load. Assume that one shear plane intercepts the threads of the bolts.  $f_y = 250$  MPa and  $f_u = 410$  MPa. [14]



- b) Explain why limit state design method has become more popular than the working stress design method. [6]
4. a) Design a suitable angle section to carry a tensile force of 250 kN (Factored). The end connection is to be done by using (i) fillet welds (ii) bolts. The yield and ultimate strengths of the steel are 250 MPa and 410 MPa, respectively. [12]
- b) Differentiate between the terms "factor of safety" and "partial safety factor" in the structural steel design. Design a circular salwood column to be used in an open shed, to carry an axial load of 200 kN. The column is 3.5 m high. [8]

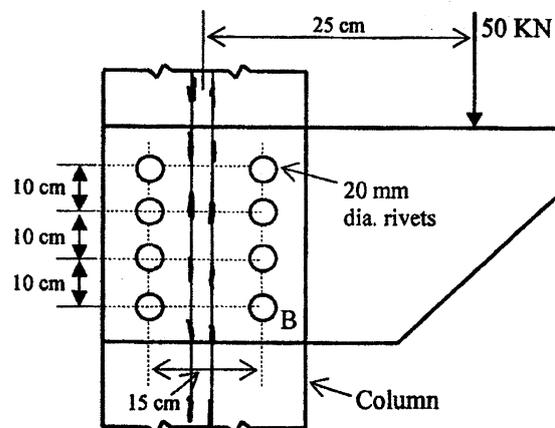
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Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Design of Steel and Timber Structures (EG662CE)**

- ✓ 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: 800-1984; IS: 1730-1989 (Steel Tables); IS: 883-1995 (Timber) and IS: 875 are followed.
- ✓ Assume suitable data if necessary.

1. Discuss briefly the principles of working stress design of steel structures. (6)
2. Determine the resultant stress on the rivet B of the eccentric connection shown in figure below. Compare this stress with the allowable rivet value if 20 mm dia. rivets are used. The bracket plate and column flange are both 10 mm thick, and allowable stresses of  $102.5 \text{ N/mm}^2$  in shear and  $236 \text{ N/mm}^2$  in bearing may be assumed. (14)



3. A strut in a roof truss carries 80 kN maximum compressive load. Design the member and the end connection if it is to be of single angle section. The centre to centre distance of the member between the fastenings is 3.5 m. (14)
4. Explain, with a neat sketch, the various components of a plate girder. (6)
5. A column is made of one ISHB 300 @58.8 Kg/m, with one plate  $400 \text{ mm} \times 12 \text{ mm}$ , symmetrically placed on each flange. The column section thus measures  $324 \text{ mm} \times 400 \text{ mm}$  overall. The column carries an axial load of 2000 kN. The column is to be provided with a base plate resting on concrete base. Design the base plate giving the full details of the connections. Take safe compressive stress in concrete as  $4 \text{ N/mm}^2$ . (14)
6. Describe the procedure for the design of the purlin of a roof truss. (6)
7. Design one sal timber joist of clear span 3.5 m at spacing of 60 cm in a roof. The bearing at each end is 12 cm. The dead load of roof covering is  $2.1 \text{ kN/m}^2$  and live load is  $2.6 \text{ kN/m}^2$ . (12)
8. Design a tension member using a channel section to carry an axial tension of 300 kN. (8)

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

**Subject:** - Design of Steel and Timber Structure (CE651)

- ✓ 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**.
- ✓ Show the results with sketches when and where required.
- ✓ IS 800 : 2007 (Code of practice for general construction in steel), Steel section book, IS 875 and IS 883 : 1994 (Design of structural Timber in Building) are allowed to use.
- ✓ Assume suitable data if necessary.

1. a) Design a single angle (unequal angle) to carry a working tensile load of 150 KN, If the end connection is done using fillet welds. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [10]

b) Design a single equal angle to carry a compression of 50 KN. The centre to centre distance between the end connections is 2.0 M. Assume that at least two bolts are used for the end connections. [10]

2. a) A building is situated in Birgunj, where the basic wind speed is found to be 60 m/sec. Find the wind pressure for the design of sloping roof of the building having following data: [6]

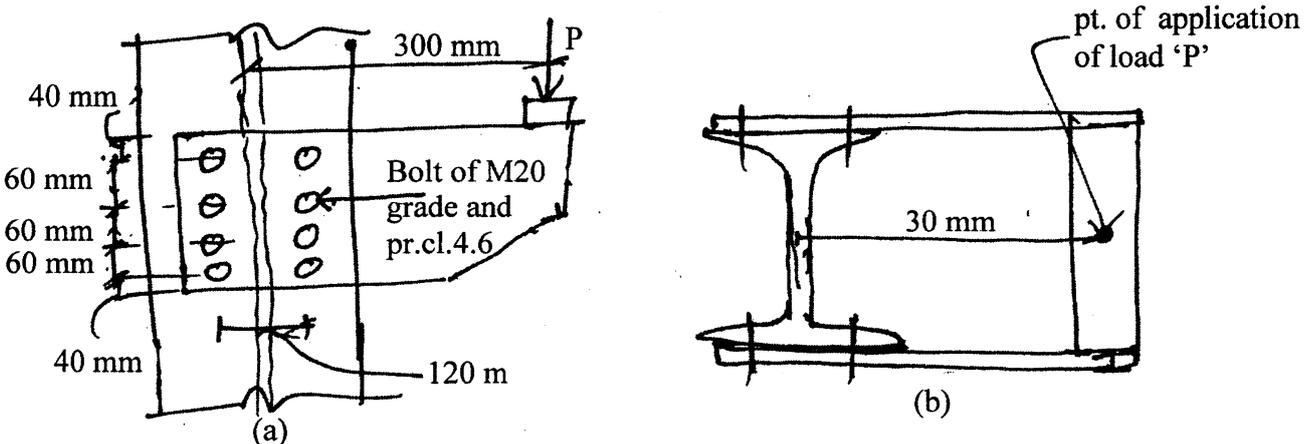
Angle of slope of roof,  $\alpha = 28^\circ$   
Building height ratio,  $h/w = 0.75$   
 $K_1 \times K_2 \times K_3 = 0.70$

b) A simply supported steel beam of 6 m effective span carries a total uniformly distributed load of 46 KN/m (inclusive of self-weight). Design the beam (Fe 410 steel) if the compression flange is restrained throughout the span against lateral bending. Apply all the necessary checks. [14]

3. a) Explain the advantages and disadvantages of steel structures compared to timber structures. [4]

b) Explain in salient features of the working stress method and limit state method for structural steel design. [4]

c) If two bracket plates are connected to the flanges of the column SC 250 as shown in figure below find the design load 'P' that can be applied at an eccentricity of 300 mm. [12]



4. a) Design a deodar column 4 m long to carry an axial load of 300 kN. [10]

b) Design the foundation base for an ISHB 350 column to carry factored load of 120 KN. Assume steel and M20 concrete. [10]

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**Examination Control Division**  
2069 Poush

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

**Subject:** - Design of Steel and Timber Structures (CE651)

- ✓ 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.
- ✓ Use of IS:800-2007, Steel Tables, Is:883-1994 and IS 875-1987 are allowed.

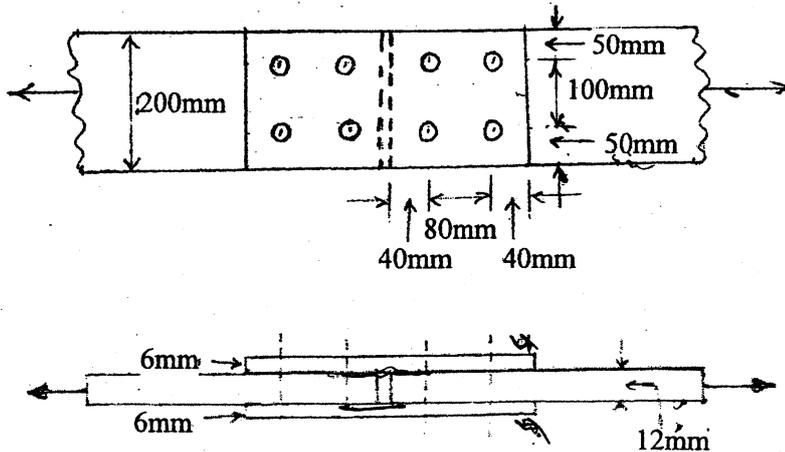
1. a) Design an I-section purlin for a trussed roof from the following data:

[8]

Span of roof = 12m  
Spacing of truss = 5m  
Spacing of purlins along slope of roof truss = 2m  
Slope of roof truss = 1 vertical, 2 horizontal  
Wind load on roof surface normal to roof = 1000N/m<sup>2</sup>  
Vertical load from roof sheets, etc = 200N/m<sup>2</sup>

- b) Two 12mm thick steel flats are spliced by two 6mm thick plates with four M16 bolts of the product grade C and the property class 4.6. Determine the ultimate load carrying capacity of the connection and check cover plate. Take  $f_y = 250\text{MPa}$  and  $f_u = 410\text{MPa}$ .

[12]



2. a) Design a laced column 10m long to carry an axial load 800KN. The column is restrained in position but not in direction at both ends. Design the lacing system with welded connections. Design column for channel section placed back-to-back.

[16]

- b) Briefly describe about the nail joint used in timber structures.

[4]

3. a) What are the basic assumptions in working stress method of steel design. Also mention its demerits.

