Subject Code: 881
Full Marks: 200
Time: 4 hours

[N.B. Figures in the right margin indicate full marks.]

Part I
Structure
Marks: 20×2=40
(Answer any two questions)

Marks

1. (a) Explain the following: 4×2.5 = 10
   (i) Static and kinematic indeterminacy.
   (ii) Conjugate beam.
   (iii) Space truss.
   (iv) Stiffness factor.

   (b) Draw shear force diagram (SFD) and bending moment diagram (BMD) of the following continuous beam. 10

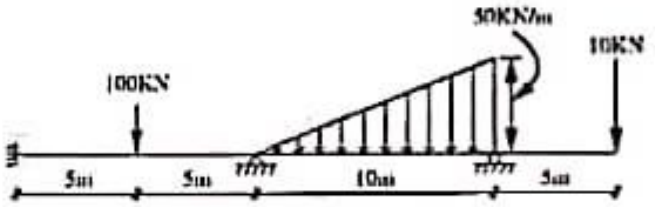

Figure for question 1(b)

2. (a) For what value of P, the deflection of beam at C will be Zero? EI = constant. 10

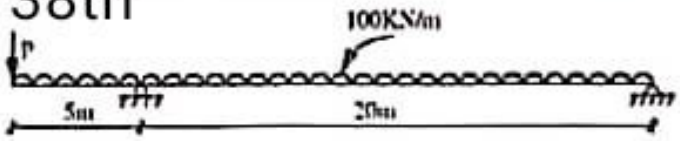

Figure for question 2(a)

   (b) Using energy method, determine the horizontal displacement of the joint D of the truss shown in the figure. Use $E = 29 \times 10^3$ ksi. 10

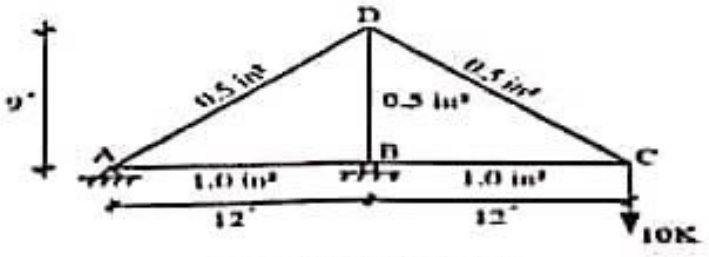

Figure for question 2(b)

3. Analyze the frame shown in the following figure. 20

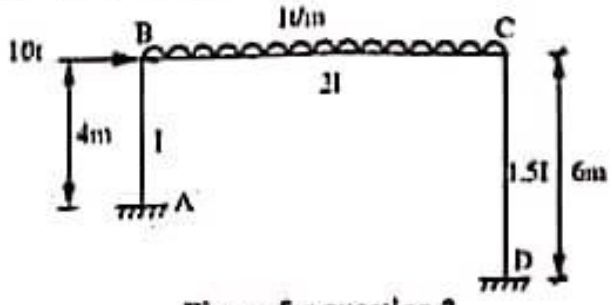

Figure for question 3

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Water Resources Engineering
Marks: 15×2=30
(Answer any two questions)

Marks

4. (a) Define consumptive use of water. What are the factors affecting consumptive use of water? 7

   (b) What are the causes of water-logging? Explain in brief the measures adopted for controlling water-logging. 8

5. (a) Define design flood. Explain the various methods for estimating the design flood of a catchment. 7

   (b) Explain the principal causes of flood and possible remedial measures for flood mitigation. 8

6. (a) Explain the term 'Leaching requirement.' 3

   (b) What is SAR? Discuss the effect of salt on plant growth. 4

   (c) A loam soil has field capacity of 25% and permanent wilting percentage 10%, the dry unit weight of soil is 14.72 kN/m^3. If the depth of root zone is 0.75m, determine the storage capacity of the soil. Irrigation water is supplied when moisture content drops to 14%. If water application efficiency is 75%, determine the water depth required to be applied in the field. 8

Environmental Engineering
Marks: 15×2=30
(Answer any two questions)

7. (a) State the basic assumptions in Hardy-cross method for pipe-flow distribution. Also, state the step-wise procedure for calculating pipe flow using Hardy-cross method. 9

   (b) Write short notes on: 3×2= 6

   (i) Aerobic and anaerobic bacteria.

   (ii) BOD and COD.

