

**Indian Forest Services (Main)  
Examination-2025****DJSM-B-CVLE****CIVIL ENGINEERING****PAPER—II****Time Allowed : Three Hours****Maximum Marks : 200****QUESTION PAPER SPECIFIC INSTRUCTIONS**

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

There are EIGHT questions in all, out of which FIVE are to be attempted.

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 A and B.

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 Question-cum-Answer Booklet must be clearly struck off.

All questions carry equal marks. The number of marks carried by a question/part is indicated against it.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if necessary and indicate the same clearly.

Neat sketches may be drawn, wherever required.

Answers must be written in ENGLISH only.

(Main) Indian Forest Services (Main)  
 Examination-2022  
**SECTION—A**

1. (a) (i) What are the various types of limes used to prepare lime mortar and how is it prepared? 4
- (ii) What mix proportion of lime mortar shall be used for various purposes, and under what circumstances is lime mortar not suitable? 4
- (b) Differentiate between thermoplastics and thermosetting plastics, with their principal uses. Also, write the major constituents of plastics. 8
- (c) What is specification? Describe the principles that shall be adopted while writing the specifications. 8
- (d) Briefly explain how channelizing islands are useful in guiding and controlling the traffic at channelized intersections. 8
- (e) During a plane table survey work at a station *S*, it was observed that centring was disturbed and the corresponding plotted point *s* was not accurately centred over *S*. The displacement of *S* was 20 cm in a direction at right angles to the ray. If the limit of precision in plotting is 0.2 mm, determine if accurate centring is required. Assume the scale as 1 cm = 1.5 m. 8
- Also, determine the scale for which accurate centring is not required for a maximum value of error of 20 cm due to inaccurate centring.
2. (a) Represent the following project by a bar chart. Duration of each activity is in actual workdays. The project commences on April 7, Monday, with a five-day workweek. Draw the bar chart with a horizontal scale denoting calendar dates :

<i>Activity</i>	1	2	3	4	5	6	7	8
<i>Days</i>	6	2	5	6	3	3	9	14

Activities 1 and 2 can occur concurrently.

Activity 3 can take place after activity 2 is completed.

Activity 4 can start concurrently with activity 5.

Activities 3 and 6 can occur concurrently.

Activity 8 can start 2 days after the commencement of activity 6.

Activity 7 should follow activity 5.

Activity 5 can start concurrently with activity 8.

Answer the following :

(i) On what calendar date will the project be completed?

(ii) What is the progress of the project on April 18?

- (b) A rotary needs to be designed for a right angle intersection of two roads  $PQ$  and  $RS$  in an Indian city. It is proposed to use 10 m wide weaving section ( $w$ ) and its length ( $L$ ) as 40 m. The average width of entry and non-weaving section ( $e$ ) may be assumed as 6.5 m. The traffic volume in terms of PCU/hour on each weaving section may be assumed as follows :

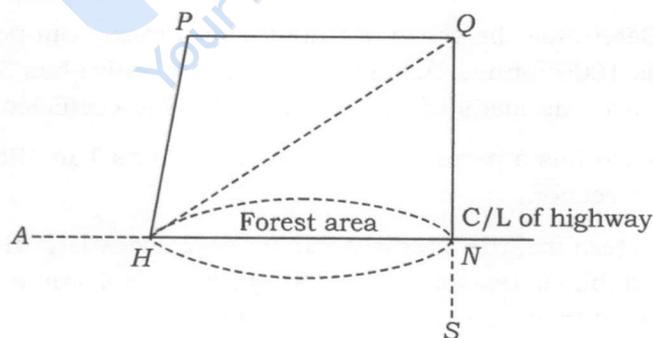
Weaving section	Weaving section traffic volume (PCU/hour)	Proportion of weaving traffic
$PS$	2800	0.97
$PR$	2200	0.88
$RQ$	2300	0.77
$QS$	2700	0.82

Determine if the proposed design of rotary shall be able to accommodate the traffic volume on each weaving section.