[2+2]

- b) Design a simply supported beam of 6 meter span carrying a reinforced concrete floor capable of providing lateral restraint to the top compression flange. The total UDL is

made up of 80KN dead load including self weight plus 120KN imposed load. Checks for sheat deflection and lateral stability are also necessary. [16]

4) a) Select a suitable angle section to carry a factored tensile force of 170KN assuming single row of 20mm dia bolts take bolt grade 4.6 and E250 grade of steel. [6]

b) How the steel sections are classified according to their moment rotation capacity. [4]

c) A column ISHB 300@ 576.8N/m is to support a load of 1000KN. The column section is to be spliced at height of 2 m. Design the splice plate using 4.6 grade bolts and Fe 410. [10]

5. a) Design a built up salwood column fabricated with 50mm thick and 250mm width planks to carry an axial load of 800KN. The effective length of column is 3.5m. Take  $E = 12700\text{N/mm}^2$ ,  $f_{cp} = 10.6\text{N/mm}^2$  constant  $U=0.6$  and  $q=1$ . [8]

b) Design one of the intermediate Deodar timber joists used in the timber roof of a hall from the following data:

Spacing of joists C/C = 50cm

Clear span of the joist = 2.0m

Bearing at each end = 8.0cm

Dead load of roof covering =  $2\text{KN/m}^2$

Superimposed load on roof =  $1.5\text{KN/m}^2$

The roofing material consists of wooden planks which support asbestos sheets. The timber is of standard grade and shall be used in inside location. [12]

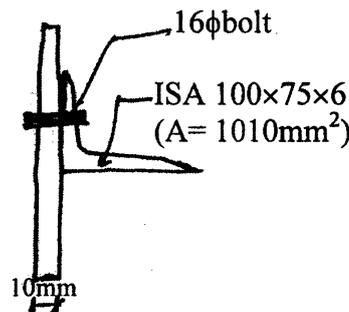
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Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: -Design of Steel and Timber Structural (CE651)**

- ✓ 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.
- ✓ Use of IS:800-2007, Steel tables: IS 883-1994; IS 875:1987 (timber) are allowed.

1. a) Design a double cover butt joint to transmit a working load of 300KN to connect two flats 100mm wide and 20mm thick using M16 high strength bolts of property class 10.9 if slip is permitted at design load. The cover plates are 12mm thick. Assume that one shear plane intercepts the threads of the bolts. [10]
- b) The center to center distance between the end connections of a discontinuous strut consisting of two L75 75×8 is 3.0m. Calculate the design load carrying capacity in compression if angles are connected to the same side of a gusset by more than one bolt in each angle. The grade of the steel is E250. [10]
2. a) Find the design wind pressure on a slopping roof of span 10 meter and pitch  $\frac{1}{4}$ . The height of eaves is 5 meter above ground. The building is situated in Delhi and it's permeability is normal. Assume  $K_1 = 1$ ;  $K_2 = 0.8$ ;  $K_3 = 1$ . [6]
- b) Design a built-up column of the effective length of 6m to carry an axial load of 1000KN using two channels and laces. Design the connections using welds. The grade of the steel is E250C. [14]
3. a) A beam of effective span 6.0m carries a uniformly distributed load of 30KN/m with a concentrated load of 16KN at mid span. The depth of the beam is limited to 300mm. Design the beam with additional plates to the flanges. Assume that the beam is laterally supported throughout. The grade of steel is E250. M16 bolts of property class 4.6 and product grade C may be used for connection. Checks for shear, deflection and lateral stability are necessary. [16]
- b) Discuss briefly the different types of limit states in steel design. [4]
4. a) Design the base plate for a ISHB 350 column to carry factored load of 1200KN. Take E250 grade of steel and M20 grade of concrete. [10]
- b) A single unequal angle 100×75×6 is connected to a 10mm thick gusset plate at the ends with six 16mm diameter bolts to transfer tension as shown in figure below. Determine the design tensile strength of the angle assuming that the yield and the ultimate stress of steel used are 250MPa and 410MPa if the gusset is connected to the 100mm leg. Also design connection for its full capacity. [10]



5. (a) Describe design methods and design basis for timber structure. [4]
- (b) Design a 4m long square column of deodar planks to carry an axial load of 350KN. Take outside location and select grade of timber. [12]
- (c) Explain simple timber beam and flitched beam with neat sketches. [4]

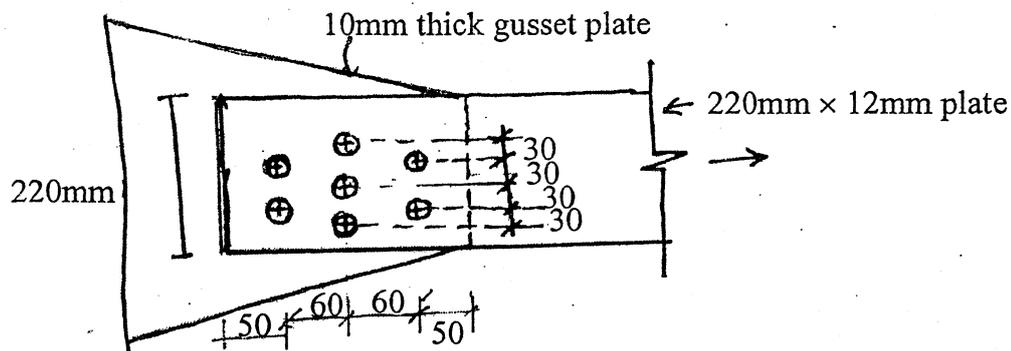
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Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

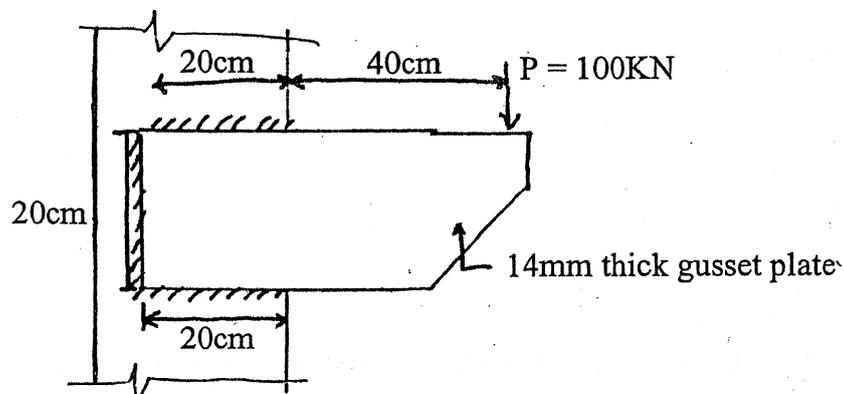
**Subject: - Design of Timber and Steel Structures**

- ✓ 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**.
- ✓ IS 800, IS 875, IS 883 and structural steel selection book is allowed to use.
- ✓ Assume suitable data if necessary.

1. a) A flat plate (220mm × 12mm) is loaded in tension and connected with 10mm thick gusset plate as shown. If the rivets are 20mm dia power driven shop rivets, calculate the maximum tension the flat can carry. [14]



- b) Describe the horizontal load resisting system in steel structure building. [6]
2. a) For the electric connection as shown, determine whether the joint is safe or not. Size of the fillet weld is 8mm and load P is equal to 100kN. Assume that permissible shear stress in the weld is 108 MPa. [14]



- b) For a steel of yield stress as  $f_y$ , what are the permissible stresses in tension, compression, bending, shear and bearing according to IS 800? [6]
3. a) Design a column to carry an axial load of 800kN using two channels laced together. The length of the column is 6m and is effectively held in position at both ends but not restrained against rotation. [14]
- b) Describe the process to find thickness of slab base foundation. Show the sketch. [6]

4. a) Design a beam of 6m span carrying UDL of 20KN/m including self wt. The beam is laterally restrained by a concrete slab and is simply supported at the ends on wall of 350mm width. Check for shear, deflection, web crippling and buckling. [14]
- b) Derive a relation for economical depth of a girder. [6]
5. a) Design a purlin using suitable section for a roof-truss. Span of roof = 10m, spacing of truss is 4m and pitch is 1/4. Assume vertical load of 500N/m (including self wt) and wind load 2 KN/m. [10]
- b) If a sal-wood column of 25cm × 25cm has a length of 4m, determine whether the column can carry 200KN axial load and 20KNm bending moment. Assume suitable data if necessary. [10]

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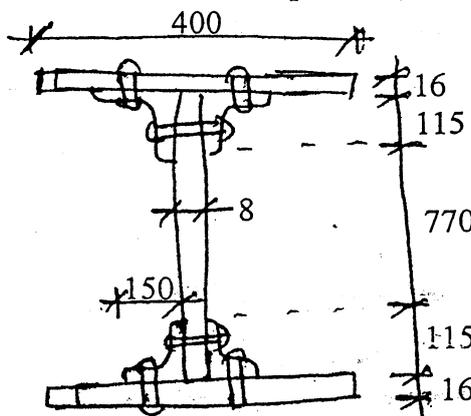
Exam.	Regular / Back		
	Level	BE	Full Marks
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Design of Timber and Steel 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**.
- ✓ IS 800, IS 875, IS 883 and structure steel section are allowed to use.
- ✓ Assume suitable data if necessary.