8. (a) Discuss, in brief, the principles involved in the design of sedimentation tank.

   (b) It is required to disinfect 500,000 gpd of water with 0.3 mg/l of chlorine. If bleaching powder that contains 33.33% of available chlorine is used, how much bleaching powder is needed to treat the daily flow of water? 5

   (c) What do you mean by coagulant and coagulation? Critically examine the purposes and process coagulation of sewage. 5

9. (a) List the properties that are required to be analyzed if solid wastes are to be used as resources. 4

   (b) Write short notes on: 6

   (i) Activated sludge

   (ii) Sludge seeding

   (iii) Enzymes

   (c) For a domestic sewage having 5-day BOD of 200 mg/l at 20°C calculate the BOD at 1 and 5 days at 12°C. Assume the value of R as 0.18 per day at 20°C. 5

Part II

Structure

Marks: 20×2=40

(Answer any two questions)

Marks

10. (a) State the necessity of approximate analysis of building frames. Also, explain the methods available for approximate analysis of building frames subject to wind or earthquake loads. 7

(b) Draw SFD and BMD of the building frames shown in the figure. Use approximate methods. 13

Figure for question 10(b)

11. (a) Write notes on: 2×5= 10

(i) Modular ratio
(ii) Stress ratio
(iii) Transformed section
(iv) Tensioned controlled member
(v) Column strength interaction diagram

(b) For the RC beam shown in the figure, calculate: 2×5= 10

(i) Maximum and minimum permissible steel ratio
(ii) Depth of neutral axis
(iii) Allowable moment capacity
(iv) Nominal moment capacity
(v) Design flexural capacity

[Use $f_c^1 = 4ksi$ adn $f y = 60ksi$?]

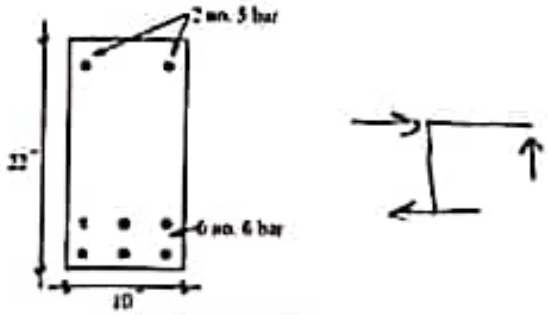

Figure for question 11(b)

12. (a) Write notes on: 2×5= 10

(i) Flat plate
(ii) Flat stab
(iii) Punching shear capacity of RC slab
(iv) Two-way RC slab
(v) Loss of prestress

(b) Why high strength materials are necessary in PC construction? Explain. 3

(c) A post-tensioned PC beam 200mm×500mm is prestressed by a circular cable (A_{PS}=800mm^2) with zero eccentricity at the ends and 160mm at the centre. The span of the beam is 12m. The cable is to be stressed from one end such that an initial stress of 850N/mm^2 is available in the unjacked end immediately after anchoring. Determine the stress in the wire at the jacking end and the percent loss of stress due to fiction. Given μ=0.6, k=0.003/m. 7

[Please turn over]

Transportation Engineering

Marks: 15×2=30

(Answer any two questions)

			Marks
13.	(a)	State the advantages of uniform gauge of a railway line.	4
	(b)	Discuss the function and requirements of sleeper and ballast.	6
	(c)	Compare railways with highways and state the social and economic advantages of railway.	5
14.	(a)	Describe the functions of base, sub-base and surface course of a flexible pavement.	6
	(b)	What are the desirable properties of coarse aggregate used in pavement construction?	5
	(c)	List the laboratory test for sand and bitumin.	4
15.	(a)	Explain the necessity and objects of highway planning.	4
	(b)	Discuss the importance of highway drainage. State the requirements of a good highway drainage system.	5
	(c)	Write notes on: (i) Geometric design of highway (ii) O & D study (iii) PIEV theory	2×3= 6

Foundation Engineering

Marks: 15×2=30

(Answer any two questions)