Also, determine the practical capacity of the rotary using the above data. 15

- (c) Briefly explain the necessity of evaluation of existing pavements. Briefly discuss the design approach of overlay thickness required for strengthening of existing flexible pavement by flexible overlay. 10
3. (a) A national highway of length 900.79 m is to be constructed in a straight line in a forest area having start point  $N$  and end point  $H$ . To establish centreline of highway, a traverse survey as shown in the figure below was carried out around the forest area and the data obtained are as given below :

Line	Length	Bearing
$AH$	—	$85^\circ$ centreline of highway
$HP$	600 m	$5^\circ$
$PQ$	800 m	$90^\circ$
$QS$	—	$175^\circ$



A station  $Q$  is to be established outside the forest area from which the end point  $H$  is visible.

Determine the coordinate of point  $Q$ . Also, to establish start point of  $N$ , determine  $\angle NQH$  and the distance of point  $N$  from  $Q$  along  $QS$ . 15

- (b) For the data given below, draw a network and calculate the total float, free float and independent float for various activities. Determine the critical path on the basis of float values. What is the total completion time for this project?

Activity	Duration (in weeks)
1-2	3
1-3	4
2-4	5
2-5	6
3-5	2
3-7	7
4-5	0
4-6	6
5-7	5
6-7	7
7-8	8

- 15
- (c) Briefly discuss the types of interface treatments used for bituminous pavement construction. 10
4. (a) Give an explanation of various components of operating costs of equipment at a construction site. 15
- (b) A BG railway track consists of two sections, i.e., section A and section B. Section A has a straight level track.
- (i) Determine the speed of train ( $v$ ) for a maximum permissible train load ( $w$ ) as 1000 tonnes. Assume that BG locomotive has 3 pairs of driving wheels with axle loads of 20 tonnes each. The coefficient of friction is 0.21.
- Section B has a permissible ruling gradient as 1 in 125. A  $4^\circ$  curve also exists at this section.
- (ii) Determine the gradient ( $g$ ) to be provided at this section so that the combined resistance due to gradient and curve should not exceed the resistance due to ruling gradient.
- (iii) Also, determine the reduction in speed as compared to speed at section A, if the train has to run on this rising gradient  $g$  and curve as above. 15
- (c) Give a brief description, in chronological order, of the major concreting equipment that is normally used at construction sites. 10

## SECTION—B

5. (a) Using the following data, find the watering frequency for the clay-loam soil :
- (i) Field capacity of soil = 30%
  - (ii) Permanent wilting point = 15%
  - (iii) Density of soil =  $1.6 \text{ gm/cm}^3$
  - (iv) Effective depth of root zone = 70 cm
  - (v) Daily consumptive use of water for given crop = 12 mm
- 8
- (b) What are spillways? Draw the neat sketches of the following types of spillways :
- (i) Ogee spillway
  - (ii) Side channel spillway
  - (iii) Siphon spillway
- 8
- (c) (i) With the aid of neat sketch, show the various zones of a reservoir. 4
- (ii) Define the 'available chlorine' of a disinfectant. What is the percentage of available chlorine in NaOCl? 4
- (d) Enumerate the various air pollutants that cause damage to vegetation. Discuss in detail how each pollutant affects the vegetation. 8
- (e) An overhead tank is to be constructed for a town water supply using the following data :
- (i) No fire demand storage
  - (ii) Tank is empty between : 12-15 hours
  - (iii) Average water supply : 20833.33 L/hour
  - (iv) Rate of pumping : 31250 L/hour
  - (v) Hours of pumping : 4-12 and 15-23

No.	Time	Hours	Draw-off factor	Water pumped, L	Water consumed, L	Accumulation or draw-off	Water in service reservoir
	1	2	3	4	5	6	7
A	0-4	4	0.15	0	5000		
B	4-6	2	1.25	62500	50000		
C	6-8	2	2.00	62500	75000		
D	8-12	4	0.80	125000	120000		