1. a) List the hot rolled steel sections used in practice with sketches. Also discuss the uses of structural steel in building structure. [6]
- b) A 20mm thick plate is jointed by double cover butt joint using a 12mm thick cover plate. The steel of main and cover plate have permissible tensile strength of 150MPa. Determine the strength and efficiency of the joint per pitch of 90cm if 20mm dia close tolerance and turned bolts of property class 5.6 are used. [14]
2. a) Describe the types of weld used in structural joints with sketches. [7]
- b) Design a lap joint for two plates of size 120×10mm and 120mm × 12mm. The permissible stresses for plate in tension and weld are 150 MPa and 108 MPa respectively. [13]
3. a) In a truss bridge, a diagonal consists of a 14mm thick flat carrying a pull of 400KN and connected to a gusset plate by a double cover butt joint. The thickness of each cover plate is 8mm. Determine the number of rivets and width of flat required. [10]
- b) Design a single unequal angle strut to carry a load of 100KN. The angle is connected by its longer leg to a 10mm thick gusset plate. Design if it is connected by two rivets. The length of member is 3m. [10]
4. a) Find the wind pressure for design of a sloping roof of span 10m and pitch 1 in 4. The height of eaves is 5 m above ground. Assume building permeability as normal and  $K_1 = 1.0$ ,  $K_2 = 0.8$  and  $K_3 = 1.0$  [6]
- b) A hall of clear dimensions 15m × 6m is provided with 15cm thick concrete slab over rolled steel beam spaced at 3mc/c. A wearing coarse of 2cm thick cement sand punning is proceeded over concrete slab. The compression flange would be supported throughout its length by providing grooves in the slab. Design an intermediate beam with following data. Live load = 4KN/m<sup>2</sup>, unit wt. of concrete = 24KN/m<sup>3</sup>, unit wt. of punning = 22KN/m<sup>3</sup>. Also check the above beam for web crippling and web buckling. [14]
5. a) Design a solid wood column to resist an axial load of 45KN and moment of 5KN-m. The column is made of sal wood and is 2m long. [10]
- b) Design a web splice for the plate girder section, if the moment and shear force applied at the section are 1500KN-m and 200KN respectively. [10]

Dimension in mm.

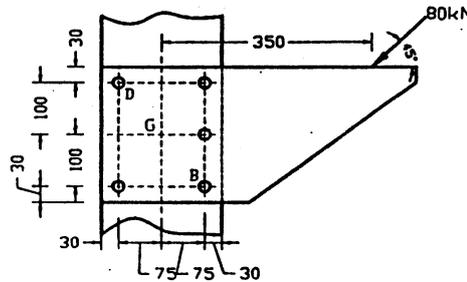


Exam. Level	Regular/Back		
	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

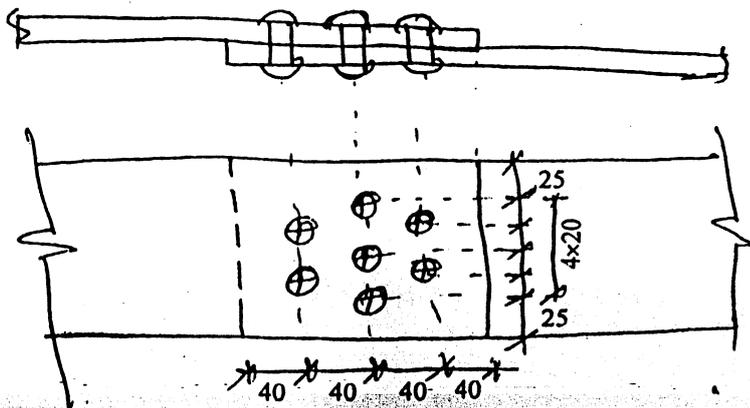
**Subject: - Design of Timber and Steel Structures**

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

1. a) Describe physical and mechanical properties of mild steel grade structural steel. Also draw the stress-strain curve showing important points. [6]
- b) In the given eccentric riveted connection, subjected to a load of 80 kN, find the resistance offered by the rivet D. [14]



2. a) Explain the salient features of the working stress method and limit state method for structural steel design. [6]
- b) An angle section ISA 50 × 30 × 5 mm is used as a tension member with its longer leg connected by one 14 mm dia. rivet. Calculate tensile strength of the member. What will be its strength if it is fillet welded? Take  $\sigma_{at} = 150$  MPa. [14]
3. a) Explain about loads and its combination for roof trusses. [6]
- b) Design a square column 4 m long to carry an axial load of 250 kN and moment of 5 kN-m. Assume I-grade timber of group A. [14]
4. a) Design a built-up column composed of two channels placed back to back, carrying an axial load of 1000 kN. Effective length of column is 6.0 m. Also design the single lacing system for it. [10]
- b) A beam simply supported over an effective span of 6 m, carries a uniformly distributed load of 70 kN/m, inclusive of its own weight. The depth of the beam is restricted to 500 mm. Design the beam, assuming that the compression flange of the beam is laterally supported by floor construction. Take  $f_y = 250$  N/mm<sup>2</sup> and  $E = 200$  GPa. Assume width of support = 200 mm. [10]
5. a) Write short notes on: [6]
  - i) Plate girder
  - ii) Eccentrically loaded column
  - iii) Group and grade of structural timber
- b) Two plates 10 mm thick are jointed by 20 mm diameter power driven field rivets in a triple staggered riveted lap joint. Show how the joint will fail and how much load can be transmitted through the joint. [14]

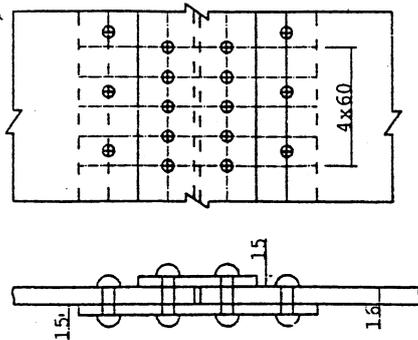


EXAM.	DATA		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

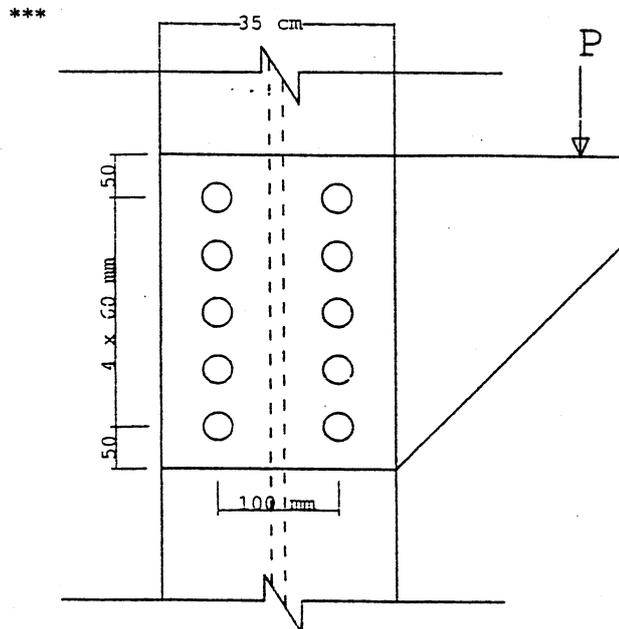
**Subject: - Design of Timber and Steel Structures**

- ✓ 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**.
- ✓ **Necessary figures are attached herewith.**
- ✓ IS 800-1994, IS 875-1987, IS 883-1994 and Structural Steel Section Book is allowed to use.
- ✓ Assume suitable data if necessary.

1. a) Explain the physical meaning of radius of gyration and buckling of compression member. [6]
- b) A double riveted double cover butt joint with the one cover plate wider than the other is shown in figure. If 20mm diameter rivets are used at a pitch of 60mm in the inner row and at a pitch of 120mm in the outer row, calculate the strength and efficiency of the joint, The permissible stress, are:  $\tau_{vf} = 80 \text{ N/mm}^2$ ;  $\sigma_{pf} = 270 \text{ N/mm}^2$ ;  $\sigma_{at} = 150 \text{ N/mm}^2$ . (See figure) [14]
2. a) Design a fillet welded end connection for a tension member ISA 125×75×8mm connected by longer leg to 10mm thick gusset plate. Assume that the steel conforms to IS: 226-1975. [10]
- b) A bracket plate 12mm thick transmits a load of 180 kN at an eccentricity of 25cm to a column section SC 250 through 10-22mm dia. power-driven shop rivets arranged as shown. Check the safety of the joint. (See figure) [10]
3. a) A secondary beam ISLB 400 @ 56.9 kgf/m is to be connected to the web of a main beam ISLB 600 @ 99.5 kgf/m. the end reaction of the secondary beam is 160 kN. Design the connection using 20mm dia pds rivets. [10]
- b) Design a I-section purlin of a roof truss spaced at 6m c/c. The slope of the roof is 30°. The 10m wide building is situated in Birgunj. Purlin is to be placed at an spacing of 1.2m c/c. Take basic wind speed 200 kmph,  $k_1 = 1.05$ ,  $k_2 = 1.15$ ,  $k_3 = 1.0$ . [10]
4. a) What is meant by efficiency of a joint? How the efficiency of the riveted joint can be increased, explain with reasons. [4]
- b) A bridge compression member is built using two channels ISLC 400 @ 45.7 kgf/m placed back to back. The effective length of the member is 8m the width over the backs of the channel is 30cm. The channels are properly connected by lacings. (i) Calculate the safe load for the member. (ii) Design the lacing system. [16]
5. a) Derive the expression for the economic depth of plate girder. [9]
- b) A timber beam having a clear span of 6 meters carrying a uniformly distributed load of 15 kN/m, excluding self weight of the beam. Assuming the beam to be made of sal wood, design the beam. [11]



Q.No.1. (b)



