Range Forest Officer (Main / Written) Examination, 2021

CIVIL ENGINEERING

Time Allowed: Three Hours | Maximum Marks: 200

Question Paper Specific Instructions

Please read each of the following instructions carefully before attempting questions:

1. There are 08 (eight) questions in all, out of which FIVE are to be attempted.
2. Question Nos.1 and 5 are compulsory. Out of the remaining SIX questions, THREE are to be attempted selecting at least ONE question from each of the two Sections I and II.
3. Answers must be written in legible handwriting. Each part of the question must be answered in sequence and in the same continuation.
4. All questions carry equal marks. The number of marks carried by a question / part is indicated against it.
5. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Answer Booklet must be clearly struck off.
6. Unless otherwise mentioned, symbols and notations have their usual standard meanings. Assume suitable data, if necessary and indicate the same clearly.
7. Neat sketches may be drawn, wherever required.
8. Use of steam tables, Mollier diagram, Psychometric charts, Refrigerant Property Table, Non-Programmable calculator, Graph sheet is allowed.
9. Re-evaluation / Re-checking of answer book is not allowed.

SECTION-I

1. (a) Find the fixed end moments for the beam as shown in Figure 1. Use Column Analogy Method. Width of analogous column and Thickness of Ms diagram (1/EI) may be taken as unity. (10)

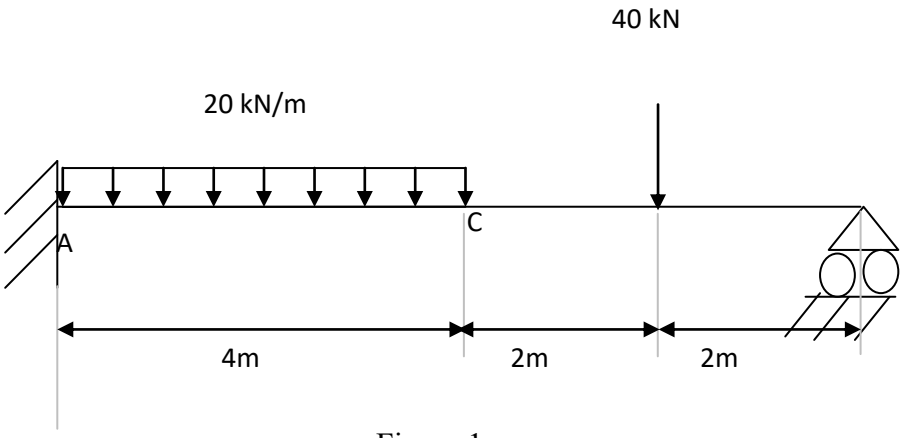

Figure 1

(b) What power is required per kilometer of a line to overcome the viscous resistance to the flow of glycerine through a horizontal pipe of diameter 100mm at the rate of 10 litres/s? Take μ = 8 poise and kinematic viscosity = 6.0 stokes. (15)

(c) A sample of saturated soil has a water content of 32%. The specific gravity of soil solids is 2.65. Determine void ratio, Saturated unit weight and dry unit weight? (15)

2. (a) Analyze the continuous beam as shown in Figure 2 using three moment equation. EI is constant. (15)

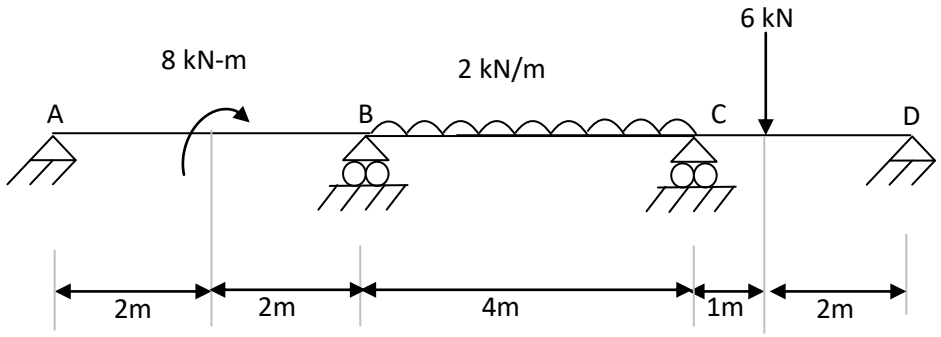

Figure 2

(b) What is a lug angle? Illustrate with sketch. Why lug angles are used? (15)

(c) A reinforced concrete wall 250mm thick carries a load of 500kN/m inclusive of its own weight. Compute thickness of the footing? Safe bearing capacity of soil is 160 kN/m^2. Use M20 concrete and Fe 415 steel. (10)