No.	Time	Hours	Draw-off factor	Water pumped, L	Water consumed, L	Accumulation or draw-off	Water in service reservoir
	1	2	3	4	5	6	7
E	12-15	3	0.50	0	15000		
F	15-17	2	0.50	62500	30000		
G	17-20	3	1.75	93750	115000		
H	20-23	3	0.85	93750	74750		
I	23-24	1	0.15	0	15250		

Reproduce only columns 6 and 7 in the QCA Booklet and find out the minimum reservoir capacity.

8

6. (a) The yield of water in  $M\text{-m}^3$  from a catchment area during each successive month is given in the following table :

Month	Yield (in $M\text{-m}^3$ )
January	1.5
February	2.8
March	4.2
April	12.4
May	16.0
June	16.0
July	11.0
August	4.0
September	3.0
October	2.5
November	2.2
December	1.5

Determine the minimum capacity of the reservoir required to allow the above volume of water to be drawn off at a uniform rate assuming that there is no loss of water over the spillway.

15

- (b) (i) List out all the possible forces acting on a mass concrete dam. 5
- (ii) The following table gives the construction costs and the storage capacity for a dam at different height :

S.N.	Height of dam (in m)	Construction cost (in million ₹)	Storage (in million m <sup>3</sup> )
1	2	3	4
1	10	5	60
2	20	10	140
3	30	15	220
4	40	20	266
5	50	30	365
6	60	40	435
7	70	50	505

Determine the most economical height of the dam from the construction point of view. 10

- (c) What is meant by elutriation of sludge? State its advantage and discuss the methods adopted. 10
7. (a) (i) Write the advantages and disadvantages of pressure filters over other gravity filters. 5
- (ii) Design a coagulation-cum-sedimentation tank with continuous flow for a population of 75000 persons with the following data :
- (1) Daily per capita water supply : 120 litres
  - (2) Maximum daily demand is 1.5 times the average daily demand
  - (3) Detention period in sedimentation tank : 4 hours
  - (4) Velocity of flow in sedimentation tank : 0.3 m/min
  - (5) Depth of water and sediment : 4.2 m; depth of sediment alone : 1.0 m
  - (6) Detention period in coagulation tank : 20 min
  - (7) Effective depth in floc chamber is half of the depth in sedimentation tank 10
- (b) (i) What is recirculation factor in sewage treatment process? State the advantages of recirculation. 5
- (ii) The BOD of a sewage incubated for 1 day at 35 °C has been found to be 125 mg/L. Calculate 5-day, 20 °C BOD, assuming  $k_1 = 0.1$  at 20 °C. 10

- (c) A 12 hours stormed rainfall with the following depths (in cm) occurred over a basin :

2.5, 3.0, 8.0, 4.5, 12.5, 5.0, 7.5, 10.0, 6.5, 4.0, 2.2, 2.2

The surface runoff resulting from the above storm is equivalent to 29.9 cm of depth over the basin. Determine the average infiltration index for the basin. 10

8. (a) A 30 cm diameter well penetrates 25 m below the static water table. After 24 hours of pumping @ 5400 L/min, the water level in a test well at 90 m is lowered by 0.53 m and in a well 30 m away, the drawdown is 1.11 m. What is the transmissibility of the aquifer? Also, determine the drawdown in the main well. 10

- (b) Explain the functions of the following irrigation structures :

(i) Silt extractors

(ii) Canal cross-regulators

(iii) Cross-drainage works

(iv) Canal falls

(v) Canal escapes 10

- (c) A 30 cm diameter sewer with an invert slope of 1 in 400 is flowing 1/3rd of the full depth. Calculate the velocity and the rate of flow in the sewer. Use Manning's  $n = 0.015$ . 10

- (d) What are the long-term ill effects of improper landfill management? How can they be overcome? 10

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