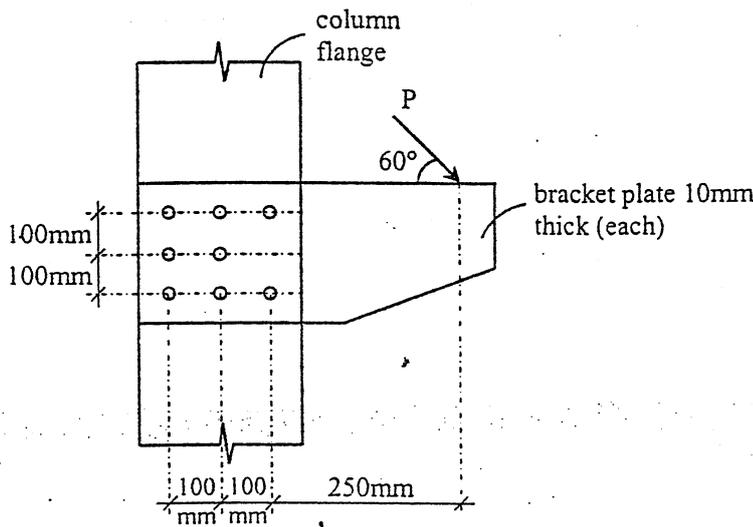
Q.No.2. (b)

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

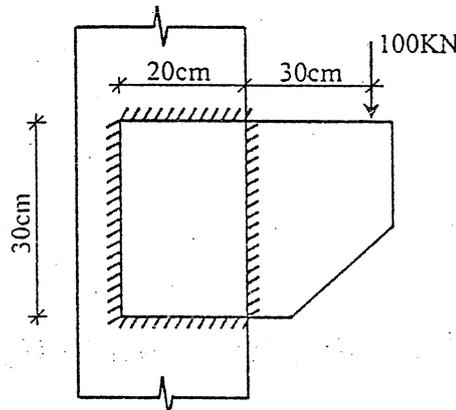
**Subject: - Design of Timber and Steel Structures**

- ✓ 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**.
- ✓ Indian Standard Code of practices IS:800; Steel Tables and IS:883 are allowed to use.
- ✓ Assume suitable data if necessary.

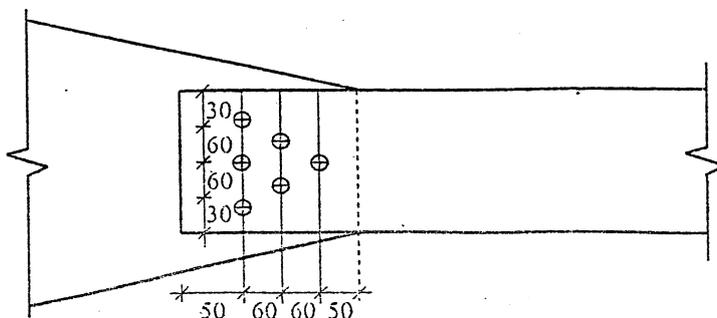
1. a) What are the assumptions of riveted joint? Explain them. [6]
- b) Find the maximum load inclined at  $60^\circ$  to the horizontal (as shown in fig.) the rivet connection can transfer. 20mm $\phi$  power driven shop rivets are used for connections. The bracket plates are attached on both sides of the column flanges. [14]



2. a) Calculate the size of the weld required for the welded bracket loaded as shown. The bracket is welded to flange of I-section by side fillet weld on four sides as shown. [10]



- b) A flat of size 180x10mm is used as tension member in a roof truss. It is connected to a gusset plate by riveting as shown in figure. Calculate the maximum tension the member can carry. The permissible stress in flat is  $150 \text{ N/mm}^2$  and 18mm $\phi$  pds rivets are used. Find also efficiency of the joint. [10]

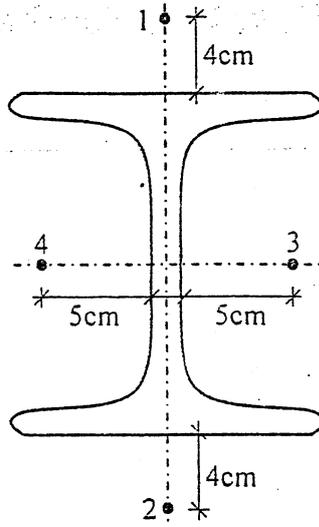


3. a) Explain the steps for design of gusseted base for a column. [8]

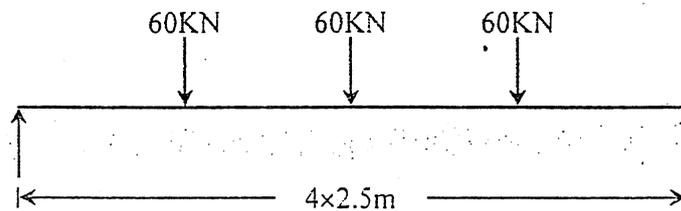
b) Design a column of a height 5m for intermediate floor. The load from upper floor is 320 KN. The column is connected to four beams transferring load as follows. [12]

Beam 1 = 140 KN      Beam 2 = 120 KN      Beam 3 = 55 KN      Beam 4 = 160 KN

The column can be assumed as effectively held in position and restrained against rotation at both ends.



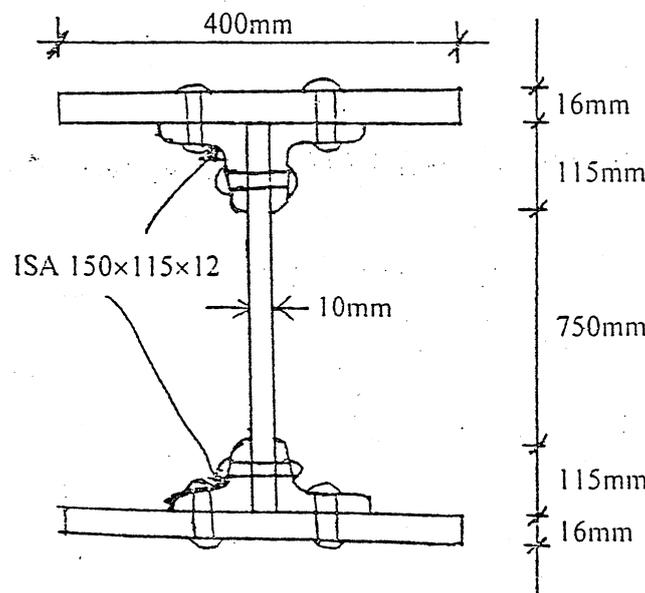
4. a) Design a main floor beam supporting three equidistant floor joist over a span of 10m. Each joists provide lateral restraint to main beams and transmits a load of 60KN on the main beam. [12]



b) Describe the steps for the design of purlins for a sloped roof. [8]

5. a) A compression member is made of 150mm×150mm deodar wood. The member is 2m long. The member is subjected to a compressive load of 16.5KN and a bending moment of 800 N-m. Calculate the safety of the design. Assume appropriate conditions if needed. [10]

b) Design web splice type-II for a plate girder section shown in figure, if the moment and shear force applied at the section are 1500 KN-m and 200 KN respectively. [10]



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

**Subject:** - Design of Timber and Steel 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:800-1984; IS:1730-1989 and IS:808-1989 (steel tables); IS:883-1970 or 1995 (Timber) are allowed.
- ✓ Assume suitable data if necessary.

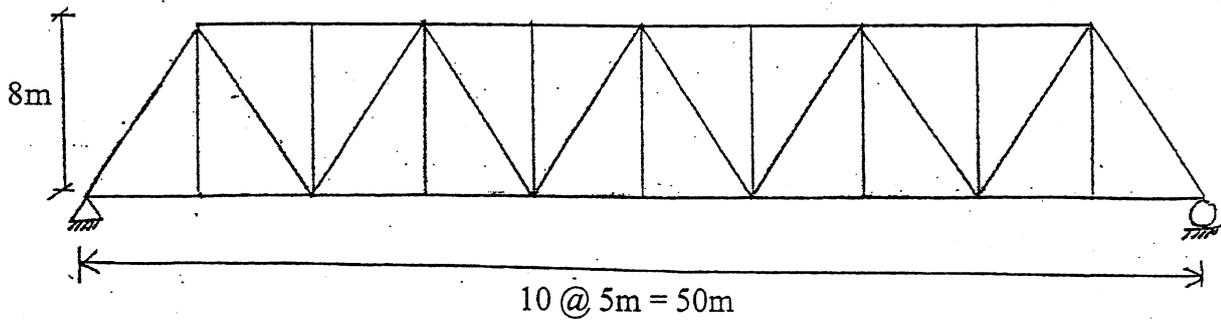
1. a) List the advantages and disadvantages of steel structures. [6]
- b) A beam ISMB 550 rests on 250mm thick brick masonry walls on either side. The clear span of beam is 7.85m. Calculate its effective span. Two floor joists transmit the floor load at a distance of 2.7m from each end of the effective span. Determine the safe load which the two floor joists can transmit individually on the beam. The beam is to be considered effectively restrained laterally by the floor joists. Consider the self weight of the beam in the analysis. Take  $f_y = 250$  MPa. [14]
2. a) Explain in brief the four methods of design stated in the design code for the steel framework design. [8]
- b) Design an unequal angle section as a tension member 2m long and with axial tension force of 150KN. Use 12mm thick gusset plate and power driven shop rivets for connection design. Provide check for stress reversal. [12]
3. a) What are the different types of failures of a rivet in case of riveted joint? Explain with sketches. [6]
- b) Design a slab base for concentrically loaded column section consisting of one SC 220 with two cover plates 250×25mm carrying an axial load of 2000KN. The safe bearing capacity of soil is 250KN/m<sup>2</sup> and the permissible bearing pressure on concrete is 4 MPa. Provide nominal cleat angle with 20mm power driven shop rivets. Design also the concrete base for it. [14]
4. a) Design a full penetration butt weld to connect a 14mm thick bracket plate to the flange of the column SC 180. The bracket is to transmit a load of 120KN at an eccentricity of 200mm (from the axis of the column) and the steel conforms to IS:226-1975. Consider permissible bending stress in weld as 165 MPa and the permissible equivalent stress as 90% of the yield stress of the steel. [10]
- b) Check the safety of a square column 200mm×200mm in cross-section. The effective length of column is 3m. The axial load and bending moment in the column is 25 KN and 2KN.m respectively. The material is timber sal wood and the column is located inside the building. [10]
5. a) List all the components of a plate girder and indicate them in a drawing. Explain how theoretical cut-off points of flange plates can be carried out graphically? [5+5]

b) The figure below shows a bridge truss of span 50m and height 8m. The two trusses constituting the bridge truss girder are spaced 7m c/c. Estimate the wind load across the bridge if the basic wind speed of the locality is 50 m/sec. The width of the members across the wind is as follows:

[10]

- i) Bottom and top chords = 500mm
- ii) Verticals = 350mm
- iii) Diagonals = 400mm
- iv) Gusset plates = 15% of total area of the top and bottom chords only.