3. (a) Explain the causes of failure of an earthen dam? (10)

(b) Prove that the condition for he maximum discharge of a trapezoidal channel section can be expressed as

(i) $(b/2 + nd) = d\,(n^2+ 1)^{1/2}$

(ii) $m= d/2$

Where d is the depth of flow, b is the width of channel and side slope is 1 vertical: n Horizontal. (15)

(c) Given that the unit discharge in a rectangular channel is 18 m^3/sec and that the head loss across a hydraulic jump that forms in this channel is 1.1m, estimate the pre jump and post jump depths? (15)

4. (a) Two Soils A and B are tested in the laboratory for the consistency limits. The data available is as follows:

	Soil A	Soil B
Plastic limit, w_p	18%	20%
Liquid Limit, w_l	38%	60%
Flow Index, I_f	10%	5%
Natural Moisture content, w	40%	50%

Answer following: (20)

1. Which soil is more plastic?
2. Which soil is better foundation material when remoulded?
3. Which soil has better strength as function of water content?
4. Which soil has better strength at the plastic limit?
5. Could organic material be present in these soils?

(b) A thin layer of silt exists at a depth of 18m below the surface of the ground. The soil above this level has an average dry density of 1.53 Mg/m^3 and an average water content of 36%. The water table is almost at the surface. Tests on undisturbed samples of the silt indicate the following values:

$Cu = 45\ kN/m^2$; $\phi_u = 18^0$: $C' = 35\ kN/m^2$; $\phi' = 27^0$

Estimate the shearing resistance of the silt on a horizontal plane,

1. when the shear stress builds up rapidly and
2. when the shear stress builds up very slowly. (20)

SECTION-II

5. (a) Explain project management? (10)

(b) The speeds of overtaking and overtaken vehicles are 70 and 40 kmph, respectively on a two way traffic road. The average acceleration during overtaking mat be assumed as $o.99m/sec^2$

(i) Calculate the overtaking site distance.
(ii) What is the minimum length of overtaking zone?
(iii) Draw a neat sketch of the overtaking zone and show the positions of sign posts. (15)

(c) An isolated 3 hour storm occurred over an area of 120 ha. as below:

Partial area of catchment	Φ-index (cm/hr.)	Rainfall (cms.)		
		1st hour	2nd hour	3rd hour
36	0.90	0.6	2.4	1.3
18	1.10	0.9	2.1	1.5
60	0.50	1.0	2.0	0.9

What is the total rainfall on the catchment in this storm? Estimate the runoff from the catchment. If the Φ-index were to remain at the same value, what runoff would be produced by a uniform rainfall of 3.3 cm in 3 hours uniformly spread over the catchment? (15)

6. (a) What would be equilibrium cant on a M.G. curved track of 7^0 for an average speed of trains 50 kmph ? Also calculate the maximum permissible speed after allowing the maximum cant deficiency. (N.B. cant deficiency for M.G. = 5.0 cms.) (20)

   (b) There is horizontal curve of radius 400m and length 200m on this highway. The distance between the centre lines of the road and the inner lane is 1.9m. Compute the setback distances required from the centre line of the inner side of the curve so as to provide for

   (i) stopping sight distance of 90m
   (ii) safe overtaking sight distance of 300m (20)

7. (a) Discuss briefly factors affecting the workability of concrete? (10)

   (b) Explain different type of defects in timber? (10)

   (c) Explain the following:

   (i) Mud-phuska roofing
   (ii) Light weight roofing (20)

8. (a) Table below gives the necessary data about the crop, heir duty and the area under each crop, commanded by a canal taking off from a storage tank. Taking a time factor for the canal to be 13/20, calculate the discharge required at the head to the canal. If the capacity factor is 0.8, determine the design discharge. (20)

Crop	Base period (days)	Area (hectares)	Duty of the head of the canal (hectares/cumec)
Sugar-cane	320	850	580
Overlap for sugar-cane in hot weather	90	120	580
Wheat (Rabi)	120	600	1600
Bajri (Monsoon)	120	500	2000
Vegetable (Hot weather)	120	360	600

   (b) A coagulation – sedimentation plant clarifies 40 million litre of water every day. The quantity of filter alum required at the plant is 18 mg/l. If the raw water is having an alkalinity equivalent to 5 mg/l of $CaCO_3$, determine the quantity of filter alum and the quick lime (Containing 85% of CaO) required per year by the plant.

   Given the molecular weights as: Al = 27, S = 32, O = 16, H = 1, Ca = 40, C = 12. (20)

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