16.	(a)	What is meant by coefficient of permeability of soil? List the factors affecting the permeability of soil.	4
	(b)	Discuss the effect of wafer table on bearing capacity of soil.	3
	(c)	A clay layer 4m thick is subject to a pressure of 55kN/m^2. If the layer has a double drainage and undergoes 50% consolidation in one year, determine the coefficient of consolidation. Take Tv = 0.196. If the coefficient of permeability is 0.020 m/yr. determine the settlement and rate of flow of water per unit area in one year.	8
17.	(a)	Write short notes on: (i) Precast and cast in situ RC pile (ii) Shallow and deep foundation (iii) Consolidation and compaction (iv) SPT and cone penetration test	2×4= 8
	(b)	A soil sample was prepared by mixing a quantity of dry soil with 10% by mass of water. Find the mass of this wet mixture required to produce a cylindrical specimen of 15cm diameter and 12.5 cm deep and having 5% air content. Also find the void ratio and the dry density of the specimen if G = 2.68.	7
18.	(a)	Discuss the shear characteristics of cohesive and cohesionless soils.	5
	(b)	Describe the salient features of a good subsoil investigation report.	4
	(c)	Differentiate between primary consolidation and secondary consolidation. Also differentiate between normally consolidated and over consolidated soils.	6

Subject Code: 881

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Full Marks: 200

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Part I

Structure

(Answer any two questions)

Marks: 20×2=40

Marks

1. Draw the quantitative shear and bending moment diagrams, and qualitative deflected curve for the beam shown in Fig. 01. Support 'B' settles 10 mm and EI is constant. $E = 200\ GPa, I = 200 \times 10^6\ mm^4$ 20

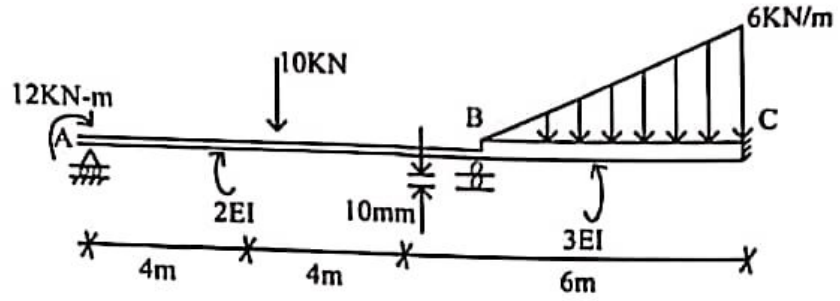


Figure for question 1

2. (a) Define influence line. Why is it drawn? 4

   (b) Analyze the frame shown in Fig. $Q2$ by slope deflection method. Assume EI is constant for all members. 16

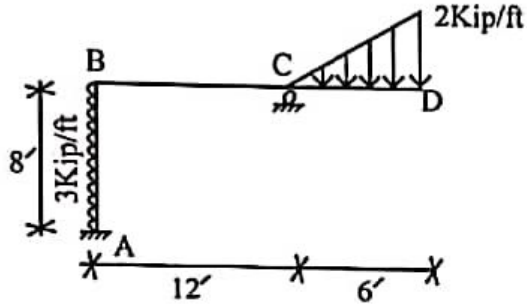


Figure for question 2(b)

3. (a) Compute the force in the tie rod of the following structure shown in Fig Q3(a). $I = 600\ in^4$, $A_2 = 20in^2$, and $A_1 = 2\ in^2$. 8

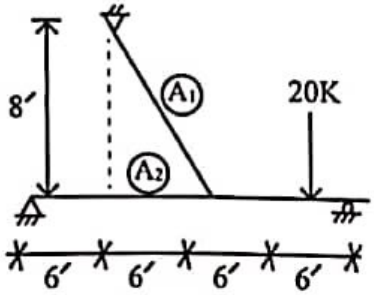


Figure for question 3(a)

   (b) A building frame is shown in Fig. 3(b). Analyze the frame using cantilever method. Area of the columns are shown at the top of each column. Draw shear force and bending moment diagrams for all members. 12

[Please turn over]

Marks

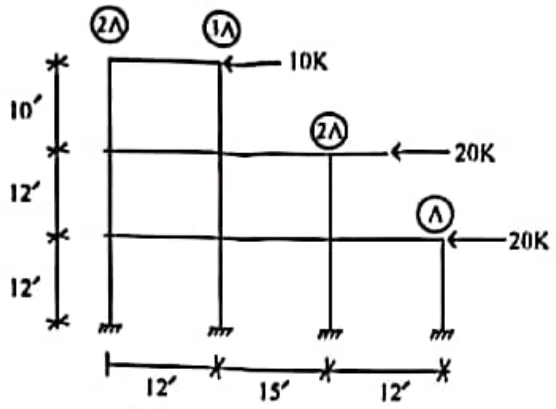


Figure for question 3(a)