Calculate solidity ratio and framing ratio. Take design wind speed factors  $K_1 \times K_2 \times K_3 = 1.1$ ; wind force coefficient  $C_f = 1.8$  for calculated solidity ratio; wind shielding factor = 0.9 for calculated solidity ratio and framing ratio.



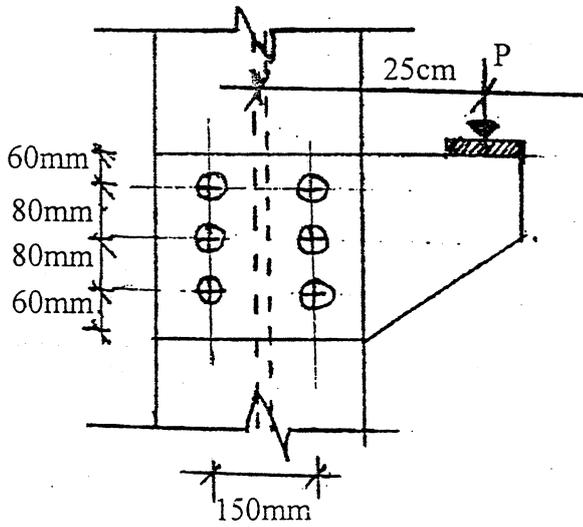
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Exam. Level	Regular / Back		
	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

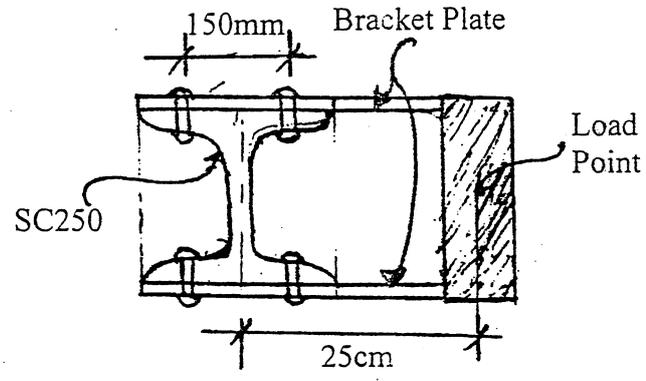
**Subject: - Design of Steel and Timber Structures**

- ✓ 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**.
- ✓ IS 800-1984; IS 883-1970 or 1995; IS 875-1987 and structural and steel section book are allowed to use.
- ✓ Assume suitable data if necessary.

1. a) Differentiate the riveted joint in comparison to welded joint. State the types of failure of riveted joints with sketch. [5+5]
- b) Bracket plate shown in figure consists of pair of mild steel plates  $f_y$  250 MPa riveted to both flanges of a ISLB 300 column. If 20mm dia. power driven shop rivets are used, calculate the maximum load 'P' the bracket can support. The thickness of each bracket plate is 10mm. [10]



**Elevation**



**Sectional Plan**

2. a) Design an unstiffened seated connection for a beam MB 400 transmitting and reaction of 150 KN to the flange of a column section SC 250. Also explain web crippling. [9+4]
- b) A tie member of length 1.6m long in a roof truss has to carry an axial tensile load of 130KN. Design an unequal angle section transferring the load through a joint with the longer leg. (Design of connection not required.) [7]
3. Design a bridge compression member consisting of two channels placed toe-to-toe. The length of member is 8m. It carries a load of 1350KN. Channels are connected by battens. Design the batten system also. [20]
4. a) Critically explain various types of simple beam end connections with sketches. [6]

b) Design the following elements of a plate girder of span 20m (effective) under an uniformly distributed load of 60KN/m including self weight. Elements to be designed: web plate, flange plates, connections between flange and web. Also specify whether stiffeners are required. Adopt steel with  $f_y$  250 MPa. (Compression flange of the beam is laterally restrained)

[14]

5. a) Design a purlin for a trussed roof from the following data using steel rolled section with  $f_y = 250$  MPa.

[8]

span of roof = 10m;

truss spacing = 4.0m;

spacing of purlins along the slope = 2.6m;

slope of the roof =  $20^\circ$ ;

wind load on roof surface =  $800 \text{ N/m}^2$ ;

vertical load (dead + live) =  $600 \text{ N/m}^2$ .

b) Teak wood floor beams are used at spacing of 3m centres. The span of the beam is 5m. The dead load of span is  $3 \text{ KN/m}^2$  and live load  $2 \text{ KN/m}^2$ . Design the beam if end bearings are 25cm at both ends. Assume necessary data if required.

[12]

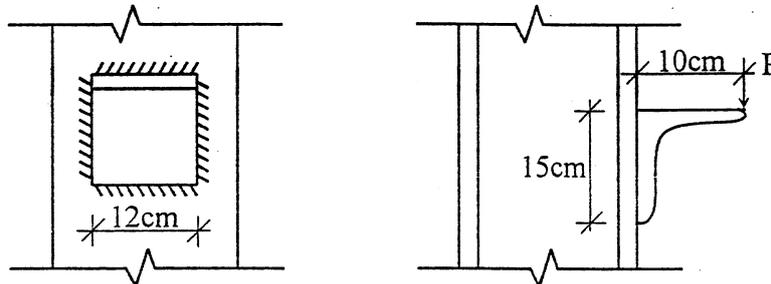
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Exam.	Back		
Level	B.E.	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Design of Steel and Timber Structure**

- ✓ 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**.
- ✓ IS 800-1984, IS 875-1987, IS 883-1970 and structural steel section book are allowed to use.
- ✓ Assume suitable data if necessary.

1. a) Calculate the safe load P to connect a bracket plate to the flange of a column as shown in figure. Weld size is 6mm. [12]



- b) Explain laterally unrestrained beam and method of calculation of permissible compressive stress in bending ( $\sigma_{bc}$ ). [8]
2. a) Design tension member using two angle sections to carry a load of 250kN. Both angles are connected on the same side of the gusset plate. [10]
- b) Design frame connection between a beam section MB 400 and column section SC 250 if the beam is to transmit end reaction of 180 kN. [10]
3. Design a built up column to carry an axial load of 1500KN. The column is built up of I-sections and battened together. The effective length is 8m. [20]
4. Design the main section (i.e. web plate, flange plate and their connections and stiffeners) of a plate girder to following data: [20]
- Span of girder = 16m  
 External Dead load = 50kN/m  
 and live load = 45 kN/m
5. a) Determine the safe axial load of a timber column having diameter 25cm and length 4m. [10]
- Permissible compressive stress = 1.06 kN/cm<sup>2</sup>  
 Young's modulus of elasticity = 1270 KN/cm<sup>3</sup>
- b) Explain method of calculating wind load in roof truss. [10]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BEX, BCT, BGE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Engineering Economics (CE655)**

- ✓ 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 why the subject of engineering economics is important to Civil Engineer. [4]

2. What is difference between nominal and effective interest rate?

You deposit Rs. 1000 in your bank account. If the bank pays 4% simple interest, how much will you accumulate in your account after 10 years? What if the bank pays compound interest? How much of your earnings will be interest on interest? [2+4]

3. a) Calculate IRR from the following cash flow and draw investment balance diagram. [6]

Year	0	1	2	3	4	5
Cash Flow	-800	250	300	400	-150	600

b) Calculate both types of BCR of a project with following details. MARR = 12% [6]

Initial Investment	Annual Income	Annual Cost	Useful Life	Salvage Value
Rs. 100000	Rs. 20000 at the end of first year and increase by 5% per year	Rs. 3000 at the end of first year and increase by Rs. 500 per year	12 years	25000

4. a) Select the best project by ERR method. Take MARR = 10% and  $\epsilon = 20\%$  [6]

EOY →	0	1	2	3	4	5	6
PROJECT A	-64,000	26,200	29,000	30,200	31,000	31,000	26,000
PROJECT B	-68,000	-4,000	39,200	38,000	38,000	38,000	38,000
PROJECT C	-75,500	20,500	40,600	40,000	39,000	39,000	32,400

b) Co-terminating both project at 5 years and select the best project by modified BCR (using AW formulation). Take Salvage Value of each project = 10% of First Cost, MARR = 15% [6]

PROJECT	First Cost	Annual Benefits	Annual O & M Costs	Useful Life
A	Rs. 4,00,000	Rs. 175,000	Rs. 25,000	6 years
B	Rs. 7,00,000	Rs. 250,000	Rs. 35,000	8 years

5. a) An existing machine has market value of Rs. 10000 and decreases by Rs. 2000 per year. Its operating cost is Rs. 2500 in year 1 and increases by 20% each year for 4 years. New machine costs Rs. 20000 now and its market value will decrease by Rs.20% per year for 4 years. Operating cost is Rs.1500 in first year and increase by 30% each year. Calculate equivalent uniform annual cost of both existing and new machines. MARR = 15%. Formulate the best replacement strategy if we need the machine for four years only. [4+4+4]

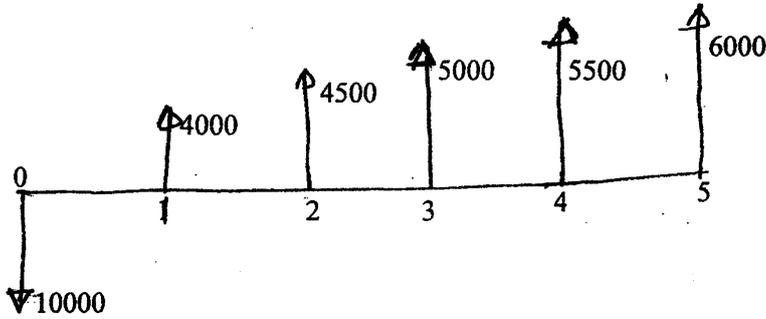
b) Define mutually exclusive project, independent project and contingent project with proper combinations. [4]

6. a) A company produces an electronics timing switch that is used in consumer and commercial products made by several other manufacturing firms. The fixed cost and total cost are Rs. 40,000 and Rs. 85,000 respectively. The total sales are Rs. 1,05,000 and sales volume is 15,000 for this situation. [4]

- i) Find the breakeven points in terms of number of units
- ii) What should be the output if the profit desired is Rs. 50,000?

b) Draw sensitivity chart using PW formulation of the following cash informations. It is desired to evaluate the sensitivity of PW to  $\pm 30\%$  changes on: [8]

- i) Interest
- ii) Investment



7. a) Explain the general procedure for after tax economic analysis with suitable example. [4]

b) Considering the following information, compute the annual depreciation and book value of each year by (i) SL method (ii) DB method (iii) SOYD method and (iv) Sinking fund method. [1+2+3+2]

Cost basis	Salvage Value	Useful Life	MARR
\$ 7,000	\$ 2,000	5 years	10%

8. Choose the best project from the following alternatives. [6]

Project	Machine X	Machine Y
First Cost	15,00,000	20,00,000
Life	7 years	7 years
Salvage Value	200,000	300,000
Annual operating and maintenance cost	300,000	250,000

Assume an average inflation of 5% for the next five years and interest rate is 15% / year.

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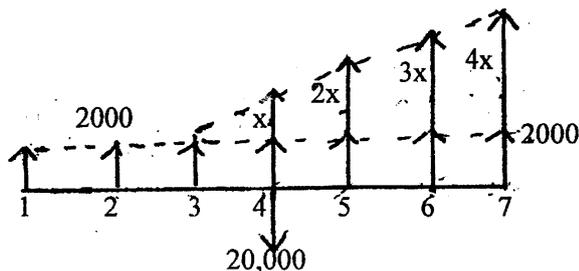
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<b>Exam.</b>	<b>New Back (2066 &amp; Later Batch)</b>		
<b>Level</b>	BE	<b>Full Marks</b>	80
<b>Programme</b>	BCE, BEL, BEX, BCT, BGE	<b>Pass Marks</b>	32
<b>Year / Part</b>	III / II	<b>Time</b>	3 hrs.

**Subject: - Engineering Economics (CE655)**

- ✓ 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 Engineering economics. Explain any three principles of engineering economic analysis. [1+4]
2. a) Define nominal and effective interest rates. If you deposit Rs 2000 per month for two years, what will be the amount at the end of five years if bank interest rate 3% in every six month? [1+3]
- b) Find the value of X if  $i = 10\%$  [4]



3. a) What is MARR? Explain the factors affecting its determination. [3]
- b) Cash flows of a project are as follows: Take MARR = 10%

EOY→	0	1	2	3	4	5
Cash inflow	0	500,000	560,000	620,000	680,000	740,000
Cash outflow	-1000,000	100,000	200,000	300,000	400,000	500,000

- i) Evaluate both type of payback period (Standard payback period = 3years). [1+2]
- ii) Evaluate IRR (PW formulation) using linear interpolation and prepare UIB both in table & diagram. [3+2+2]
- c. Explain the financial and economic analysis. [3]
4. a) Choose the best project among these alternatives using IRR, if MARR = 12% and study period 10 years. [6]

Project	A	B	D	E
First Cost Rs.	2000	1500	4000	3000
Annual Revenue Rs.	390	276	925	500

- b) Determine both types of B/C ratio for the given project if interest rate is 11%. [7]
- Investment = 10000  
Annual benefit = 4600  
Annual cost = 3000  
Salvage value = 2500  
Life of project = 8 years

5. a) Explain the required assumption and decision framework for replacement analysis when required service life is long. [4]
- b) An old machine can sell it now for \$5,000. If repaired now, can be used for another 6 years. It will require an immediate \$1,200 for overhaul to restore it to operable condition. Future market values are expected to decline by 25% each year over the previous year's value. Operating costs are estimated at \$2,000 during the first year and these are expected to increase by \$1,500 per year thereafter. Determine economic service life of this machine. [8]
6. Perform sensitivity analysis by IRR using FW formulation (with increment of 10%) over a range of  $\pm 30\%$  in (a) useful life and (b) MARR. Take MARR= 10%. [8]

PROJECT	First Cost	Annual Benefits	Annual Expenses	Salvage Value	Useful Life
A	Rs. 3,00,000	Rs.1,50,000	Rs.25,000	10% of First Cost	10 years

7. a) What are the purpose of depreciation calculation? Compute the annual depreciation allowances and the resulting book value using the double declining balance method with Switch over to straight line method. Cost of asset = Rs 1,00,000, Useful life = 5 years, Salvage Value = 20,000. [1+5]
- b) A machine is expected to cost Rs. 5,00,000 and will generate revenue of Rs 1,50,000 per year for five years. Its salvage value is Rs 2,00,000. Calculate after tax cash flow and corresponding NPV if tax rate is 30% and depreciation is on sum of year digit method. MARR = 15% [6]
8. Explain any two reasons for inflation and compute the equivalent present worth using deflation method. [2+4]

EOY→	0	1	2	3	4	5
Cash inflow	-	5,00,000	5,60,000	6,20,000	6,80,000	7,40,000
Cash outflow	-10,00,000	1,00,000	2,00,000	3,00,000	4,00,000	5,00,000

Given cash flow are in Actual Dollars. Take  $f = 5\%$  and  $i = 10\%$

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BEX, BCT, BGE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Engineering Economics (CE655)**

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- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
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1. Explain why the subject of engineering economics is important to Civil Engineer. [4]

2. What is difference between nominal and effective interest rate?

You deposit Rs. 1000 in your bank account. If the bank pays 4% simple interest, how much will you accumulate in your account after 10 years? What if the bank pays compound interest? How much of your earnings will be interest on interest? [2+4]

3. a) Calculate IRR from the following cash flow and draw investment balance diagram. [6]

Year	0	1	2	3	4	5
Cash Flow	-800	250	300	400	-150	600

b) Calculate both types of BCR of a project with following details. MARR = 12% [6]

Initial Investment	Annual Income	Annual Cost	Useful Life	Salvage Value
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4. a) Select the best project by ERR method. Take MARR = 10% and  $\epsilon = 20\%$  [6]

EOY→	0	1	2	3	4	5	6
PROJECT A	-64,000	26,200	29,000	30,200	31,000	31,000	26,000
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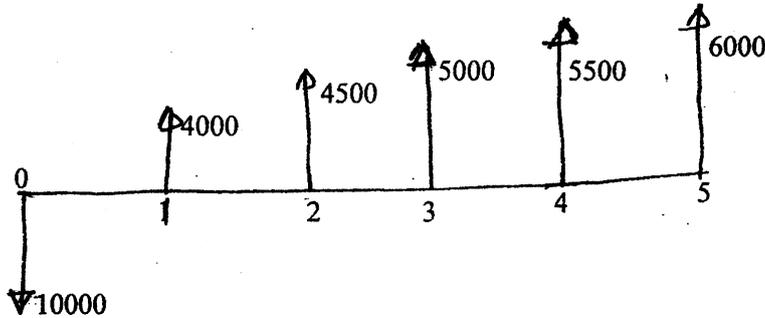
b) Co-terminating both project at 5 years and select the best project by modified BCR (using AW formulation). Take Salvage Value of each project = 10% of First Cost, MARR = 15% [6]

PROJECT	First Cost	Annual Benefits	Annual O & M Costs	Useful Life
A	Rs. 4,00,000	Rs. 175,000	Rs. 25,000	6 years
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5. a) An existing machine has market value of Rs. 10000 and decreases by Rs. 2000 per year. Its operating cost is Rs. 2500 in year 1 and increases by 20% each year for 4 years. New machine costs Rs. 20000 now and its market value will decrease by Rs.20% per year for 4 years. Operating cost is Rs.1500 in first year and increase by 30% each year. Calculate equivalent uniform annual cost of both existing and new machines. MARR = 15%. Formulate the best replacement strategy if we need the machine for four years only. [4+4+4]

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6. a) A company produces an electronics timing switch that is used in consumer and commercial products made by several other manufacturing firms. The fixed cost and total cost are Rs. 40,000 and Rs. 85,000 respectively. The total sales are Rs. 1,05,000 and sales volume is 15,000 for this situation. [4]
- Find the breakeven points in terms of number of units
  - What should be the output if the profit desired is Rs. 50,000?
- b) Draw sensitivity chart using PW formulation of the following cash informations. It is desired to evaluate the sensitivity of PW to  $\pm 30\%$  changes on: [8]
- Interest
  - Investment



7. a) Explain the general procedure for after tax economic analysis with suitable example. [4]
- b) Considering the following information, compute the annual depreciation and book value of each year by (i) SL method (ii) DB method (iii) SOYD method and (iv) Sinking fund method. [1+2+3+2]

Cost basis	Salvage Value	Useful Life	MARR
\$ 7,000	\$ 2,000	5 years	10%

8. Choose the best project from the following alternatives. [6]

Project	Machine	
	X	Y
First Cost	15,00000	20,00000
Life	7 years	7 years
Salvage Value	200000	300000
Annual operating and maintenance cost	300000	250000

Assume an average inflation of 5% for the next five years and interest rate is 15% / year.