Water Resources Engineering

(Answer any two questions)

Marks: 15×2=30

4. (a) What is SAR? What is the effect of salt on plant growth? 5

   (b) A sandy loam soil holds water at 140 mm/m depth between field capacity and permanent wilting point. The root depth of the crop is 30 cm and the allowable depletion of water is 35%. The daily water use by the crop is 5 mm/day. The area to be irrigated is 60 ha and water can be diverted at 28 Lps. The surface irrigation application efficiency is 40%. There are no rainfall and groundwater contribution. Determine: 10

   (i) Allowable depletion depth between irrigations
   (ii) Frequency of irrigation
   (iii) Net application depth of water
   (iv) Volume of water required
   (v) Time to irrigate 4 ha plot

5. (a) What is meant by 'Furrow Irrigation' and 'Sprinkler Irrigation'? Which one is preferred in Bangladesh and why? 5

   (b) A pump is installed on a well to lift water and to irrigate rice crop, sown over 3 hectares of land. If duty for rice is 864 hectares/cumec on the field and pump efficiency is 84%; determine the minimum input (H.P.) required by the pump if the lowest water level is 8 meters below the highest portion of the field. Assume negligible field channel losses. (1 $H.P. = 0.735\ k.watt$). 10

6. (a) What are the different forms of soil water? Show them in case of sandy soil and silty loam soil with a diagram. 5

   (b) What is meant by 'canal lining' and what are its advantages? Also discuss the factors which are responsible for selecting a particular material in a particular project. 5

   (c) Write short notes on: 5

   (i) Watershed management
   (ii) Floodplain zoning
   (iii) Artesian aquifer
   (iv) Design flood
   (v) Duty of water

Environmental Engineering

(Answer any two questions)

Marks: 15×2=30

7. (a) State the SDG targets 6.1 and 6.2 related to water supply and sanitation. 4

   (b) Explain the significance of detention time, surface loading rate, forward velocity and weir loading rate in the design of sedimentation tanks. 5

Marks

(c) Write short notes on: 6
(i) BOD and COD
(ii) Activated sludge
(iii) Break point chlorination

8. (a) Explain the process of arsenic removal by co-precipitation and adsorption indicating the probable chemical reactions involved. 5

(b) Analysis of hardwater gave the following results: Total hardness = 5 meq/L; ca-hardness = 2.6 meq/L; alkalinity = 4 meq/L; acidity = 0.2 meq/L. Calculate the required doses of lime($Ca(OH)_2$) and soda(Na_2Co_3) for softening. Assume excess lime equivalent to 1.0 meq/L. 10

9. (a) Describe the effect of alkalinity in alum coagulation. 5

(b) An aerated lagoon (50 m × 50 m at water surface) is 3 m deep with banks sloped at $2H:1V$ receives a wastewater flow of 2.5 MLD with 600 mg/L BOD. Calculate the detention time, volumetric arganic loading rate and F/M ratio. (Assuming that equivalent volatile SS concentration in the lagoon is 4000 $mg/L = 0.4\ kg/m^3$). 10

Part II

Structure

(Answer any two questions)

Marks: 20×2=40

10. (a) What do you mean by under-reinforced, balance and over-reinforced beams? Also explain the neutral axis depth position in the above-mentioned conditions of beams. 6

(b) A rectangular beam has a width 12 $inch$ (305 mm) and an effective depth to the centroid of the tension reinforcement of 18 $inch$ (457 mm). The tension reinforcement consists of six no. 10 $bars$(7.59 in^2) in two rows. Compression reinforcement of two no. 9 $bars$ (2.0 in^2) is placed 2.5 $inch$ from the compression face of the beam. If $fy' = 50\ ksi$ (345 MPa) and $fc' = 5\ ksi$ (34.5 MPa), What is the design moment capacity of the beam? 14

11. (a) An 18 $inch$ × 18 $inch$ column with $fc' = 4\ ksi$, reinforced with eight no. 8 $bars$ of $fy = 50\ ksi$, supports a dead load of 225 $kips$ and a live load of 175 $kips$. The allowable soil pressure q_u is 5 ksf. Design a square footing 5′ below grade, using $fc' = 4\ ksi$ and $fy = 50\ ksi$. 16