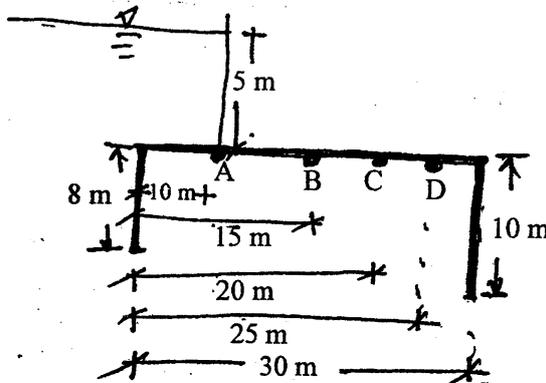
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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Irrigation and Drainage Engineering (CE654)**

- ✓ 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 farmer with his 40 m × 40 m plot plans to irrigate his field using 4 sprinklers having a throw distance as 10 m and each placed 20 m apart. Prepare a sketch of wetting pattern of these sprinklers. Write your comments on the moisture pattern and suggest measure to improve it if required. [5]
2. a) How to determine the design capacity of a canal. [3]
- b) With the following data: FC = 35%, PWP = 12% root depth = 70 cm, Soil density = 1.4 gm/cc,  $ET_c = 9$  mm/day, RAM = 70% AMC, application efficiency = 85%, conveyance loss and distribution loss 20% where the abbreviations have their usual meanings. Calculate: (i) Available moisture content (ii) Readily available moisture content (iii) Depth of irrigation at the outlet of the field (iv) Irrigation interval and (v) Depth of irrigation water required at the headwork. [5]
3. Drawing a neat sketch, show the major components of an irrigation system from headworks to command area. [5]
4. a) A canal is to be designed to carry a discharge of 32 cumecs. The beds slope is kept 1 in 1500. The soil is coarse alluvium having a grain size of 30 mm. Assuming the canal is trapezoidal and to be unlined with unprotected banks. Determine a suitable section for the canal. Assume  $\phi = 37^\circ$  [5]
- b) Using Lacey's regime equations prove that  $R = 1.35 (q^2/f)^{1/3}$ . Where, R = hydraulic mean radius, q = discharge per unit wetted perimeter and f = silt factor. [5]
5. a) Drawing a neat sketch of an irrigation headworks, draw a longitudinal section through a head regulator showing upstream floor, regulator gates; energy dissipaters and protection works. [3+3]
- b) A section of a hydraulic structure is shown in figure below, calculate the average hydraulic gradient. Also find the uplift pressures at points A, B, C, and D. Find the thickness of the floor at these points. Take  $G = 2.24$  [6]



6. Write various methods of river trainings. Discuss with necessary sketch, the types of spurs used for river training works. [3+5]
7. a) Making a suitable sketch compute the minimum water level required in the distributary to convey a flow as 50 lps through a 10 m long, free-discharging pipe outlet ( $n = 0.016$ ) of 20 cm dia to a water course with FSL at 100.0m [1+4]
- b) Drawing a definition sketch, design a vertical drop in a 10 m wide canal (side slope 1:1) discharging a flow as  $20 \text{ m}^3/\text{s}$ . The canal bed level upstream and downstream is 102 m and 100 m respectively, whereas the FSL upstream and downstream is 105 m and ~~130 m~~ <sup>103 m</sup> respectively. Determine design level, length of cistern and upstream floor length using Bligh's safe hydraulic gradient as  $1/8$ . [1+6]
8. a) What are the various types of cross drainage works? Draw the section of canal syphon. [2+2]
- b) Design a suitable cross drainage (water way, bed levels of different section and design of transitions) works if the following data at the crossing of a canal and drainage are given. [6]
- Canal  
 $Q = 40 \text{ m}^3/\text{s}$ , Bed width = 30 m, FSD of canal = 1.6 m, Bed level = 206.4 m, Side slope =  $1 \frac{1}{2} \text{ H:1V}$
- Drainage  
 $Q = 45 \text{ m}^3/\text{s}$ , HFL = 207 m, Bed level = 204.5 m, General ground level = 206.50 m
9. Explain all steps required to arrive design discharge of a drainage canal in irrigated paddy field. [10]

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07 TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2072 Ashwin

Exam.	Regular		
	Level	BE	Full Marks
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject:** - Irrigation and Drainage Engineering (CE654)

- ✓ 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 status of irrigation in Nepal. [5]
2. a) Explain about soil-moisture-irrigation relationship. [3]
- b) Three distributories are used for irrigation. The details are given below. Find which one is more efficient. [5]

	Distributary-1	Distributary-2	Distributary-3
Discharge	15 m <sup>3</sup> /s	20 m <sup>3</sup> /s	25 m <sup>3</sup> /s
C.C.A	15,000 ha	25,000 ha	30,000 ha
Intensity of irrigation	60%	80%	50%
Base period	200 days (cotton crop)	120 days (wheat crop)	365 days (sugarcane)

3. An irrigation channel has a bottom width 8 m and side slopes of 1.5H: 1V in cutting and 2H:1V in filing. The width of the crest of bank is 2 m and its height above the ground level is 3m. Compute the balancing depth and draw a neat x-section of the canal illustrating the various dimensions and level it. [3+2]
4. a) A canal has to be designed to carry a design discharge as 50 m<sup>3</sup>/s. The slope of the canal is 1:1000 and passes through medium with mean particles as 50 mm. Assuming a trapezoidal section, determine the stable depth of the canal assuming angle of repose of canal bed/side particles as 36°. [5]
- b) Design a stable irrigation canal carrying a discharge of 50 m<sup>3</sup>/s, which passes through alluvium (d<sub>mean</sub> = 0.50 mm). Draw a sketch of the designed section. [5]
5. a) An irrigation barrage has to be designed to pass a flood of 10,000 m<sup>3</sup>/s, through alluvium media (median dia of particles = 0.33 mm). The flood level, pond level and downstream floor level are 207.0 m, 204 m and 198.0 m respectively. If the safe exit gradient is 1/6, compute minimum total impervious floor length required to safeguard the structure from piping. Prepare a conceptual section of the designed structure. [7+1]
- b) What are slit ejectors and slit excluders in irrigation system? Write their design principles. [4]
6. a) Explain with sketch how spur assist in river control work. [3]
- b) Design the length, radius of curved head, length and thickness of launching apron of a guide bund to train a river with the following data. [5]

Design Flood Discharge : 4500 cumecs  
HFL : 154.00 m

Bed Level of river : 150.00 m  
Av. dia. of river bed material : 0.1 mm

7. a) Explain the working principle of non-modular and semi modular outlet. What are the requirements of a good module? [2+2]
- b) Design the crest and cistern of a vertical drop structure for the data given below. [8]

Discharge = 4.5 cumec, Bed level u/s = 105.00, side slope of channel = 1:1, bed level d/s = 103.5, FSL u/s = 106.5, Bed width u/s and d/s = 3.0m, Top width of crest = 0.75m (for initial assumption),  $C_d = 0.41$

8. Following data are obtained at the crossing of a canal and drainage. [10]

Canal Data

Discharge : 50 cumec, Full supply depth : 1.6m, Bed width : 35m, Bed level : 210.3m, Side slope : 1.5H:1V

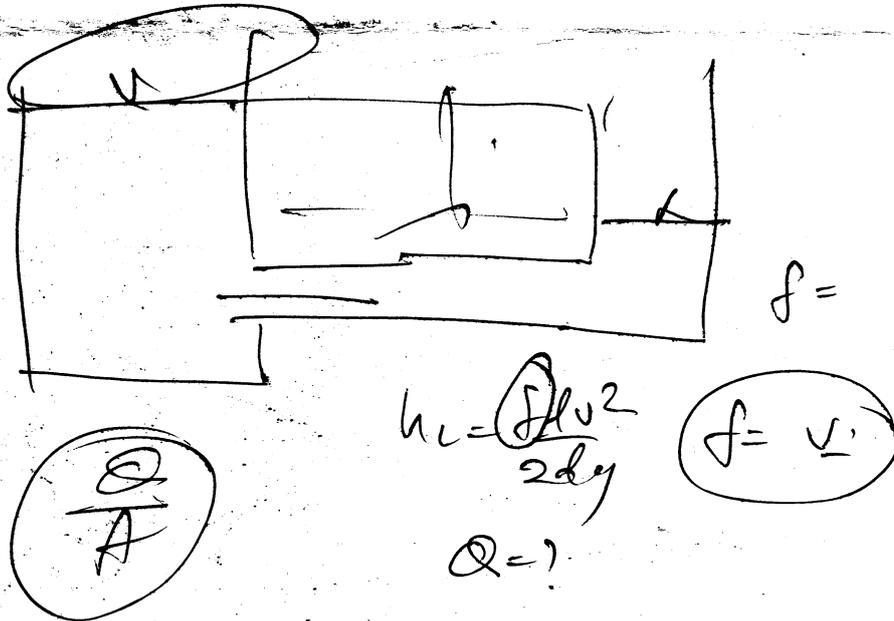
Drainage Data

Discharge : 400 cumec, HFL : 211.0m, Bed level : 208.5m, General ground level: 210.5m

Design the drainage waterway, canal waterway and find the bed levels and FSL at four different sections of the canal Trough.

9. Explain in details the procedures of designing drainage canals in irrigated paddy fields. [10]

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE, BGE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

**Subject: - Communication English (SH651)**

- ✓ 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. Edit the following text: [5]

A husband and wife were having problems and decided to end their union after a very short time together. After a brief attempt to reconcile, the couple went to court to finalize their break up.

The judge asked the husband, what had brought you to this point, where you're unable to keep this marriage together.

The husband replied, "In the six weeks we have been together, we have not been able to agree on a single think"

seven weeks the wife said.

2. Read the following text and interpret its meaning in your own language: [5]

For half of the day we are slave to necessities which we cannot shirk, whether we are monarchs with a thousand servants or humble laborers with no savants but their wives. And the wives must undertake the additional heavy slavery of child-bearing if the world is still to be peopled. These natural jobs cannot be shirked. But they involve other jobs which can. As we must eat we must first provide food; as we must sleep we must have beds and bedding in houses with fireplaces and coals; now, food and houses and clothes can be produced by human labour. If you are too lazy to get about from place to place on your own legs, you can make a slave of a horse. And what you do to a horse, you can also do to a man or a woman or a child if you can get the upper hand of them by force or fraud or trickery of any sort.

3. After reading the test given below carefully, make notes and write summary of it: [5+5]

We can alter the characteristics of steel in various ways. In the first place, steel which contains very little carbon will be *milder than* steel which contains a higher percentage of carbon, up to the limit of about  $1\frac{1}{2}\%$ . Secondly, we can heat the steel above a certain critical temperature, and then allow it to cool at different rates. At this critical temperature, changes begin to take place in the molecular structure of the metal. In the process known as annealing, we heat the steel above the critical temperature and permit it to cool very slowly. This causes the metal to become softer than before, and *much easier to machine*. Annealing has a second advantage. It helps to relieve any internal stresses which exist in the metal. These stresses are liable to occur through hammering or working the metal, or through rapid cooling. Metal which we cause to cool rapidly contracts *more rapidly* on the outside than on the inside. This produces unequal contractions, which may give rise to distortion or cracking. Metal which cools slowly is *less liable* to have these internal stresses than metal which cools quickly.

$$\frac{14 \times 10}{140} + 52 = 200$$

14  
On the other hand, we can make steel harder by rapid cooling. We heat it up beyond the critical temperature, and then quench it in water or some other liquid. The rapid temperature drop fixes the structural change in the steel which occurred at the critical temperature, and makes it very hard. But a bar of this hardened steel is *more liable to fracture than* normal steel. We therefore heat it again to a temperature below the critical temperature, and cool it slowly. This treatment is called tempering. It helps to relieve the internal stresses, and makes the steel *less brittle than* before. The properties of tempered steel **enable** us to use it in the manufacture of tools which need a fairly hard steel. High carbon steel is *harder than* tempered steel, but it is *much more difficult to work*.

These heat treatments take place during the various shaping operations. We can obtain bars and sheets of steel by rolling the metal through huge rolls in a rolling-mill. The roll pressures must be *much greater* for cold rolling than for hot rolling, but cold rolling **enables** the operators to produce rolls of great accuracy and uniformity, and with a better surface finish. Other shaping operations include drawing into wire, casting in moulds, and forging.

4. Answer any two of the following question:

- a) How are the cables for a suspension bridge constructed? (Suspension Bridges)
- b) What do you mean by 'a sense of proportion'? (Knowledge and Wisdom)
- c) What lesson can we learn from the text 'How much land does a man need'?

5. Choose the correct words from the brackets:

- i) Many a flower ..... born to blush unseen. (is, are)
- ii) Every boy and every girl ..... given sweets. (was, were)
- iii) He is absent ..... the class. (from, in)
- iv) Steel is made ..... iron. (of, from)
- v) I saw him ..... the race. (win, to win)
- vi) If he comes to me, I ..... him. (help, would help)
- vii) If one buys a car, it ..... money (cost, costs)
- viii) New houses ..... up every where. (go, are going)
- ix) His words are strongly ..... on my memory. (impressed, impressing)
- x) I should be ..... (listened at, listened to)

6. Put the following information into APA and MLA styles of citation.

Name of the book – Reading Through the Language Arts  
Author's name – Angela M. Ridsdale  
Publisher – Thomas Nelson (Australia) Limited  
Publishing place – Australia  
Year of publication - 1973

- 7. Investing all the necessary details, draft a notice with a four point agenda for the 20<sup>th</sup> meeting of a local youth club regarding establishment of library for the locality.
- 8. As the chief contractor of a hydro-power project launched in one of the remote sites, write the second quarterly progress report in memo format.
- 9. Write a proposal, to be submitted to the Chief Engineer, Department of Roads on controlling the sound pollution of the Kathmandu valley. Prepare only the title page, abstract and conclusion parts of the proposal.
- 10. Write a short research article in about 500 words on the importance of English for the engineering students in our country, Nepal.
- 11. Supposing that you are the chief Engineer of a suspension bridge construction project in your local area which is nearing completion, write abstract, discussion, conclusion and recommendation of your report.

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160

(OX)

170

900  
2000  
2000

[2x5]

[0.5x10]

[4]

[5]

[6]

[10]

[10]

[10]

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

**Subject: - Sanitary Engineering (CE656)**

- ✓ 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. ✓ The environment is getting worse day by day due to insanitation especially in some urban area of Nepal. In this context explain the importance of wastewater and solid waste management to solve these environment problems. [4]
2. ✓ Calculate the design discharge for a sewer from the following data: [4]
  - Projected population = 75,000
  - Area = 8 km<sup>2</sup>
  - Rate of w/s = 100 lpcd
  - Permeability factor = 60%
  - Rainfall duration = 15 minutes
  - Time of flow = 15 minutes
  - Time of entry = 5 minutes

Assume that 80% supplied water converted as wastewater and maximum demand is 3 times average demand.
3. ✓ List the various types of pipe materials used in sewer line. Describe them with merits and demerits. [8]
4. ✓ With a neat sketch, describe the purpose, features and construction of Automatic flushing device used in sewerage system. [4]
5. a) ✓ Why the examination of wastewater is necessary? How wastewater sampling is done? [4]
 

b) ✓ The following observations were made on 5% dilution of a sewage sample. The DO of blank is 5 mg/L. The DO of diluted sample after 5 days and incubation at 20°C is 1 mg/L. Calculate BOD<sub>5</sub> and ultimate BOD of sample. Assume the DO of original sample 0.5 mg/L. [4]
6. ✓ A town is discharging sewage of 300 liters/second in the river having discharge of 1300 liters/second and a velocity of 48 km/day. The BOD<sub>5</sub> of sewage and river water are 400mg/l and 4mg/l respectively. The DO of sewage sample is nil. D.O. in the river water is 80% of the saturation value. Temperature of both sewage and river water is 20°C. The saturation DO at 20°C is 9.17 mg/l. Assume K<sub>1</sub> = 0.1/day and K<sub>2</sub> = 0.4/day (both with base 10). Calculate the critical DO deficit. [8]
7. a) ✓ What do you understand by suspended growth and attached growth process in wastewater treatment? Explain in detail the principles of biological wastewater treatment. [8]
 

b) ✓ The effluent from PST is applied to a standard rate trickling filter at the rate of 4 MLD having a settled sewage BOD of 180 mg/L. Determine the depth and volume of the filter considering (hydraulic) surface loading of 2000 liter/m<sup>2</sup> day and organic loading of 150 gram/m<sup>3</sup> day. Also determine the efficiency of the filter using NRC equation. [8]

c) ✓ A activated sludge system is to be used for secondary treatment of 10,000 m<sup>3</sup>/day of municipal wastewater. After primary clarification, the BOD is 250mg/l and is desired to have not more than 50 mg/l of soluble BOD in the effluent. A completely mixed reactor is to be used. MLSS concentration is of 3000 mg/l. Determine: [8]

  - i) The volume of reactor
  - ii) Detention time
  - iii) The recycle ratio

6

8. a) Describe the various stages of sludge digestion. [4]

b) Determine the volume of sludge produced in a sewage sedimentation tank from the following data: [4]

Flow rate = 10 million liters/day  
Suspended solids content in raw sewage = 250 mg/l  
Sedimentation tank removes 60% of suspended solids  
Specific gravity of sludge = 1.02  
Moisture content of sludge = 95%

9. Design a septic tank and soak pit for 10 number of users of a house at a place where infiltration capacity of soil is 85 liters per square meter per day. The peak sewage flow rate 80 lpcd and the septic tank is cleaned at an interval of 2 years. The ground water table lies 6 m below the ground level. [8]

10. Describe incineration of solid waste with its merits and demerits. [4]

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