(b) What are the advantages of T-beam over a rectangular beam? 4

12. (a) Draw typical stress-strain curve for pre-stressing steels. 3

(b) Where should doubly reinforced beam should be provided? Give reasons. 3

(c) Discuss various ways of failure of reinforced concrete structure. 4

(d) What is diagonal tension? Derive an expression for spacing of vertical stirrups. 4

(e) Write short notes on: 6
(i) Flat slab and two-way RC slab
(ii) Column interaction diagram
(iii) Punching shear of RC slab

Transportation Engineering

(Answer any two questions)

Marks: 15×2=30

13. (a) What are the considerations in selecting a highway alignment? What special considerations are needed in hilly areas and desert areas? 5

(b) Develop an equation for determining the breaking distance of a vehicle in terms of initial speed and coefficient of friction. 5

(c) Calculate the safe stopping distance of a vehicle while travelling at a speed of 80 km/hour on an upward gradient of 2%. Assume perception and brake reaction time = 2.5 sec and coefficient of friction = 0.36. 5

Marks

14. (a) Explain the desirable properties of aggregate to be used in different types of pavement construction. 5

(b) A 7-degree curve branches off from a 4-degree main curve in an opposite direction in the layout of a B.G. Yard. If the speed of the branch line is restricted to 30 km/hr, determine the speed restriction on the main line. Assume permissible cant deficiency 75 mm. 5

(c) Explain the principle and factors affecting the properties of soil-cement stabilization. 5

15. (a) What are the different causes of traffic accidents? Explain various measures that may be taken to prevent accidents. 5

(b) Explain the importance of road drainage. List out the requirements of a good highway drainage system. 4

(c) Write short notes on: 6

(i) Level crossing

(ii) Compensator

(iii) Negative super elevation

Foundation Engineering

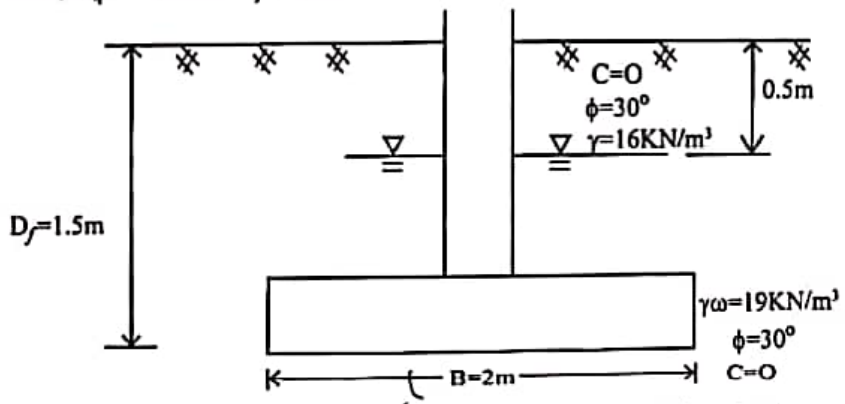
(Answer any two questions)

Marks: 15×2=30

16. (a) Write down the laboratory and field test generally used in determining the shear strength of soil. State the sources of shear strength of clay. 5

(b) What is an influence diagram? Discuss various methods for the determination of vertical stress at a point. What are their limitations? 5

(c) A square footing is shown in Fig. Q. 16 below. Determine the gross allowable load that the footing can carry. Use Terzaghi's bearing capacity equation for general shear failure. Given factor of safety = 3, $N_c = 30$, $N_q = 18$ and $N_f = 15$. 5



17. (a) What is soil liquefaction? Discuss with neat sketches the mechanism of liquefaction. 5

(b) What is pre-compression? Describe how you can describe pre-compression parameters in the field? 4

(c) A sand-fill compacted to a bulk density of 18.84 KN/m^3 is to be placed on a compressible saturated marsh deposit 3.5 m thick. The height of sand-fill is to be 3m. If the volume of compressibility of the deposit is 7×10^{-4} m^2/kN, estimate the final settlement of the fill. 6

18. (a) Under what circumstances wet sieve analysis is preferred over conventional dry sieve analysis? 4

(b) Discuss the effect of water table on bearing capacity of soil. 3

(c) Write short notes on: 8

(i) SPT and cone penetration test

(ii) Consolidation and compaction

(iii) Friction circle method of stability analysis

(iv) Over consolidation ratio